



CREATIVE
COMPOSITES
GROUP®

TridentStrong™ Utility Poles

Pole Design & Installation Guide



POLES FROM 35 – 110 FEET MEETING ALL ANSI
05.1 CLASSES

CreativeCompositesGroup.com

About CCG and Trident Industries

Trident complements CCG's core values of providing the highest-quality composite products on the market backed by engineering experts and made in the USA and contributing to a more resilient U.S. infrastructure.



HEADQUARTERS
HOUSTON, TX



FABRICATION
ST. LOUIS, MO

VISION: BUILD SAFER AND MORE SUSTAINABLE COMMUNITIES.

MISSION: TO DRIVE VALUE FOR OUR CUSTOMERS THROUGH SERVICE AND INNOVATION, FOR MORE RELIABLE POWER AND COMMUNICATION THROUGHOUT THE WORLD.

CORE VALUES: VISTA: VISION / INNOVATION / SAFETY / TEAMWORK / ACCOUNTABILITY

WHY TRIDENTSTRONG™ COMPOSITE POLES?

CCG is a global supplier of TridentStrong Fiberglass Reinforced Polymer (FRP) transmission and distribution utility poles, designed for lightweight ease of installation in the harshest of conditions. Our wide range of pole offerings allows us to construct a pole of your specific strength and stiffness requirements up to 110 feet in length which meet all wood equivalent ANSI O5.1 class sizes.

Advantages of FRP poles are plentiful, and we've helped our customers solve problems that simply cannot be done with traditional wood, steel, or concrete options.

STRENGTH & RESILIENCE

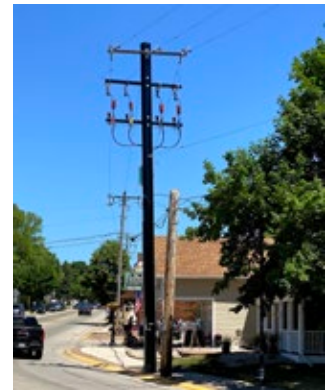
Fiberglass composite materials are often utilized in applications in which high strength, fatigue resistance and resilience are critical to end use performance. Meaning that poles can undergo significant stress in severe events and return to their original position with no property loss.

Trident makes some of the strongest composite poles on the market today. Testing of our 65 ft. tall, 14" diameter pole proved the ability to withstand wind speeds of over 260 MPH.



SERVICE LIFE

All of our poles have a 14mm UV stable veil, creating a resin-rich surface to protect them from the elements. They will not rust, rot or corrode, and have a service life expectancy of **80+ years**. All poles come with a 40-year warranty.



LIGHTWEIGHT

Composite poles are roughly 50% lighter than steel, 70% lighter than wood, and 90% lighter than concrete equivalents, making installation **safer**.

HIGH DIELECTRIC STRENGTH

Composite utility poles do not conduct electricity, allowing for a **safer** environment for linemen when operating on live lines.



INERT, NON-LEACHING

Unlike chemically treated wood poles or galvanized steel, composite poles are inert and will never leach chemicals into the soil, groundwater or watersheds. Because of this they can easily be repurposed, recycled as grindings, or landfilled at end of life.



INSECT AND WOODPECKER PROOF

Composites are impervious to termites, woodpeckers, ants or vermin, making them aesthetically pleasing and safer for wildlife.



AVIAN PROTECTION

Given the inherent non-conductive nature of composites they are a much safer option for our avian friends.



FIRE RESISTANT

Our poles have been tested to the standard **ASTM E-84 Class A** for flame spread and smoke density.

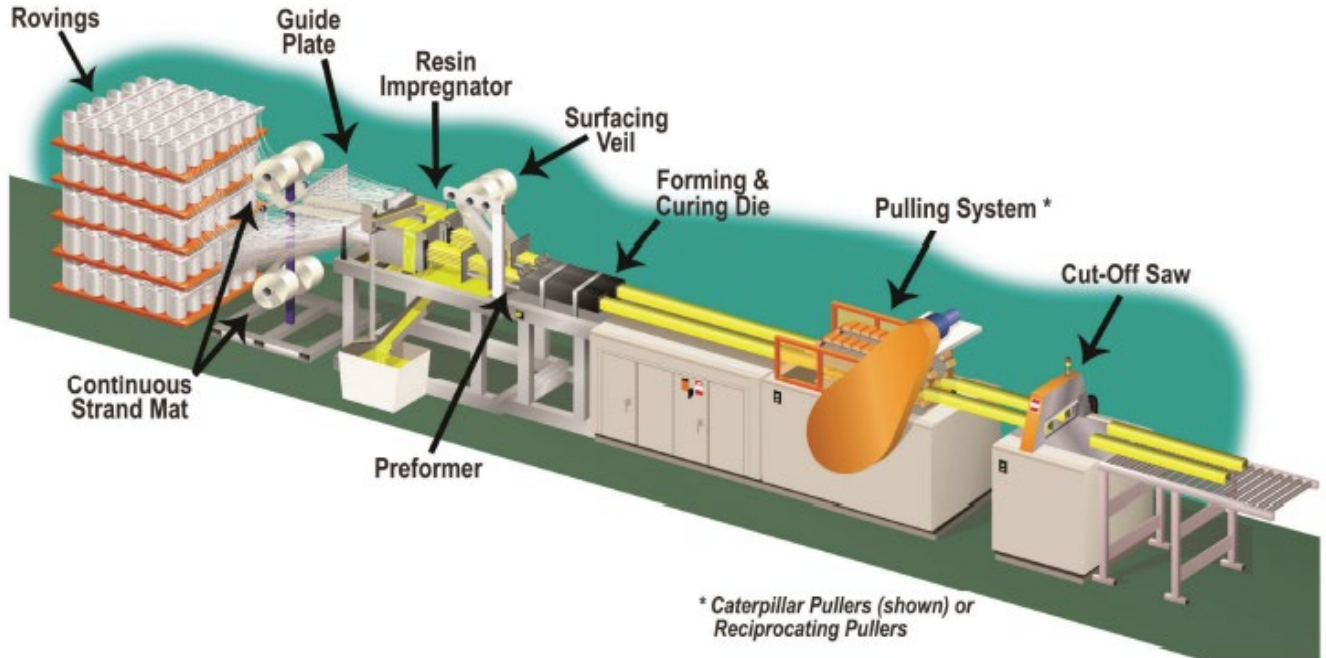


NO ROUTINE MAINTENANCE

Other than visual inspection for surface inclusions, no regular scheduled maintenance is required for composite poles.



TRIDENTSTRONG POLE MANUFACTURING



PULTRUSION

All of our poles are manufactured via a pultrusion process. Pultrusion is a continuous fabrication method by which unidirectional glass fibers, fiberglass woven roving or mat, and a surface veil are impregnated with a thermoset resin formula including UV stabilizer and other additives. The glass is then folded around a mandrel and into a die. Inside the die at elevated temperature the resin is cross-linked, a solid pole exits, and the poles are cut to length in-line.

FABRICATION

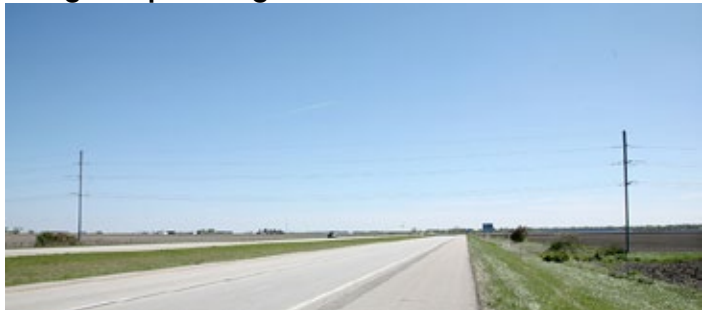
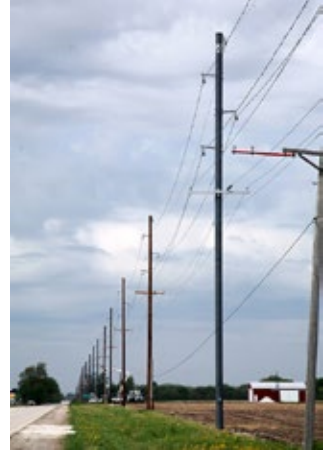
Our poles are then fabricated to an individual utility specification. Prior to leaving our facility all poles will have the necessary holes drilled for steps, cross-arms, and any other accessory installation. We will route ground wires, install base plates and anchors for foundational support, and top caps to prevent water and wildlife intrusion.



TRIDENTSTRONG FRP POLE APPLICATIONS

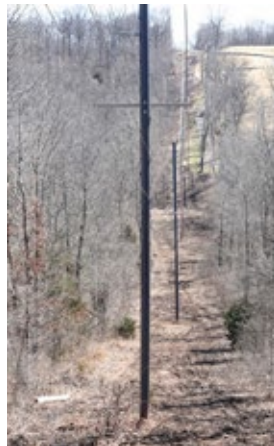
STORM HARDENING

With storm intensity and frequency increasing, improving the resilience of the electrical grid has never been more critical. Trident composite poles routinely find application in areas susceptible to hurricanes, tornadoes, ice storms and seismic events. Composites can absorb significant elastic strain, allowing them to take on much higher loads during these severe events and return to their original position after the storm. Whether replacing every pole, or every fifth pole to prevent a cascading event, Trident poles are up to the challenge and will keep your grid operating.



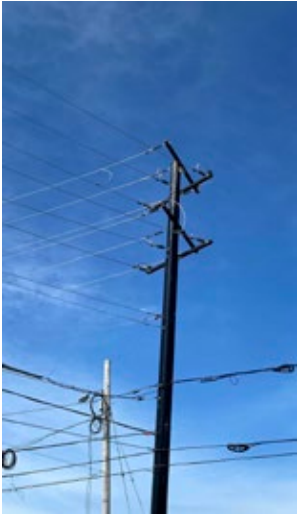
LIMITED ACCESS INSTALLATION

The superior strength to weight ratio of composite utility poles make them an excellent candidate for applications in which traditional installation may be difficult. The use of lighter duty equipment for installation saves time and cost in these environments.



UNGUYED APPLICATIONS

Whether it is space constraints, easement issues, or simply cost, our multi-layer pole systems are strong enough for any self-sustaining, unguyed application. Our team will work with yours to understand the loading requirements on the pole and suggest which of our multi-layer pole systems is right for the job. Download and complete our Structural Design Guide and send to info@tridentstrong.com to get started.



ENVIRONMENTAL CHALLENGES

The inert nature of composites make them ideal for challenging environmental conditions. Composites do not rust and will long outlast steel in coastal applications. They do not leach chemicals, can be safely deployed without environmental concern, and they are impervious to woodpecker or insect damage. Trident poles are engineered to perform in the harshest of conditions.



TRANSFORMER AND SWITCH APPLICATIONS

Trident poles are built to bear the weight of transformers and can be used in multi-function methods, for example a storm hardened, unguyed switch pole.



H-FRAMES

Being that composites are an engineered material, there is a great amount of consistency from one pole to the next. H-frames are an excellent application for Trident poles in that they will age at the same rate and not need to be replaced until both poles have exceeded their expected lifespan, unlike wood. Their strength and stiffness also make them great candidates for long-span designs.



MOTOR VEHICLE IMPACTS

Our poles can absorb significant energy in an impact event, twice that of wood and ten times that of steel. The result is a safer situation in the event of a vehicle strike.

SINGLE-LAYER POLE PHYSICAL & MECHANICAL PROPERTIES


Physical Properties (Imperial Units)	12" Diameter Pultruded Pole (12" x 0.5")	14" Diameter Pultruded Pole (14" x 0.75")	15" Diameter Pultruded Pole (15" x 0.80")	17" Diameter Pultruded Pole (17" x 0.85")
Outer Diameter (in)	12.18	13.76	15.49	17.27
Inner Diameter (in)	11.18	12.28	13.89	15.57
Wall Thickness (in)	0.50	0.75	0.80	0.85
Weight (lb/ft)	15.8	25.4	30.8	35.8
Density (lb/ft ³)	123.8	117.7	118.6	117.1
Cross Sectional Area (in ²)	18.3	30.6	36.9	43.8
Section Modulus (in ³)	51.4	94.5	129.0	171.6
Moment of Inertia (in ⁴)	313	650	999	1481
Radius of Gyration (in)	4.13	4.61	5.20	5.81
Poisson's Ratio	0.31	0.31	0.31	0.31
Fiber Weight Fraction	≥68%	≥68%	≥68%	≥68%
Coefficient of Thermal Expansion (in/in/°F)	2.70E-06	2.70E-06	2.70E-06	2.70E-06
UV Testing (>10,000 hrs) ¹	Passed	Passed	Passed	Passed
Water Absorption (%) ²	0.13	0.13	0.13	0.13
Mechanical Properties (Imperial Units)				
Average Ultimate Moment Capacity (lb*ft)	213,842	407,121	477,595	645,629
5% LEL Ultimate Moment Capacity (lb*ft)	194,693	356,678	398,870	574,312
Average Maximum Allowable Bending Stress (psi)	49,898	51,730	45,807	46,449
5% LEL Maximum Allowable Bending Stress (psi)	45,430	45,320	38,256	41,318
Average Modulus of Elasticity (psi)	4,533,211	4,503,858	4,431,731	4,424,767
Shear Modulus, G _{xy} (psi)	879,000	879,000	879,000	879,000
Pin-Bearing Strength Lengthwise (lbs) ⁴	15,940	25,828	45,340	44,648
Washer Pull-Through Strength (lbs) ⁴	10,488	16,746	18,884	19,132

1. Based on both Xenon Arc and QUV Testing
2. Determined per ASTM D570 (24 hours)
3. Determined per ASTM D1036
4. Testing conducted with utility grade 13/16" bolts and 3"x3" curved washers

For more demanding applications, such as self-supporting poles and sub-transmission structures, our engineering support team will help in identifying the correct multi-layer pole to fit your needs.




ACCESSORIES



Permanent steps can be ordered in single-sided or working step configurations. Steps are secured through the pole and will support up to 750 lbs. of load without fracture or disassembly from the poles.

Composite sleeves slide inside pre-drilled or field-drilled holes to prevent over-torquing and maintain steel isolation. Trident composite sleeves are 1-inch round and can be preinstalled and capped for field hardware installation.



Trident poles come complete with impact resistant **pole caps** and composite **base plates**. Caps are fitted to poles using removable self-tapping screws for easy access. UHMWPE base plates include drainage holes that can be drilled to customer specifications.



TESTING GUIDELINES FOR FRP POLES

Our poles have been subjected to the most rigorous test standards for utility poles and adhere to the 5% lower exclusion limit (LEL) rule.

FULL SECTION POLE TESTING – ASTM D1036

This test is conducted on a routine basis to determine the ultimate bending moment of the poles. Poles are tested in a horizontal cantilever arrangement with the base placed in a rigid test frame held in place with 12-inch nylon straps. A nylon sling is placed two feet from the tip of the pole, a load is applied at a constant rate of deformation, and load vs. deflection is plotted.

MODULUS OF ELASTICITY – ASTM D8019

The modulus of elasticity (MOE) can be computed from the ASTM D1036 results and shall be based on approximately 30% of the ultimate pole strength.



ULTIMATE MOMENT CAPACITY

The ultimate moment capacity is calculated based on maximum recorded load prior to failure. The moment is calculated by multiplying the ultimate load by the moment arm (distance between load application and first constraint at the base of the pole).

TORSIONAL STRENGTH – ASTM D5379

Torsional strength is computed based on in-plane shear strength as determined by ASTM D5379. The torsional strength is calculated in the following manner:

$$T = \tau_{xy} 2\pi r^2 t$$

Where:

T = Torque (lb-ft) [N-m]

τ_{xy} = Inplane shear strength (psi) [Pa]

r² = mean radius (in) [mm]

t = wall thickness (in) [mm]

ELECTRICAL – ASTM F711

This is a dielectric strength test, and while FRP poles have inherent, non-conductive behavior, they are not intended to be used as insulators.

UV AND ATMOSPHERIC MOISTURE – ASTM G154 CYCLE 1

Trident poles have been tested for UV stability via both xenon arc and QUV methods at 100% relative humidity. Our construction with a 14 mm surface veil provides for a resin rich surface which meets the criteria for passing this standard test. After 10,000 hours of exposure, no indication of fiber blooming was observed.

WATER ABSORPTION – ASTM D570

Excessive water absorption of a composite structure can ultimately lead to degradation, especially in climates which experience freeze and thaw cycles. Trident poles have been tested to ASTM D570 and pass easily with water absorption measurements well below the 2% (by weight) allowable limit, making our poles ideal for application in wetlands or areas with seasonally high water tables.

FIRE EXPOSURE – UL94, ASTM D635, ASTM E84

FRP poles are often subjected to multiple fire tests:

- (a) UL 94 is a vertical burn test in which a flame is applied to a coupon of the pole and must pass a “self-extinguishing” rating in which the flame extinguishes when removed from the sample, denoting a V-0 passing criteria.
- (b) ASTM D635 is a horizontal burn test in which passing criteria means the following:
 - 1. There are no visible signs of combustion after the source is removed; or
 - 2. The flame front does not pass the 1 in. [25 mm] reference mark; or
 - 3. The flame front passes the 1 in. [25 mm] reference mark but does not reach the 4 in. [100 mm] reference mark; or
 - 4. The flame front reaches the 4 in. [100 mm] reference mark and the linear burning rate does not exceed 1.5 in./min [40 mm/min] for specimens having a thickness between 0.1 in and 0.5 in. [3 and 13 mm] or 3 in./min [75 mm/min] for specimens having a thickness less than 0.1 in [3 mm].
- (c) ASTM E84 is a test measuring flame spread and smoke density in which Trident poles meet Class A performance of flame spread index <25 and smoke development index <450.

INSTALLATION GUIDE

In general, FRP utility poles can be installed similarly to wood, steel or concrete poles.

POLE MARKINGS

Information tag is placed 6' above ground level. Tag is at 0 degrees, which is located directly under the middle phase of the source line. The pole ground is always mounted at 45 degrees internal.

Ground line is marked with red tape.

Balance point is marked with yellow tape.

STORAGE

Composite poles are intended to be in the elements and can be stored virtually anywhere with little concern.

Do not stack poles directly on top of one another to prevent pole surface damage. We recommend use of wood dunnage to separate poles and allow for lifting straps to be slid under poles for picking.

HANDLING

Do not drag the pole. Butt plate shall be protected during install.

Use nylon or fabric straps for lifting poles. Do not use chains, cable or other metal rigging to lift poles.

Take care to prevent damage to the UV protective surface.

Plug any unused holes with Trident rubber plugs.

PPE

Wear eye protection when drilling or cutting. Goggles or face shield may be preferred when cutting.

Wear dust mask at all times when cutting and as needed when drilling. The dust created is considered a skin and respiratory irritant and has no proven long term health effects due to exposure. An approved respirator meeting 42 CFR Part 84 standards should be worn if dusty conditions exist.

Wear long sleeves and gloves when drilling or cutting to minimize minor skin irritation associated with fiberglass dust.

FOUNDATION AND BACKFILL

FRP utility poles are designed to be embedded in the ground similar to wood, steel and concrete poles. Typical burial depth is 10% of the pole length plus 2 ft.

Backfill lifts shall be every 6" - 8".

Tamp backfill at each lift to assure good compaction. Care should be taken to avoid impacting the pole wall with steel tools during backfill and tamping.

Backfill options include crushed limestone, road crush, pole setting foam, or concrete.

Install 1' of backfill in hole prior to installing the pole.

When pole is set in concrete, use 1" to 2" of expansion material between pole and concrete.

Hole Diameters and Backfill Type:

<u>Pole Size</u>	<u>Hole diameter (in)</u>	<u>Backfill Type</u>
17" pole	34" diameter hole	2" minus rock with fine
15" pole	30" diameter hole	1.5-2" minus rock with fine
14" pole	28" diameter hole	1.5-2" minus rock with fine
12" pole	24" diameter hole	1-2" minus rock with fine

The standard burial depth for composite poles is as follows:

- 10% + 2' is used for tangent applications and storm structure for storm hardening
- 10% + 3.5' is used for angles up to 20°, switch applications, and super storm structures
- 10% + 5' is used for angles from 20° to 60°
- 10% + 6.5' is used for angles from 60° to 90°

REPAIRS

Minor Scrapes and Scratches

Minor scratches can also be addressed with cleaning the area and then applying one to two coats of a Sherwin Williams Resilience Exterior Acrylic Latex paint.

Large Surface Area Repairs

Deeper or larger scrapes and gouges can be filled with 3M™ Short Strand Fiberglass Reinforced Filler. After the patched area has dried, sand it with a 220 Grit paper and then apply a coat of the paint referenced above.

FRP DO'S AND DON'TS

DRILLING

Do	Don't
Use Carbide or diamond tipped bits .	Use wood pole bits or spade bits as they will burn up instantly.
Drill pilot holes so that only the threads are biting into composite material.	Install screws into pole without drilling pilot holes as they can bind and shear screw heads. Self-tappers tend to hollow out the hole and therefore do not provide a firm grip.
Use low speed electric or cordless drills (≤ 1000 rpm).	Use high speed drills (Hydraulic or Pneumatic) as it will break the drill bit.
A 6" hole spacing is recommended; however, a minimum of a 4" hole spacing may be used if necessary, if no more than 2 holes are drilled within a 12" span.	

FRAMING

Do	Don't
Use inserts or spacers when drillings holes to mount bolted on hardware to prevent over torquing of bolts. <i>Recommended bolt torque should not exceed 50 ft.-lbs</i> or hand tightened plus $\frac{1}{2}$ to one full turn.	Install bolts without installing inserts or spacers.
	Over torque bolts with high-speed drills.
Use through bolts for all load bearing hardware attachments.	Use lag bolts for loading bearing hardware attachments.
Use non-cleated hardware or tools.	Use cleated hardware or other hardware designed to be drawn into the pole.

CUTTING

Do	Don't
Use segmented diamond blades for partner or handheld circular saws. Standard concrete cutting blades may also be used.	Use any type of wood blade, they will burn up or can break up and throw metal fragments.

TECHNICAL SUPPORT

CCG's Support Team is available to assist utilities with all composite utility pole needs. We can help with all facets from line design to installation. We provide the following services to utilities:

STANDARDS SUPPORT

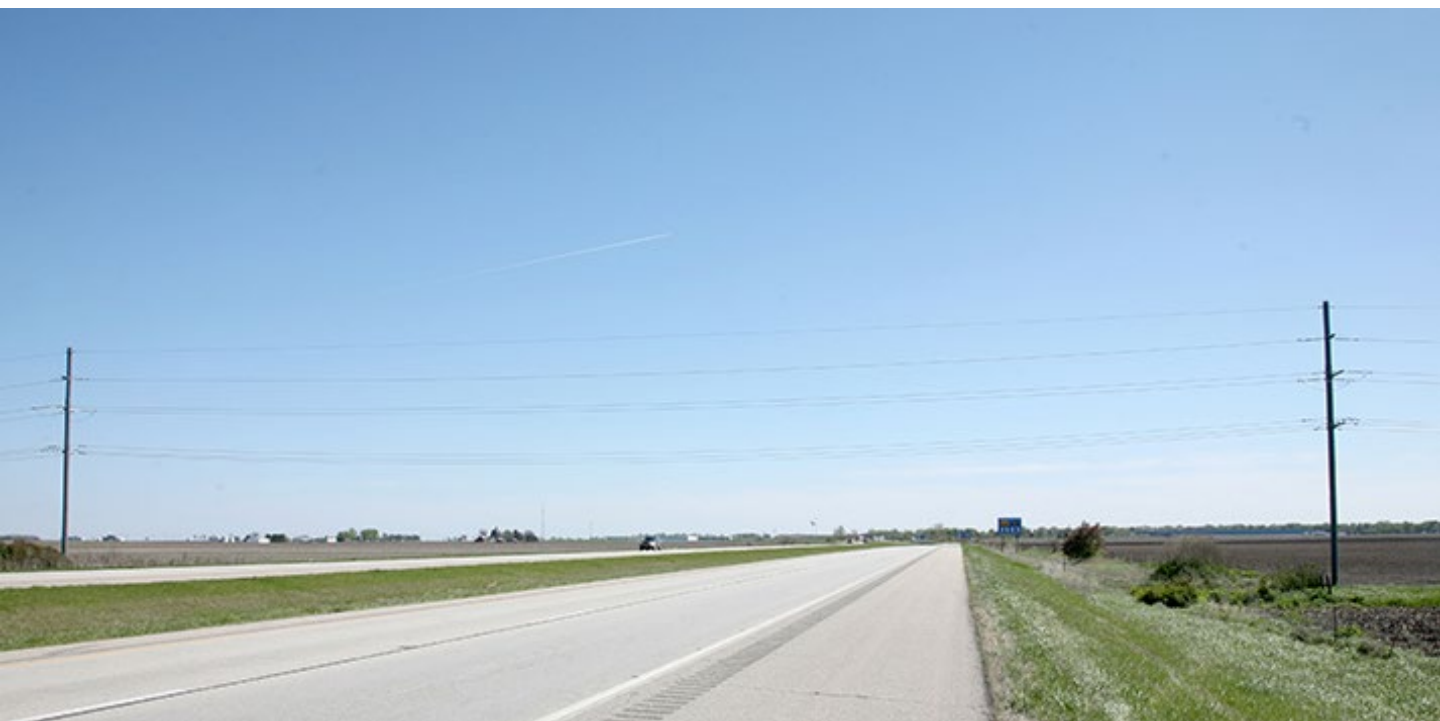
Trident's Support Team can assist in writing or reviewing industry standards for composite utility poles.

LINE DESIGN & POLE SELECTION

Our team is happy to work with yours in line design and pole selection, for which our proprietary software can help calculate the right pole for the right application.

INSTALLATION

We offer full on-site installation support and will work with your crew to assist with burial depth, rake, and type of backfill.





CREATIVE
COMPOSITES
GROUP®

Trident Industries Division
16602 Central Green Blvd.
Houston, TX 77032

Contact Us:

Email: info@TridentStrong.com

Phone: 312-245-2850

CreativeCompositesGroup.com