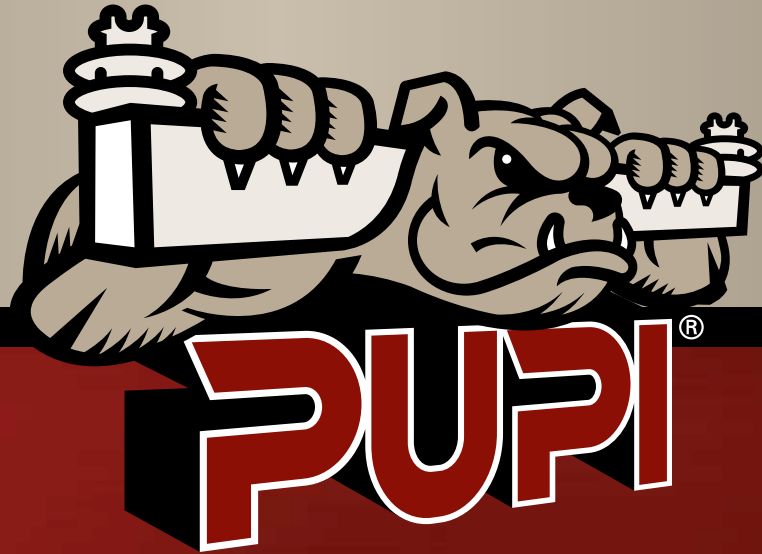


PUPI[®] TECHNICAL INFORMATION



One Tough PUPI[™]

800.533.1680 | www.pupicrossarms.com

PUPI is a product of:



A Whole New World of Composites

TESTING METHODS

PUPI crossarms are made to stand the test of time. Thorough testing is done on a regular basis to make sure our products are performing as designed. Testing methods used on PUPI products include: Mechanical, UV Resistance, and Electrical Performance. It is our continued goal to produce the best products in the industry and our exhaustive testing helps us maintain this. We complete both internal and external testing. PUPI uses several independent test facilities including: EDM International, Fort Collins, CO; Composite Materials Testing Center (COMTEC) at Winona State University, Winona, MN; and PFS Corporation, Madison, WI. Published strength and deflection data for PUPI crossarms are based upon extensive testing performed at these independent test facilities.

GEOTEK STANDARD TEST METHODS

ASTM

C518	Thermal Conductivity	D3801	Flammability (same as ANSI/UL94)
D149	Dielectric Strength	D3916	Tensile Properties, rods
D257	Surface and Volume Resistivity	D3917	Dimensional Tolerances
D570	Water Absorption	D4385	Visual Defects
D635	Flammability	D4475	Short Beam Shear Strength, rods
D638	Tensile Strength and Modulus, including high and low temps	D4476	Flexural Properties, rods
D648	Heat Distortion Temperature	D5117	Dye Penetration of Pultruded Stock
D695	Compressive Strength	D7774	Flexural Fatigue
D696	Thermal Expansion Coefficient, -30C to +30C	E84	Flame Spread, tunnel test
D790	Flexural Strength and Modulus, including high and low temps	E662	Smoke Optical Density
D792	Specific Gravity and Density	E831	Thermal Expansion Coefficient, TMA
D2344	Short Beam Shear Strength	G90	Accelerated Outdoor Weathering
D2583	Hardness, Barcol	G154	UV Resistance, Weathering (replaces G53)
D2584	Ignition Loss	<u>IEC</u>	60060-1 High Voltage Testing
D3039	Tensile Properties of Composites	<u>IEEE</u>	4-1995 High Voltage Testing

PUPI® CROSSARM DESIGN SUMMARY

- PUPI Series 2200, 2000, 2500 and 3000 crossarm beams are 3 5/8" X 4 5/8" to fit standard hardware for wood crossarms.
- PUPI Series 4400 and 4000 crossarm beams are 4.00" X 6.00" with heavy walls and are designed for extra heavy loading applications.
- PUPI Series 1000 crossarm beams are 2.10" X 4.04" outside dimensions and are suitable for lower cost, lighter weight applications.
- Many PUPI tangent crossarms and deadend assemblies are offered with all mount hardware attached at our factory for easy, low cost installation.
- PUPI crossarms can be field drilled through the center line of each major axis when needed.
- PUPI crossarms are attached to wood, steel, fiberglass or other poles consistent with the attachment methods for wood crossarms.
- PUPI crossarms are completely filled with a high quality, closed cell polyurethane foam. Our process ensures a strong adhesive bond between the foam and the beam walls so that moisture or other contaminants cannot penetrate the arm or travel along the foam/fiberglass interface.
- PUPI crossarms are made with high strength polymer endcaps that are bonded to the crossarm ends to fully seal the ends of the arms.
- PUPI crossarm endcaps include the PUPI logo in bold letters and the year of manufacture.
- PUPI crossarms are offered with our patented TorqueGUARD™ fiberglass inserts at all bolt attachment holes to give by far the most crush-resistant fiberglass crossarms in the world. The narrow edge (the direction of primary loading) of PUPI crossarms can withstand over 450 ft-lbs of torque loading applied to high strength 5/8" or 3/4" bolts without damage to the crossarms. This exceeds the torque exerted by standard pole line hardware.
- PUPI crossarms have projected field life exceeding 60 years.

PUPI® CROSSARM MECHANICAL TESTING

Mechanical testing of PUPI crossarms has been performed at several independent test facilities including: EDM International, Fort Collins, CO; the Composite Materials Technology Center (COMTEC) at Winona State University, Winona, MN; and PFS Corporation, Madison WI. EDM specializes in testing services for the electrical power industry, COMTEC specializes in testing fiber reinforced composite structures, and PFS specializes in testing wood structures. Published strength and deflection data for PUPI crossarms are based upon extensive testing of PUPI arms performed at these independent test facilities.

PUPI test beams are taken as random samples from standard pultrusion runs. 10' and 12' arm flexure tests have been conducted at EDM; 5', 8', and 10' arm flexure tests have been conducted at COMTEC; pin torque tests have been conducted at EDM and COMTEC; and ASTM D198 tests (test for solid wood crossarms) have been conducted at EDM and PFS. Crossarm flexure tests for braceless tangents and deadends use PUPI mounts and attachment hardware.

Flexural test fixtures at EDM and COMTEC use two large I beams to support mounts for attachments to eyebolts on each end of a crossarm. Tests are conducted by applying a vertical load at a constant rate to the steel mount and measuring load versus deflection to beam fracture. Load/deflection plots are essentially linear to the fracture point for all PUPI crossarms. An example of a flexure test setup at COMTEC is featured below:



PUPI test methods closely replicate actual product service conditions. Test specimens are drilled with the same hole configuration as in the final product, production mounts and beam attachment hardware are used, and loads are applied at the same points as in the final product application.

PUPI® CROSSARM RESISTANCE TO ULTRAVIOLET RADIATION

PUPI fiberglass crossarms are made with triple protection against environmental degradation:

1. Outer arm surface is our patented thermally-bonded SunGUARD® UV resistant coating. This extremely abrasion resistant polyurethane coating has demonstrated exceptional UV resistance over 30 years in environments from hot wet tropical areas to frigid northern climates.
2. An ultraviolet-resistant polyester veil forms a resin rich surface under the bonded coating.
3. The entire PUPI resin system contains a broad spectrum UV inhibitor.

SUNGUARD® COATING

GEOTEK engineers have been manufacturing fiberglass structural products for outdoor applications since 1972. We started coating fiberglass products for outdoor applications in 1973 and started shipping SunGUARD® coated fiberglass structures in 1982. Since that time, we have not had a single product failure of any SunGUARD® coated product anywhere in the world due to environmental degradation nor have we seen any measurable coating erosion over time.

- **PUPI crossarms have resin rich synthetic veil surfaces and UV resin inhibitors PLUS our unique thermally-bonded SunGUARD® coating to give unmatched UV resistance.**

ACCELERATED TESTING OF RESISTANCE TO ULTRAVIOLET RADIATION

The Rural Utilities Service, US Department of Agriculture specifies 2500 hours of accelerated testing according to ASTM G53-96, now G154-12a. PUPI beams have been tested with QUV Accelerated Weathering Testers at the Composite Materials Technology Center at Winona State University, an independent testing facility. Results:

- PUPI crossarms had no degradation in flexural strength, modulus, or deflection to failure after 2500 hours of exposure and minimal lightening of coating color.
- A more aggressive test of 10,000 hours of accelerated exposure to intense UV-B radiation showed some lightening of the coating color and loss of gloss but minimal coating erosion with no effects at all on the fiberglass structure.

NOTE: The QUV is a comparative test. The ASTM states in G151 for accelerated testing: "Even though it is very tempting, calculation of an acceleration factor (ASTM italics) relating x hours of a laboratory accelerated test to y months or years of exterior exposure is not recommended."

FIELD EXPERIENCE

At present, there are well over one million PUPI fiberglass crossarms installed in a wide variety of environments including the hot and wet climates of Southern Florida and Southeast Asia, the hot and dry environment of the Arizona desert and other Southwestern states and the frigid Northern areas of Canada and Alaska.

- With over 19 years of exposure in various natural environments, not a single PUPI beam has failed due to environmental degradation.
 - In the most intense UV exposure environments, some lightening of the coating color may occur, particularly on the top surface, but the coating remains intact.
- **PUPI crossarms have projected service life well over 60 years.**

PUPI® SUNGUARD® UV COATING **PROTECTION FROM ULTRAVIOLET LIGHT DEGRADATION**

SUNGUARD® UV COATING SOUTH FLORIDA TESTING

SunGUARD® UV coatings used on PUPI crossarms are the first line of protection against ultraviolet light degradation over long periods of time. The coatings are high temperature cured, two-component polyurethanes with powerful ultraviolet light inhibitors to minimize UV degradation.

SunGUARD® UV coatings are applied in-line during the fiberglass beam pultrusion process. Applying the coatings directly onto the hot beams creates strong thermal bonding and high crosslink density resulting in extremely tough and solvent resistant coatings.

SunGUARD® UV coatings were developed jointly with a major US coating manufacturer. The coatings were tested in the standard 45 degree angle exposure test to the South Florida sun for 4 years. Percent weight loss of one mil films was then determined. These results were compared to 10 year test results in 45 degree South Florida exposure for a number of other well-known coating materials. The 45 degree South Florida testing is considered one of the best tests for ultraviolet light resistance because it tests performance in actual intense outdoor sunlight with its full spectrum of radiation rather than artificial light.

After 4 years of South Florida exposure, the amount of film erosion of the SunGUARD® UV coating was 0.02%. Extrapolating this result to 40 years, just 0.2% film erosion would occur. While the film erosion rate would likely increase somewhat over time, taking into consideration the chemical composition of the coatings tested and drawing upon decades of experience by the coating manufacturer, the manufacturer projects that erosion of the SunGUARD® UV coating over 40 years of 45 degree South Florida exposure will not exceed 20% of a one mil coating.

With the PUPI minimum dry film thickness of 1.5 mils, SunGUARD® UV coatings on PUPI crossarms have a minimum project life well beyond 60 years.

PUPI® CROSSARM FLAMMABILITY TESTING

PUPI crossarms are self-extinguishing after removal of direct flames.

- Flammability tests have been conducted on standard crossarms and also on cut specimens according to ASTM D635 horizontal burn and ASTM D3801 vertical burn tests.
- Organic surface materials in the coating and the fiberglass beam surface ignite under direct flame exposure, but the arm quickly extinguishes after the flame is removed.
- PUPI arms are highly loaded with fiberglass and other inorganic materials that do not support combustion.

FLAMMABILITY TESTS

• Beam Wall Cut Specimens

PUPI crossarm cut specimens 13mm wide were tested according to ASTM D635 and D3801 (equivalent to ANSI/UL 94) test procedures by Element Testing, St. Paul, Minnesota:

- D635 horizontal burn: no specimen of ten reached the 25mm reference mark.
- D3801 vertical burn: passed V1 vertical burn classification.

• Full Beams

We conducted more aggressive tests on standard PUPI beams:

1. Flame is applied for 30 seconds and then withdrawn, record after flame and afterglow times.
2. As soon as the flame goes out, repeat the flame exposure at the same location for 30 seconds.
3. Record after burn and afterglow times.
4. Run longer flame exposure: two minute flame application followed by 2 minutes additional flame application at same location.
5. Then 5 and 10 minute flame applications.
6. Tests were run with gray PUPI Series 2000 crossarms, which are thin wall PUPI 3-5/8" X 4-5/8" beams. Five specimens per test for the shorter tests, two for the longer tests.

Results:

- Flames self-extinguished for all tests. There was no afterglow in any test. There was no dripping of material in any test.
- Beams burned only in the area of direct flame application.
- Burn diameter and burn depth into the beams were measured. Beam wall thickness is 0.27".

FLAME TIME	AFTERFLAME TIME	BURN DIAMETER	BURN DEPTH
1 ST 30 SECONDS	1.5 - 2.0 SECONDS		
2 ND 30 SECONDS	4.0 - 5.0 SECONDS	1.0"	SURFACE ONLY
1 ST 120 SECONDS	26 - 40 SECONDS		
2 ND 120 SECONDS	45 - 70 SECONDS	2.0"	0.13"
300 SECONDS	110 - 120 SECONDS	2.2" - 2.5"	0.19"
600 SECONDS	125 - 145 SECONDS	2.7" - 2.8"	0.27" (THROUGH BEAM WALL)

Conclusion:

- PUPI fiberglass crossarms are self-extinguishing products.

PUPI® CROSSARM HIGH VOLTAGE TESTS

TESTS PERFORMED AT THE NATIONAL ELECTRIC ENERGY TESTING RESEARCH AND APPLICATIONS CENTER

(NEETRAC), GEORGIA INSTITUTE OF TECHNOLOGY

PUPI Braceless Tangents on wood pole

- 8' PUPI Series 2000 braceless tangent with PUPI mount
- 8' PUPI Series 3000 braceless tangent with PUPI mount

Test method IEEE Standard 4-1995:

- Arms attached to wood power pole, three phase configuration.
- Arms tested with ANSI Class 55-5 (25 kV porcelain) insulators mounted 4" from crossarm ends and also with the insulators removed and impulses applied directly to the pin mounting hole.
- Center phase grounded, outer phase impulsed.
- Maximum output of the generator used is 500kV.

Results:

1. No flashover at maximum output of generator of 500 kV.
2. Since flashover did not occur, BIL level of the PUPI Series 2000 and Series 3000 crossarms exceeds 450kV.

PUPI Braceless Tangents and Deadends on steel pole

- 8' PUPI Series 2000 braceless tangent with PUPI mount
- 8' PUPI Series 2000 braceless deadend assembly with PUPI mount

Test method IEEE Standard 4-1995:

- Tested with steel pole and higher power generator than above test.

Results:

1. **PUPI Series 2000 tangent:** Critical impulse flashover = 577.9 kV
 - Arc from conductor tie to front and back of crossarm mounting bracket.
 - BIL = 555kV = 15kV/inch
2. **PUPI Series 2000 deadend:** Critical impulse flashover = 578.4 kV
 - Arc from hot end of insulator to crossarm mounting bracket.
 - BIL = 555kV = 15kV/inch

TESTS PERFORMED AT KINETRICS INC.

TORONTO, ONTARIO, CANADA

PUPI Braceless Tangents on fiberglass pole

- 10' PUPI Series 2000 braceless tangent with PUPI mount

Results:

1. 25kV Distribution Line mockup
 - Critical Lightning Impulse Flashover Voltage: 683kV (dry), 572kV (wet)
2. 69kV Distribution line mockup
 - Critical Lightning Impulse Flashover Voltage: 855kV (dry), 886kV (wet)
 - Lightning arc took air gap under dry condition, often crept along crossarm surface under wet.

PUPI® CROSSARM HIGH VOLTAGE TESTS, CON'T

PUPI Transmission Arms on steel lattice

• 275 kV Transmission Arm on steel lattices

Test method IEC 60060-1 (15 +impulses, 15 –impulses)

- Dry lightning impulse tests to 1050 kV
- Dry switching impulse tests to 850 kV
- Dry power frequency tests to 460 kV
- Wet power frequency tests to 460 kV

Results:

1. No flashover in any tests, pass all tests.

PUPI Braced Tangents

• 2.4m (7.9') PUPI Series J tangent, braced model

- J211Z steel insulator pins with 720mm spacing, no insulators on pins

Results:

1. Critical Lightning Impulse Flashover Voltage: 424.5kV (+ dry) = 590V/mm or 15.0 kV/in
2. Critical Lightning Impulse Flashover Voltage: 485.9KV (- dry) = 675V/mm or 17.1 kV/in

ASTM TESTS

(COUPONS CUT FROM BEAM WALLS)

Element New Berlin laboratory, Wisconsin and Delsen Testing laboratory, Glendale, CA

- Dielectric Strength (ASTM D149), PUPI 2000, 2200, 2500 and J Series tested
 - 200 - 320 V/mil through beam wall, mean 254 V/mil
 - 141 - 196 V/mil along beam principal axis, mean 167 V/mil
- Surface Resistivity (ASTM D257), PUPI 2500 & 3000 tested
 - 1 - 4 X 10¹⁵ ohms

Trace Laboratories, Hunt Valley, MD

- Arc Tracking (ASTM D495)
 - 131 seconds, PUPI J Series tested

NOTE: PUPI fiberglass crossarm beams are pultruded using the same base materials and all have the same UV resistance polyurethane coating thickness, polyester veil and surface construction so PUPI crossarms all have similar electrical performance to those tested.

PUPI® TANGENT CROSSARM PIN TORQUE TESTS

PIN TORQUE TEST, LONGITUDINAL

Test Method:

- Test specimens are standard PUPI beams with standard drilling pattern.
- Arms are mounted using standard PUPI mount.
- Three pin designs were tested: MacLean standard pins J203Z and J647Z, 5" and 7" pins with nylon thread and MacLean clamp pins J3322Z. Series 1000 arms were tested with J203Z pins only.
- Pins are attached to the crossarms at standard outer pin locations 4" from the end of the arm.
- Steel nut is threaded onto insulator pin as the loading contact.
- Insulator pin tip is placed under load cell in Instron test system.
- Load is applied to pin tip perpendicular to the crossarm major axis until beam fractures.
- No contact with the shaft of the pin or the end of the arm is allowed.
- RUS requirement is no crushing of the fiberglass beam to 700 lbs load.

Results:

Series 1000 Crossarms

All passed 900 lbs load with no damage to crossarms.

Series 2000, 2200, and 2500 Crossarms

All passed 1000 lbs load with no damage to crossarms.

Series 3000 Crossarms

All passed 1250 lbs load, clamp pins exceeded 2300 lbs load with no damage to arms.

Series 4000 and 4400 Crossarms, 7" pins only

All passed 1250 lbs load with no damage to arms.

PIN TORQUE TEST, TRANSVERSE

Test Method:

- Specimens are 30" sections cut from the ends of standard PUPI crossarms.
- Cut end of arms are placed into a steel fixture to hold the arm section vertically.
- MacLean insulator pin is attached to the free end of the beam section at the normal location 4" from the end of the crossarm.
- Insulator pin tip is placed under load cell in Instron test system
- Load is applied to the insulator pin tip parallel to the beam major axis until beam fractures or load limit of test is achieved.
- RUS requirement is no crushing of the fiberglass beam to 750 lbs load with standard pins, no crushing of the fiberglass beam to 1000 lbs with clamp pins.

Results:

Series 1000, 2000, 2200, 2500 and 3000 Crossarms

All passed 1000 lbs load with no damage to crossarms, tests truncated at 1000 lb load.

Series 4000 and 4400 Crossarms, 7" pins only

All passed 1250 lbs load with no damage to arms.

PUPI arms have also been tested for torque strength with various post insulator types. Contact PUPI for details. PUPI crossarms exceed RUS pin torque test requirements.

PUPI® CROSSARM BOLT HOLE TORQUE STRENGTH

- Tested with 4" galvanized square steel washers on each side of hole except for 2" square washers on 2" side of PUPI 2"X 4" arm
- 5/8" diameter bolts through 11/16" diameter holes and 3/4" bolts through 13/16" diameter holes.
- SAE Grade 5 bolts as used in PUPI products
- 36" long torque wrench used for these tests

PUPI with TorqueGUARD™ fiberglass bushings at bolt holes

- All crossarms exceed the 450 ft-lbs capability of the test on the narrow side of the crossarm, which is designed to be the primary load direction.

PUPI without internal bushings

- Series 1000 2.10" X 4.04"
 - 11/16" hole through 4.625" side: 75 ft-lbs
 - 11/16" hole through 3.625" side: 200 ft-lbs
- Series 2200 3.625" X 4.625"
 - 11/16" hole through 4.625" side: 70 ft-lbs
 - 11/16" hole through 3.625" side: 190 ft-lbs
- Series 2000 3.625" X 4.625"
 - 11/16" hole through 4.625" side: 110 ft-lbs
 - 11/16" hole through 3.625" side: 180 ft-lbs
- Series 2500 3.625" X 4.625"
 - 11/16" hole through 4.625" side: 125 ft-lbs
 - 11/16" hole through 3.625" dimension: 185 ft-lbs
- Series 3000 3.625" X 4.625"
 - 11/16" hole through 4.625" side: 165 ft-lbs
 - 11/16" hole through 3.625" side: 200 ft-lbs
- Series 4000 4.00" X 6.00"
 - 11/16" hole through 6.00" side: 100 ft-lbs
 - 11/16" hole through 4.00" side: 225 ft-lbs
 - 13/16" hole through 6.00" side: 100 ft-lbs
 - 13/16" hole through 4.00" side: 225 ft-lbs

NOTE: PUPI crossarms without bushings have higher bolt hole crush resistance than comparable fiberglass crossarms from competitors.

TECHNICAL INFORMATION

PUPI Braced Tangent Crossarms

CROSSARM STRENGTH EXAMPLES

CROSSARM	Arm Wt per foot	Ultimate Vertical Capacity lbs/end	Ultimate Longitudinal Capacity lbs/end	Ultimate Transverse Capacity	Vertical Design Stress psi
2" X 4"					
PUPI T1000 2.10" X 4.04"	1.96 lbs	3,300 (8') 2,700 (10')	1,500 (8')	1,750 (8')	58,000 (8') 66,000 (10')
STANDARD					
PUPI T2200 3.625" X 4.625"	2.50 lbs	3,500 (8') 3,100 (10')	2,500 (8') 2,000 (10')	2,500 (8') 2,500 (10')	57,500 (8') 65,000 (10')
PUPI T2000 3.625" X 4.625"	3.35 lbs	5,400 (8') 4,600 (10')	2,500 (8') 2,100 (10')	3,000 (8') 3,000 (10')	45,500 (8') 49,000 (10')
HEAVY DUTY					
PUPI T2500 3.625" X 4.625"	3.58 lbs	6,000 (8') 4,800 (10')	4,000 (8') 3,200 (10')	4,000 (8') 4,000 (10')	50,500 (8') 51,500 (10')
PUPI T3000 3.625" X 4.625"	4.35 lbs	8,000 (8') 7,500 (10')	5,600 (8') 5,200 (10')	7,000 (8') 7,000 (10')	54,500 (8') 65,000 (10')

Notes:

- Capacity depends upon the type of brace; these values are with PUPI bottom mounted fiberglass braces.
- Load capacities are for two positions per arm with pins 4" from arm ends.
- Design stress is outer fiber stress, values typically increase with arm length.

PUPI Braceless Tangent Crossarms

CROSSARM STRENGTH EXAMPLES

CROSSARM	Arm Wt per foot	Mount Assembly	Ultimate Vertical Capacity lbs/end	Ultimate Longitudinal Capacity lbs/end	Ultimate Transverse Capacity	Vertical Design Stress psi
2" X 4"						
PUPI TB1000 2.10" X 4.04"	1.96 lbs	12 lbs	4,000 (8') 3,000 (10')	1,750 (8')	1,750 (8')	70,000 (8') 73,000 (10')
STANDARD						
PUPI TB2200 3.625" X 4.625"	2.55 lbs	15 lbs	3,500 (8') 2,750 (10')	2,650 (8') 2,000 (10')	2,500 (8') 2,500 (10')	51,000 (8') 52,500 (10')
PUPI TB2000 3.625" X 4.625"	3.35 lbs	15 lbs	6,400 (8') 5,400 (10')	3,000 (8') 2,500 (10')	3,000 (8') 3,000 (10')	48,000 (8') 53,000 (10')
HEAVY DUTY						
PUPI TB2500 3.625" X 4.625"	3.58 lbs	15 lbs	7,500 (8') 6,000 (10')	5,000 (8') 4,000 (10')	4,000 (8') 4,000 (10')	56,000 (8') 58,700 (10')
PUPI TB3000 3.625" X 4.625"	4.35 lbs	18 lbs	10,000 (8') 9,400 (10')	7,000 (8') 6,500 (10')	7,000 (8') 7,000 (10')	60,000 (8') 74,000 (10')
EXTRA HEAVY DUTY						
PUPI TB4000 4.00" X 6.00"	5.63 lbs	22.5 lbs	13,000 (8') 12,000 (10')	9,500 (8') 8,700 (10')	8,000 (8') 8,000 (10')	45,800 (8') 68,300 (10')

Notes:

- Load capacities for crossarms with PUPI tangent mounts.
- Load capacities are for two positions per arm with pins 4" from arm ends.
- Design stress is outer fiber stress, values typically increase with arm length.

TECHNICAL INFORMATION

PUPI Tangent Crossarms

FIBERGLASS BEAM PROPERTIES

BEAM	Wall Thickness	Area in ²	Moment I _x in ⁴	Moment I _z in ⁴	Mod E _x 10 ⁶ lb/in ²	Mod E _z 10 ⁶ lb/in ²	S _x in ³	S _z in ³
2" X 4"								
PUPI TB1000 2.10" X 4.04"	H side (2.10"): 0.175" V side (4.04"): 0.205"	2.158	4.646	1.514	4.4	4.4	2.300	1.442
STANDARD								
PUPI TB2200 3.625" X 4.625"	H side (3.625"): 0.200" V side (4.625"): 0.180"	3.037	9.138	6.489	4.4	4.4	3.952	3.580
PUPI TB2000 3.625" X 4.625"	H side (3.625"): 0.270" V side (4.625"): 0.240"	3.934	12.044	7.742	3.5	3.5	5.208	4.271
HEAVY DUTY								
PUPI TB2500 3.625" X 4.625"	H side (3.625"): 0.270" V side (4.625"): 0.240"	3.934	12.044	7.742	4.6	4.6	5.208	4.271
PUPI TB3000 3.625" X 4.625"	H side (3.625"): 0.350" V side (4.625"): 0.320"	5.075	14.926	9.704	5.4	5.4	6.454	5.353
EXTRA HEAVY DUTY								
PUPI TB4000 4.00" X 6.00"	H side (4.00"): 0.375" V side (6.00"): 0.375"	6.988	33.218	17.171	5.5	5.5	11.073	8.586

Notes:

1. H is horizontal side of beam, V is vertical side of beam, Area is cross-sectional area of fiberglass composite beam walls only.
2. X is vertical load, Y is transverse load (along the arm principal axis), Z is longitudinal load (along wire direction)
3. S is section modulus, I/c.

TECHNICAL INFORMATION

PUPI Deadend Crossarms

DEADEND STRENGTH EXAMPLES

DEADEND	Arm Wt./Foot	Hardware Assembly	Ultimate Longitudinal Capacity lbs/wire	Ultimate Vertical Capacity lbs/wire	Ultimate Transverse Capacity	Longitudinal Design Stress psi
STANDARD						
PUPI DA1000 2.10" X 4.04"	1.96 lbs	16 lbs	5,000 (8') 4,000 (10')	1,750 (8') 1,500 (10')	1,750 (8') 1,750 (10')	80,400 (8') 85,200 (10')
PUPI DA2000 3.625" X 4.625"	3.35 lbs	25 lbs	8,000 (8') 6,500 (10')	4,000 (8') 3,700 (10')	4,000 (8') 4,000 (10')	56,800 (8') 61,200 (10')
PUPI DA2500 3.625" X 4.625"	3.58 lbs	25 lbs	10,000 (8') 7,500 (10')	5,300 (8') 4,000 (10')	5,300 (8') 5,300 (10')	71,000 (8') 70,600 (10')

HEAVY DUTY						
PUPI DA3000 3.625" X 4.625"	4.35 lbs	28 lbs	14,700 (8') 13,000 (10')	9,400 (8') 8,300 (10')	10,000 (8') 10,000 (10')	84,300 (8') 98,700 (10')
PUPI DA4400 4.00" X 6.00"	6.25 lbs	31 lbs	12,800 (8') 13,000 (10')	8,500 (8') 7,250 (10')	7,500 (8') 7,500 (10')	42,800 (8') 57,500 (10')

EXTRA HEAVY DUTY						
PUPI DA4000 4.00" X 6.00"	6.25 lbs	31 lbs	17,000 (8') 17,000 (10') 17,000 (12')	12,500 (8') 10,000 (10') 8,000 (12')	10,000 (8') 10,000 (10') 10,000 (12')	56,800 (8') 75,200 (10') 93,600 (12')
PUPI DA3020 2 stacked 3000s	8.70 lbs	42 lbs	26,000 (10') 20,000 (12') 16,000 (14')	16,500 (10') 13,000 (12') 10,000 (14')	20,000 (10') 20,000 (12') 20,000 (14')	98,700 (10') 94,500 (12') 90,500 (14')

Notes:

1. Load capacities are for arms with PUPI deadend mounts, 2 wires each 6" from arm end.
2. Design stress is outer fiber stress.

PUPI Deadends

FIBERGLASS BEAM PROPERTIES

BEAM	Wall Thickness	Area in ²	Moment I _x in ⁴	Moment I _z in ⁴	Mod E _x 10 ⁶ lb/in ²	Mod E _z 10 ⁶ lb/in ²	S _x in ³	S _z in ³
STANDARD								
PUPI DA1000 2.10" X 4.04"	H side (4.04"): 0.205" V side (2.10"): 0.175"	2.158	4.646	1.514	4.4	4.4	2.300	1.442
PUPI DA2000 3.625" X 4.625"	H side (4.625"): 0.240" V side (3.625"): 0.270"	3.934	12.044	7.742	3.5	3.5	5.208	4.271
PUPI DA2500 3.625" X 4.625"	H side (4.625"): 0.240" V side (3.625"): 0.270"	3.934	12.044	7.742	4.6	4.6	5.208	4.271

HEAVY DUTY								
PUPI DA3000 3.625" X 4.625"	H side (4.625"): 0.320" V side (3.625"): 0.350"	5.075	14.926	9.704	5.4	5.4	6.325	5.354
PUPI DA4400 4.00" X 6.00"	H side (6.00"): 0.375" V side (4.00"): 0.375"	6.988	33.218	17.171	3.6	3.6	11.073	8.586

EXTRA HEAVY DUTY								
PUPI DA4000 4.00" X 6.00"	H side (6.00"): 0.375" V side (4.00"): 0.375"	6.988	33.218	17.171	5.5	5.5	11.073	8.586
PUPI DA3020 2 stacked 3000s	H side (4.625"): 0.320" V side (3.625"): 0.350"	10.15	29.852	57.448	5.4	5.4	12.909	15.319

Notes:

1. H is horizontal side of beam, V is vertical side of beam, Area is cross-sectional area of fiberglass composite beam walls only.
2. X is longitudinal load (along wire direction), Y is transverse load (along the arm principal axis), Z is vertical load
3. S is section modulus, I/c.

RUS ACCEPTED PUPI® PRODUCTS

PUPI offers the largest number of fiberglass crossarms, braces and deadend assemblies accepted by the USDA Rural Utilities Service to their List of Materials.

18 Fiberglass Tangent Crossarms (section g)

PUPI Braced Application

- T220009603X 8' Type-3 Drill Pattern
- T220009604X 8' Type-4 Drill Pattern
- T220012005X 10' Type-5 Drill Pattern
- T200009603X 8' Type-3 Drill Pattern
- T200009604X 8' Type-4 Drill Pattern
- T200012005X 10' Type-5 Drill Pattern
- T250009603X 8' Type-3 Drill Pattern
- T250009604X 8' Type-4 Drill Pattern
- T250012005X 10' Type-5 Drill Pattern
- T300009603X 8' Type-3 Drill Pattern
- T300009604X 8' Type-4 Drill Pattern
- T300012005X 10' Type-5 Drill Pattern

PUPI Braceless (Centermount) Application

- TB220009603X 8' Type-3 Drill Pattern
- TB220009604X 8' Type-4 Drill Pattern
- TB220012005X 10' Type-5 Drill Pattern
- TB200009603X 8' Type-3 Drill Pattern
- TB200009604X 8' Type-4 Drill Pattern
- TB200012005X 10' Type-5 Drill Pattern
- TB250009603X 8' Type-3 Drill Pattern
- TB250009604X 8' Type-4 Drill Pattern
- TB250012005X 10' Type-5 Drill Pattern
- TB300009603X 8' Type-3 Drill Pattern
- TB300009604X 8' Type-4 Drill Pattern
- TB300012005X 10' Type-5 Drill Pattern
- TZ220209603X 8' Type-3 Drill Pattern
- TZ220209604X 8' Type-4 Drill Pattern
- TZ220212005X 10' Type-5 Drill Pattern

3 Fiberglass Braces (section cu)

- B6018-BM underarm 60" span, 18" drop
- B6030-BM underarm 60" span, 30" drop
- B3818-SM side mount 26" span

10 Fiberglass Deadend Assemblies (section gj)

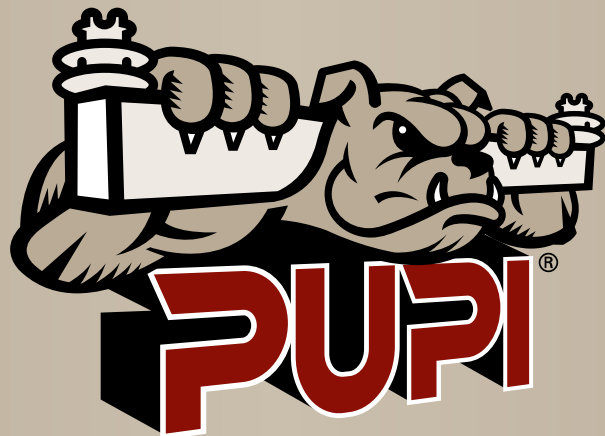
- DA2000096 3-5/8" x 4-5/8" x 8'-0"
- DA2000120 3-5/8" x 4-5/8" x 10'-0"
- DA2500096 3-5/8" x 4-5/8" x 8'-0"
- DA2500120 3-5/8" x 4-5/8" x 10'-0"
- DA3000096 3-5/8" x 4-5/8" x 8'-0"
- DA3000120 3-5/8" x 4-5/8" x 10'-0"
- DA4000096 4" x 6" x 8'-0"
- DA4000120 4" x 6" x 10'-0"
- DA4400096 4" x 6" x 8'-0"
- DA4400120 4" X 6" X 10'-0"

6 Crossarm Assemblies for H-frame Construction (section gy)

- TX3020VO 32' TH-10VO crossarm assembly (two braces on outside of poles)
- TX3020V4 32' TH-10V4 crossarm assembly (four braces)
- TX4020V 32' TH-10V crossarm assembly (no braces)
- TX4020VO 32' TH-10VO crossarm assembly (two braces on outside of poles)
- TX4020VI 32' TH-10VI crossarm assembly (two braces on inside of poles)
- TX4020V4 32' TH-10V4 crossarm assembly (four braces)

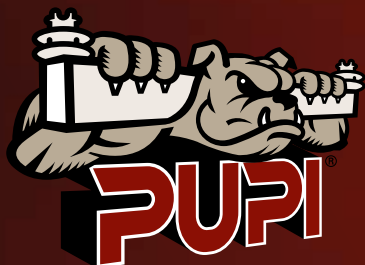
2 Cross Brace Assemblies for H-frame Construction (section vx)

- XBR3020-1 Item 1-vx
- XBR3020-2 Item 2-vx



FOR MORE INFORMATION PLEASE VISIT US AT:

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