

COMPOSITE CROSSARMS FOR A ROBUST GRID

GET THE SHAKESPEARE COMPOSITE ADVANTAGE

LEADERS CHOOSE LEADERS

- Millions of Shakespeare composite structures are installed across North America.
- Crafting composite innovations for more than 65 years, Shakespeare designs and produces exceptionally tough, durable crossarms for customers requiring superb performance.
- Shakespeare's ruggedly engineered FRP crossarms are essential electric utility assets for today's modern, resilient grid.
- As part of Valmont Composite Structures, Shakespeare is a US-based industry leader with local expertise and global resources.
- For your next composite crossarm order, choose Shakespeare - the composite brand North American utilities have been relying on for decades.



Shakespeare

A valmont BRAND

MORE OF EVERYTHING YOU NEED

SHAKESPEARE CROSSARM FEATURES & BENEFITS



A pioneer in developing composite products for the utility industry, Shakespeare's know-how and industry leadership is unparalleled. Our team listens carefully to customer feedback and responds with crossarm products that meet or exceed utility specifications and expectations from across North America and beyond.

Shakespeare's growing customer base appreciates the many advantages Shakespeare composite tangent crossarms and composite deadend assemblies provide over wood and other materials.

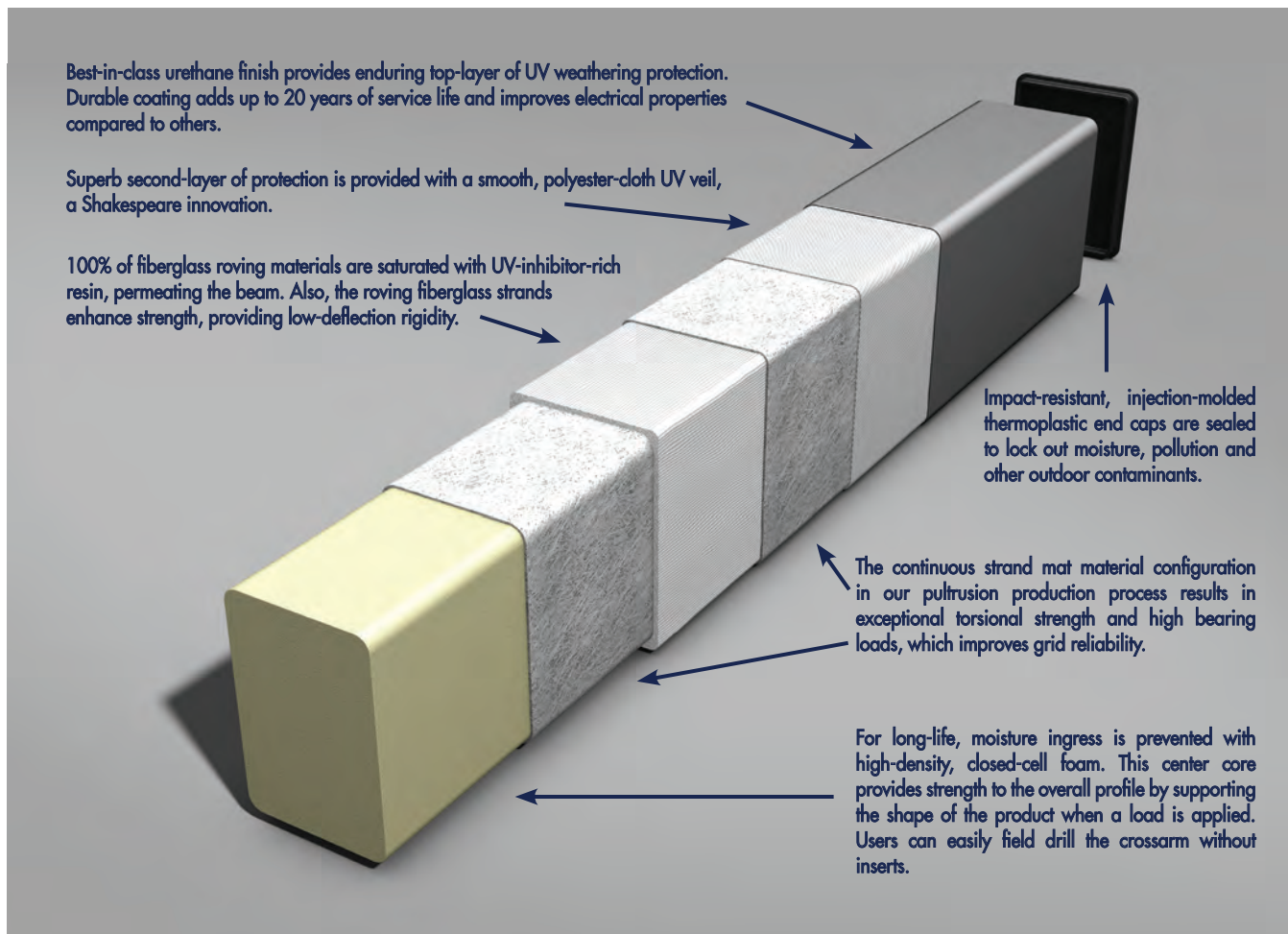
In fact, the inherent advantages of composite materials are leading many utilities to specify composite crossarms and deadend assemblies on new and replacement transmission and distribution installations. Shakespeare is a time-proven, logical choice for these composite products.

- **LONG-LIFE DURABILITY** – Designed for use in all climate types and with a remarkable performance longevity of 60 years, Shakespeare crossarms will not splinter and rot like wood, nor rust like metal. Unlike wood, composites are impervious to insects, woodpeckers, and weather. The specified strength factors remain intact over the product lifespan.
- **SUPERB WEATHERING & UV PROTECTION** – Shakespeare provides triple protection from ambient ultraviolet exposure. First, during the pultrusion production process, 100% of the glass fiber strands and fiberglass mat components are saturated with UV-inhibitor-laden resins. Second, these materials are then covered with a UV-polyester-veil barrier. Third, the crossarm exterior is coated with a high-performance urethane finish.
- **DEFLECTION MITIGATION** – Shakespeare provides the best selection for load vs. deflection considerations by offering multiple crossarm profiles to ensure low deflection rates. The engineered deflection-mitigation characteristics yield a desirable side benefit in that the crossarms are often crafted to be stronger than necessary in order to address deflection.
- **LIGHTWEIGHT DESIGN** – Up to one-third the weight of wood, Shakespeare crossarms are easier to transport, lift and install than unwieldy wooden beams. Shakespeare composite structures can be hand carried into hard-to-reach locations, which saves utilities time and money.
- **EASE OF INSTALLATION** – With a high-density, closed-cell foam fill that locks out moisture and contaminants, Shakespeare crossarms can easily be field drilled along the entire length of the crossarm using standard installation equipment. Further, Shakespeare can pre-drill crossarms to specified settings at the factory for your convenience. Shakespeare composite structures are impact resistant for easy transport in the field.

- **SAFE** – Shakespeare composite structures are strong, yet remarkably light in weight compared to wood or steel. This inherent advantage may help alleviate possible injury to linemen, warehouse staff, and other utility personnel. Further the composite crossarms low-weight characteristics reduces pole structural fatigue, improving overall network grid robustness.
- **LOW MAINTENANCE** – Shakespeare’s maintenance-free construction saves time and money over the product lifetime. Shakespeare non-corroding composites will not deteriorate in salt-air climates, desert heat or acid rain. Regardless of humidity, they will not rust, ever, and they easily withstand harsh, industrial environments.
- **ATTRACTIVE** – Typically, customers choose our standard grey color and our dark bronze color is also popular. Custom colors are available upon request. The urethane coating provides excellent protection and color retention when exposed to the sun and environmental contaminants. Accelerated testing confirms, the 3-stage UV protection will consistently resist weathering and maintain its strength.

SEE THE SHAKESPEARE DIFFERENCE

LAYERS OF INNOVATION AND TRIPLE UV CROSSARM PROTECTION FOR LONG LASTING DURABILITY



UNPARALLELED EXPERTISE

JOIN THE GROWING NUMBER OF
UTILITIES CHOOSING SHAKESPEARE



Shakespeare has been crafting composite products for utilities and municipalities for generations. Likewise, our valued customers count on Shakespeare year after year because our FRP composite products are built to last for decades.

Shakespeare crossarms increase grid reliability and are engineered to meet or exceed the requirements of the National Electric Safety Code (NESC). Tested per ASTM D8019-15, our crossarms are also Rural Utilities Service (RUS) approved.

If you were able to combine the advantages of steel, aluminum, PVC, plastic and wood into a single product, the resulting combination may very well be a custom-composite crossarm from Shakespeare. Strong but lightweight, non-corrosive, dielectric, without rot and with a durable finish, and environmentally smart ... all these qualities are integrated into a single precision-engineered composite solution.

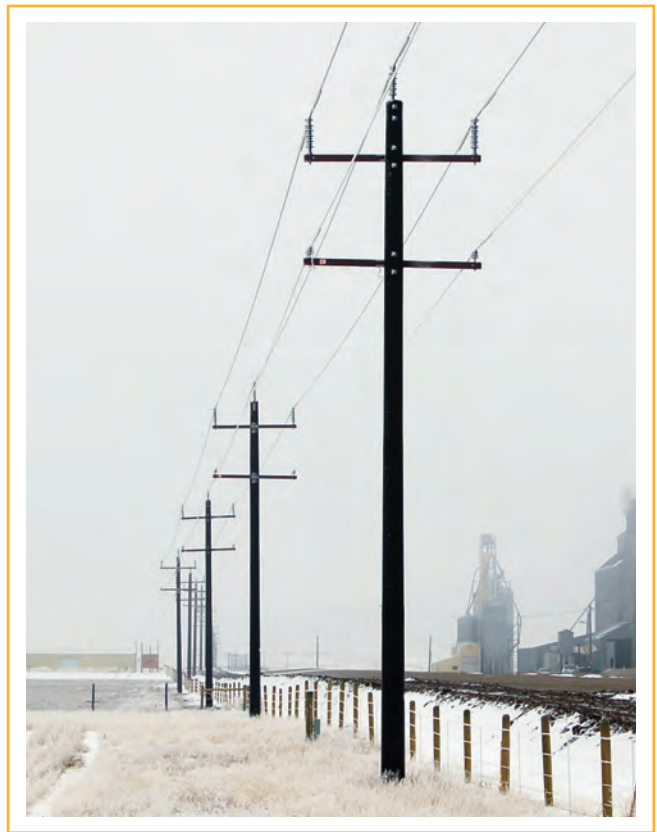
- **SMART ALTERNATIVE TO OTHER MATERIALS** – A fiberglass reinforced plastic (FRP) / composite component won't rust and will often simply outlast wood and metal components under the same climatic conditions. Our feather-light composite crossarms are remarkably easy to install – potentially saving time, manpower, equipment, and money during installation. Often a single Shakespeare crossarm has the strength to replace three or four wood crossarms. Further, unlike wood, our crossarms are completely free of knots, twists and imperfections that can accelerate wood crossarm failure.
- **BUILT FOR TOUGH ENVIRONMENTS** – Shakespeare UV inhibitors are formulated into the crossarm from the beginning of the production process. In addition, the finished products are coated with a pigmented, proprietary, high-performance polyurethane containing UV inhibitors to help prevent color fading over time - for long-lasting good looks.

With a high-density, closed-cell foam fill that locks out moisture and contaminants, Shakespeare crossarms can easily be field drilled along the entire length of the crossarm using standard installation equipment. Further, Shakespeare can pre-drill crossarms to specified settings at the factory for your convenience.

Shakespeare non-corroding composites will not deteriorate in extreme heat or cold, in salt-air climates, nor in desert installation. Regardless of humidity, they will not rust, ever, and they easily withstand harsh, natural and industrial environments.

- **EXCELLENT DIELECTRIC PROPERTIES** – Fiberglass composite materials are non-conductive, making Shakespeare crossarms an excellent support beam for high and low voltage electric-power lines.

- **ENVIRONMENTALLY SOUND** – Unlike treated wood, Shakespeare composite crossarms need no harmful chemical preservatives to protect them from decay or insects. Plus, composites are especially well suited for environmentally sensitive areas where heavy equipment may damage sensitive land. Compared to heavier materials, the lightweight construction saves energy during transport. The long-life performance means fewer replacements will be needed, which will provide future cost savings and energy conservation in the decades ahead.
- **SUPERB CUSTOMER CARE** – Utility customers count on Shakespeare because of the quality of our products and great care with which our agent network and factory respond to daily customer needs. Also, after significant storm events, when a rapid response is imperative, Shakespeare consistently meets the needs of utilities striving to restore power. For example, after a recent hurricane caused widespread power outages, Shakespeare produced and shipped more than 500 composite crossarms to 3 utility customers within 24 hours of the orders being received.



- **CONTACT SHAKESPEARE** – Since 2014, Shakespeare has been part of Valmont Composite Structures. A global leader in engineering and manufacturing structures for transmission and distribution applications, Valmont is a proven resource for utility customers across North America, Europe, Africa, Asia, India and Australia.

Put our expertise to use for your team. Shakespeare has been crafting composite products for more than 65 years. Contact Shakespeare today to discuss your crossarm product needs.



ENGINEERING EXCELLENCE SUPPORTS CUSTOMER NEEDS

SPECIFY SHAKESPEARE TANGENT CROSSARMS FOR YOUR NEXT PROJECT

Shakespeare composite structures are an ideal choice for power-distribution and power-transmission tangent crossarms. Our composite tangent crossarms can be installed with ease, on any utility pole, whether the pole is a wood, steel, concrete, aluminum, or composite material.

With more than a million crossarms installed over the past 25 years, Shakespeare composite tangent structures provide an exceptional return on investment.

When compared with conventional crossarms, these FRP beams will not rot or splinter like wood and provide a far superior strength-to-weight ratio. The engineered designs are free from knots and imperfections that can cause failure over time. As such, Shakespeare composites are increasingly the preferred choice on new installations and for the replacement of aging infrastructure on power transmission and distribution infrastructure.

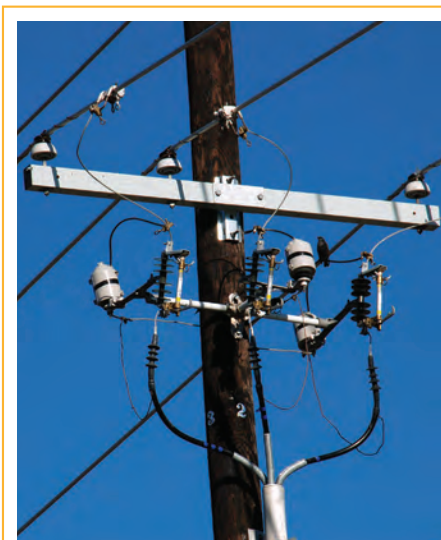
Shakespeare offers the widest selection of composite crossarms in the industry with lengths up to 40' in six different profiles from 3.5" x 4.5" to 4" x 7.5".

- **S-SERIES:** 3.5" x 4.5" x .18"
- **M-SERIES:** 3.5" x 4.5" x .25"-.30"
- **H-SERIES:** 3.5" x 4.5" x .38"
- **T-SERIES:** 3.5" x 4.5" x .38"
- **I-SERIES:** 4" x 6"
- **X-SERIES:** 4" x 7.5"
- **4"X4" AND 5"X5" CROSSARMS** are also available for special applications.

Shakespeare takes a systematic approach to UV protection, and formulates UV inhibitors into the liquid resin mixture from the beginning of the production process. Our crossarm outer shell then is covered with a tightly woven fiberglass veil that is saturated with a UV-inhibitor. This veil provides a resin-rich surface that controls blooming. In post-production, the finished product receives an exterior coating of our high-performance, UV-protective urethane finish.

Product performance is verified by extensive accelerated testing which demonstrate that Shakespeare crossarms can easily handle what nature dishes out - for decades.

To prevent the risk of internal moisture contamination, inside every Shakespeare tangent crossarm we inject closed-cell polyurethane foam that seals the beam. This allows for easy field drilling along the entire length of the arm during installation, with no special tools required. Also, Shakespeare can pre-drill the arms prior to shipment, as per specified requirements. Contact the factory for more details.



RUGGED END CAPS PROVIDE CROSSARM PROTECTION

Shakespeare pioneered the use of highly durable, impact-resistant end caps on composite crossarms. Our crossarm end caps are produced by an injection molding process. During production, these end caps are inserted into the crossarm and foamed into place. Our process ensures end caps will remain securely in place and not come off of the arm.

Shakespeare crossarm and deadend assembly end caps are made of a thermoplastic that exhibits optimal flexibility during temperature extremes. The flexibility is also important because it helps protect the end of the crossarm during the shipping, storing and handling of the product.

STRONG, DURABLE DEAD-END ASSEMBLIES

The benefits of Shakespeare composites are equally compelling for the deadend assemblies, which serve as the anchoring points along transmission and distribution lines. Engineered for robust performance, oftentimes, a single Shakespeare composite deadend structure can replace multiple wood structures at each deadend point. In short, at one-third to one-half the weight of wood, a single composite structure can provide greater strength and durability than three or four wood beams.

As utilities seek to improve system resiliency and maximize uptime through storms, droughts, and repeated freezes and thaws, Shakespeare composite deadend assemblies provide proven strength and durability and are essential components of a hearty, robust grid.



H-FRAME CROSSARMS AND H-FRAME BRACES

Shakespeare also produces superb HFrame crossarms and crossbraces for high-voltage transmission line applications. These Shakespeare pultruded composite innovations provide the same benefits as our power-distribution crossarm products.

Shakespeare brings engineered technology to bear on HFrame crossbraces with an innovative fiberglass reinforced composite solution. Our X-braces come in 4 sizes to match your strength requirements and they're available in gray or dark bronze. You can order HFrame crossbraces to fit any pole spacing necessary for your installation.

CUSTOM ENGINEERED SPECIALTY STRUCTURES

POWERHOUSE PERFORMANCE
FOR UNIQUE APPLICATIONS

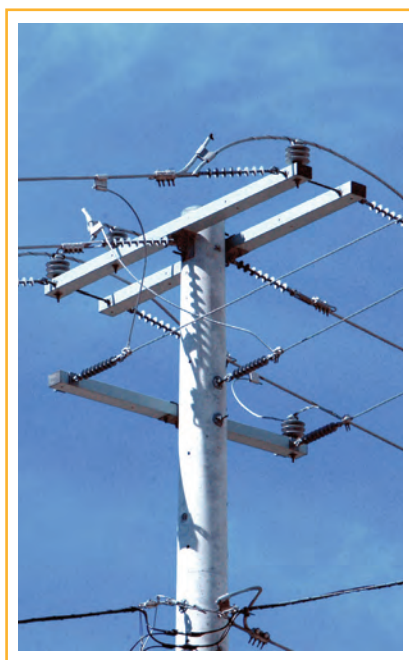


The products Shakespeare offers are often custom-engineered to meet the specific needs of an individual customer or installation site. As such, our employees and representatives value every customer engagement and are adept at delivering customized solutions to tough technical challenges.

For customers who require custom-engineered specialty crossarms and other utility structures, Shakespeare maintains an experienced team of engineering, drafting, manufacturing and customer-service talent who is eager to transform your concepts into reality. Put simply, Shakespeare possesses the capabilities to design and deliver one-of-a-kind utility structures.

Shakespeare can also provide crossarms to support surveillance cameras, antennas or sports lighting. Further, Shakespeare offers mounting arms for equipment such as cutouts, arrestors, and cable terminators. And of course, Shakespeare routinely designs and produces composite transmission and distribution poles for the power industry. In fact, composite poles are ideal for direct burial applications in most any soil and climatic condition.

Shakespeare products are designed to meet or exceed customer specifications and applicable standards. Construction drawings and calculations are made using modern software and technology, some of which is proprietary.





Working together as a team, the inherent structural integrity of our products is reflected in the personal integrity of our people who each day strive to deliver remarkable service to every customer. This interwoven culture of integrity is one reason a growing number of utility industry customers are choosing Shakespeare and Valmont Composite Structures.

Shakespeare's standard tangent crossarm models are engineered products, created on highly-sophisticated, computer-controlled pultrusion equipment for precise consistency and exacting quality control. With expertise measured in decades rather than years, Shakespeare has designed and manufactured composite structures for 65 years and has crafted structures for utility customers for 50 years.

Our continuous pultrusion production process yields composite crossarm structures with high structural integrity along the full length of the cross-section. Shakespeare integrates a continuous roll of high-quality, reinforced fiberglass strands with a high-strength fiberglass mat, which adds multi-directional reinforcement and resilience when combined with the fiberglass filaments.

These components are integrated and saturated in a liquid resin mixture, prior to being pulled through a heated, steel forming die using a continuing pulling device, (hence the term, pultrusion). The output is a rigid, fiberglass-reinforced composite structure that will never rot like wood.

To provide superior crush-resistant strength, and to eliminate the risk of crushing the crossarm while installing hardware, Shakespeare injects a high-density, closed-cell urethane foam into the fiberglass shell. The finished product density ranges from 4-5 lb. per cubic foot density as standard.

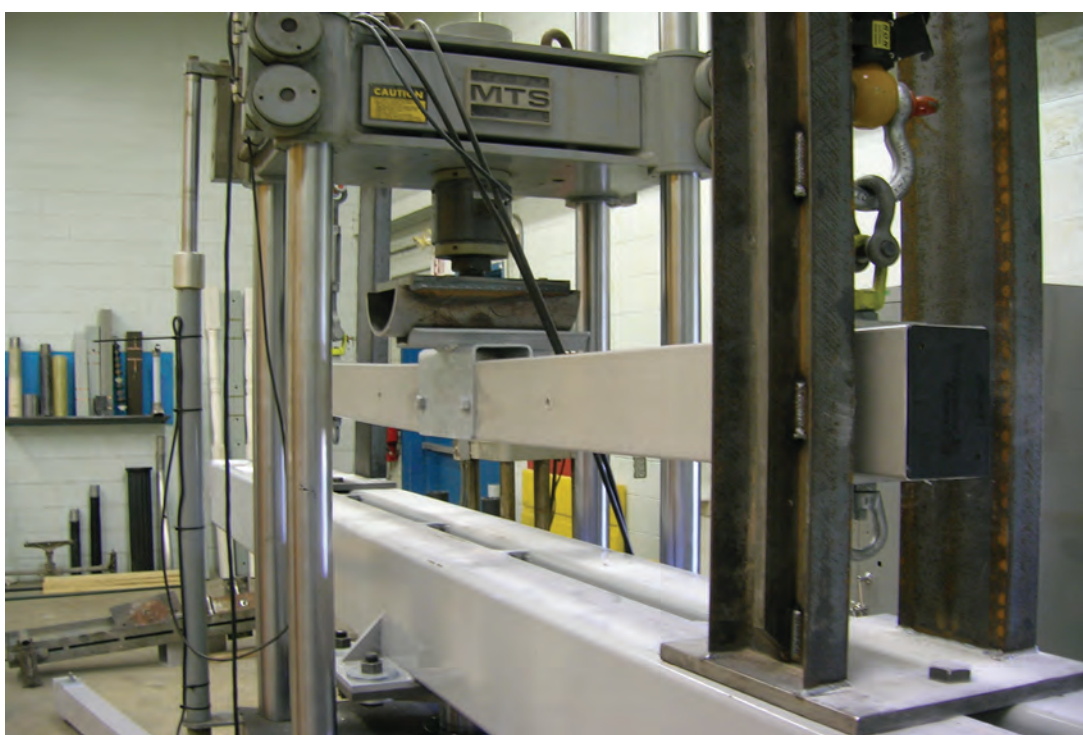
The advantages of this dense foam are numerous. The foam adheres to the walls of the outer fiberglass shell to produce an encapsulated composite structure. This is important to keep any possibility of water working its way into the structure. In electrical testing, the composite structure shows no evidence of water absorption, whereas a wooden counterpart will show signs of absorption. Further, because the foam is infused throughout the structure, you have the ability to drill holes of any size or placement along the crossarm.



PRECISELY ENGINEERED AND PERFORMANCE TESTED

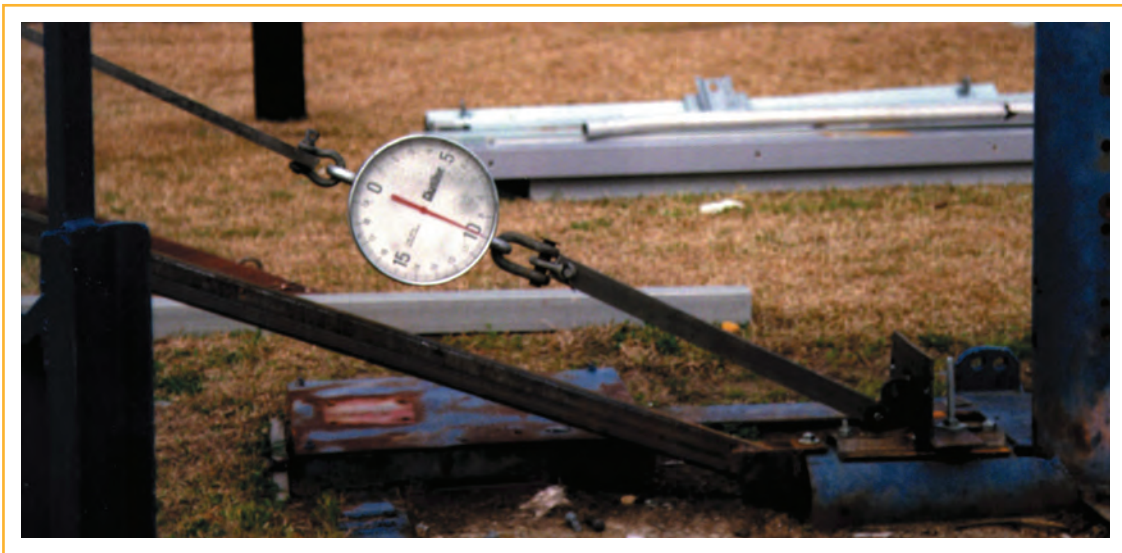
QUALITY ASSURANCE FOR DECADES OF PERFORMANCE

Shakespeare manages an extensive tangent crossarm testing program, which includes industry-standard beam testing. Our crossarms also undergo advanced, Tangent Eccentric Load Testing. These tests result in data that are valid for the whole system, including the mounting hardware and the brackets, not just the crossarm, a far better indicator of real-world performance.



SUPERIOR UV RESISTANCE

- Shakespeare pioneered the use of a 3-stage UV protection process to ensure the long service life of our crossarms
 1. UV inhibitors are integrated throughout the liquid resin formulation
 2. UV stable veil material is installed as a protective outer layer during the pultrusion process
 3. UV stable coating is applied after pultrusion, using the highest-grade coating of any crossarm manufacturer of which we know
- 15,000 hours of QUV testing also meets or exceeds every crossarm supplier of which we know



STRENGTH & DEFLECTION TESTING

- Shakespeare has built its crossarm business by reducing deflection inherent in fiberglass products
- A great selection of our industry-leading, low-deflection arms are available
- To meet competitive offerings, we also offer the less expensive equivalent strengths and deflection rates as the competition

ELECTRICAL TESTING

- Electrical testing at various labs confirm the excellent BIL and the increased tracking resistance as compared to wood
- The arms are not designed to be insulators but there is some degree of added benefit due to the inherent nonconductive properties of FRP material

ADDITIONAL STANDARDS TO WHICH SHAKESPEARE CROSSARMS COMPLY

- National Electric Safety Code (NESC)
- Rural Utilities Service (RUS) approved
- ASTM D635 (Burning of Self Supporting Plastics)
- ASTM G154 (Operating light and water exposure apparatus for non-metallic materials)
- ASTM D8019-15 (Determining the full section flexural modulus and bending strength of fiber reinforced polymer crossarms assembled with center brackets)
- ASTM A153 (Zinc Coating)



Shakespeare

GENERATIONS OF INNOVATIONS

**SUPERB QUALITY AND PERFORMANCE
SHAPES THE SHAKESPEARE STORY**

Shakespeare's composite product origins date back 65 years. For the utility market, Shakespeare's first innovation was to design and produce the first commercially successful composite light pole in 1967. Building logically on the fiberglass reinforced composite technologies developed for this and other demanding applications, the company's engineers scaled the manufacturing processes up to create a range of strong, durable composite structures, including utility transmission and distribution poles and of course, crossarms.

Over the years, our continued innovation has developed proprietary and custom formulated resins, coatings, and assembly techniques to achieve unmatched quality and durability.

Today, millions of our composite products are performing in every conceivable application, weathering every storm, every season. Impervious to the elements, our fiberglass retains its lustrous beauty for generations, and its strength never wears out or tires. Our composite structures are built to sustain heavy loads and look great doing it.

SHAKESPEARE COMPOSITE PRODUCTS A HISTORY OF FIRSTS

- 1967** First composite light pole installation
- 1974** First composite light pole filament winding machine - direct burial
- 1978** First full surface filament winding machine
- 1979** First anchor base fiberglass composite poles
- 1980** First smooth surface fiberglass poles
- 1986** First light pole arms
- 1987** First full surface filament winding machine for poles up to 47 feet
- 1989** First breakaway composite light poles
- 1991** First CAD/CAM computer controlled filament winding machine
- 1992** First Lewtex® composite crossarm shipped, company later acquired by Shakespeare
- 1992** First historical reproduction composite light poles
- 1992** First pultrusion of 5" x 5" straight square composite light poles
- 1993** First composite distribution poles
- 1995** First composite transmission poles up to 70 feet
- 1996** First installation of transmission poles
- 1997** First Tuff-Pole® programmed process
- 1998** First composite sports lighting poles
- 1999** First fiberglass composite hinged poles
- 2000** First composite burial foot
- 2003** First affordable TL-2 full-scale tested Energy Absorbing Pole
- 2007** First fiberglass composite poles to 125 feet
- 2009** First fiberglass composite poles to 130 feet
- 2009** First non-conductive composite safety fencing system for utility substations
- 2010** First sound-absorptive, non-conductive composite safety fence to protect people and utility assets
- 2014** Acquired by Valmont Industries, Inc. (NYSE: VMI)
 - a global leader in engineered utility structures
- 2014** Shakespeare is a part of Valmont Composite Structures
 - a composite innovations leader

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