



Technical Specification

for

***Duratel
Composite Poles, Crossarms,
and H-Frame Structures***



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1. Purpose

The intent of this document is to provide designers of utility and communication structures with the basis for specifying and procuring composite poles, crossarms, and H-Frame structures.

2. Scope of Specification

This technical specification is applicable to single-piece or sectional composite monopoles, composite crossarms and complete H-Frame structures used in electrical distribution and transmission applications, and also to composite poles for communication structures. This document addresses various topics relating to the composite poles, crossarms or H-Frame structures including design, materials, manufacturing, UV protection, hardware and attachments, testing, quality control, shipping and delivery, and warranty.

Unless otherwise specified, all composite poles shall have a circular cross section and all composite crossarms shall have a rectangular cross section.

Items such as foundation design, loading or unloading of materials, and the assembly or installation of the poles, crossarms or H-Frame structures are considered outside the scope of this specification.

3. Applicable Codes, Standards and Guidelines

Codes, standards, guidelines or other documents referred to in this specification shall be considered as part of this specification for the purposes of defining applicable requirements for composite poles, crossarms and H-Frame structures:

ANSI

(American National Standards Institute)

- ◆ ANSI O5.1 *For Wood Poles – Specifications and Dimensions*
- ◆ ANSI/NEMA C29.1 *American National Standard for Electrical Power Insulators - Test Methods*

ASCE

(American Society of Civil Engineers)

- ◆ ASCE Manual No. 74 *Guidelines for Electrical Transmission Line Structural Loading*
- ◆ ASCE Manual No. 104 *Recommended Practice for Fiber-Reinforced Polymer Products for Overhead Utility Line Structures*
- ◆ ASCE/SEI Standard 48-05 *Design of Steel Transmission Pole Structures*

ASTM

(American Society for Testing and Materials)

- ◆ ASTM D1036-98 *Standard Test Methods of Static Tests of Wood Poles*
- ◆ ASTM G154 *Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials*
- ◆ ASTM D198-09 *Standard Test Methods of Static Tests of Lumber in Structural Sizes*

CSA

(Canadian Standards Association)

- ◆ CSA C22.3 No. 1 *Overhead Systems*
- ◆ CSA S37-01 *Antennas, Towers, and Antenna-Supporting Structures*

IEEE

(Institute of Electrical and Electronics Engineers)

- ◆ NESC C2-2007 *National Electrical Safety Code*

RUS

(Rural Utilities Service)

- ◆ Bulletin 1724E-200 *Design Manual for High Voltage Transmission Lines*
- ◆ Bulletin 1724E-204 *Guide Specification for Steel Single Pole and H-Frame Structures*
- ◆ Bulletin 1724E-205 *Design Guide: Embedment Depths for Concrete and Steel Poles*

TIA

(Telecommunications Industry Association)

- ◆ ANSI/TIA/EIA-568-B *Commercial Building Telecommunications Cabling Standard, including 568-B.1-2001, 568-B.2-2001, and 568-B.3-2001*
- ◆ ANSI/TIA/EIA-222-G-2006 *Structural Standards for Steel Antenna Towers and Antenna Supporting Structures*

4. Conflict Between This Specification, Drawings, and Reference Documents

In the event of any conflict between this specification and the above referenced documents, the requirements of this specification shall take precedence. If a conflict exists between this specification or the referenced documents and applicable drawings, the applicable drawings shall be followed. If required, the Owner or Purchaser may be consulted for additional clarification.

5. Definitions

Definitions are provided as an aid to the reader to understand the terms as used in this specification, and which are commonly used by composite structure manufacturers or designers. The definitions provided herein are relevant to the practices used in the composite utility and communication structure industry.

Above Ground Height (AGH) - The length of the structure from the ground line to the top of the structure.

Attachment - Any hardware or structural members that are attached to the pole to make a complete structure.

Base/Bottom Plate - A plate at the bottom of the pole that is intended to transfer the vertical loads of the pole to the supporting soil or foundation.

Composite - A combination of one or more materials differing in form or composition on a macroscale. The constituents retain their identities; i.e. they do not dissolve or merge completely into one another, although they act in concert. Normally, the components can be physically identified and exhibit an interface between one another.

Connection Joint - A mechanical method of joining two pole sections together by means of internal and/or external fittings, resulting in the joint being at least as strong as the adjacent pole sections.

Degradation, Ultraviolet - Degradation of resin characterized by resin loss between fibers. Enabled by a breakdown of UV inhibitors used to protect resin from ultraviolet rays (sunlight).

E-Glass - A family of glass fiber reinforcement that has a calcium alumina borosilicate composition and a maximum alkali content of 2.0 percent. A general-purpose fiber that is most often used in reinforced polymers, and is suitable for electrical laminates because of its high resistivity.

Engineer - A registered or licensed person, who may be an employee of the owner or an outside consultant, and who provides engineering services. Engineer also includes duly authorized assistants and representatives of the licensed person.

Exclusion Limit - A limiting threshold value at which a specified percentage of members must exceed. Typically a five percent lower exclusion limit is utilized referencing material properties such as strength and stiffness.

Factored Load - A structural design load which has been multiplied by an applicable load factor.

Fiber - A general term used to refer to filamentary materials. Often, fiber is used synonymously with filament.

Fiber Orientation - Direction of fiber alignment in a nonwoven or mat laminate wherein most of the fibers are placed in the same direction to afford higher strength in that direction.

Filament Winding - A composites manufacturing process for fabricating cylindrical structures in which continuous fiber reinforcements such as roving or mats, either pre-impregnated with resin or drawn through a resin bath, are wound around a rotating mandrel.

Grade of Construction - Desired Grade of Construction for supporting structures as referenced in Section 24 of the NESC, with Grade B being the highest grade

Groundline - A designated location on the pole where the surface of the ground will be after installation of a direct embedded pole.

Guy Hardware - Cables, anchors, and hardware used in the cable support system of a “guyed pole.”

Guyed Pole - A utility structure, which relies on support cables to carry at least a portion of the tension load to the ground.

Inspection Report - A document that accompanies a product through its process of manufacture on which is recorded pertinent information regarding its identity. Sometimes called a traveler.

Line Designer - The Engineer(s) with overall line design and specification writing responsibilities. Is either employed by or is a hired consultant of a utility or company that uses the structures.

Load Factor (LF) - A factor by which working loads are multiplied to account for uncertainties in loading.

Manufacturer - The company responsible for the manufacture of the composite products.

Owner - The entity assuming final ownership of the composite poles, crossarms, or H-Frame structures.

P-Delta (P- Δ) Moment - Also called secondary moment, is a measure of the increase in bending moment resulting from a structure’s displacement under load.

Pole Length - The length from the pole top to the pole bottom plate.

Pultrusion - An automated, continuous process for manufacturing composite rods, tubes and structural shapes having a constant cross section. Roving and/or tows are saturated with resin and continuously pulled through a heated die, where the part is formed and cured. The cured part is then cut to length.

Purchaser - The entity responsible for purchasing the composite poles, crossarms, or H-Frame structures.

Secondary Moment – Also called P-Delta (P- Δ) Moment, a measure of the increase in bending resulting from a structure's displacement under load.

Strength Factor (SF) - A factor by which material strengths are reduced to account for uncertainties in the material.

Structure Designer - The engineer(s) with specific responsibility for structural design of the product. Is usually employed by or is a hired consultant of the company which manufactures the product.

Thermoplastic - A material that softens when heated, but does not cure or set, and hardens with a decrease in temperature. Thermoplastic materials may not be used in the manufacture FRP poles, but may be used as accessory items for the poles.

Thermoset - A base polymer resin material such as epoxy, polyester, polyurethane or vinyl ester that is formed by cross linking polymer chains into a three dimensional matrix, and cures or hardens into a given shape, generally through the application of heat. Thermoset resin is the standard material used for FRP poles, although pole accessory items may be made of either thermoset or thermoplastic materials.

Tip Load - The horizontal load that is applied to the standard class pole at a distance of 2 feet from

Ultimate Load - A design load that includes the appropriate Load Factor and any additional factor of safety specified by the line designer.

UV Inhibitors - Components used in the manufacture of FRP poles and crossarms, which impede degradation of the product caused by ultraviolet rays. Can be a part of the resin formulation and incorporated into the pole wall thickness, and/or may consist of a separate coating or veil cloth.

Veil Cloth - Thin woven fiberglass material used on the surface of an FRP product to enhance UV protection and resistance to weathering.

Working Load - An unfactored load resulting from everyday weather or other specified loads, which do not include a Load Factor or other additional safety factor.

6. Design

6.1 Best Practices

The design, materials, manufacturing, UV protection, hardware and attachments, testing, quality control and shipping procedures for the composite poles, crossarms and H-Frame structures shall generally conform to current best practices and shall comply with applicable codes and standards such as NESC (National Electrical Safety Code) and CSA (Canadian Standards Association). Other documents such as ASCE (American Society of Civil Engineers) Manual No. 104, "Recommended Practice for Fiber-Reinforced Polymer Products for Overhead Utility Line Structures" and various Bulletins from RUS (Rural Utilities Service) may also be used as a general reference guide where appropriate.

6.2 Non-Linear Analysis

Finite Element Analysis (FEA) software is typically utilized to confirm the capability of composite poles, crossarms and H-Frame structures to meet specified loading, deflection or other applicable requirements. For composite poles, crossarms and H-Frame structures non-linear analysis is required to take into account the P-Delta or secondary moment effects (i.e., deflected unbalance) and overall structure stability (i.e., buckling) under combined vertical and transverse loading.

6.3 Appearance

The composite poles, crossarms and H-Frame structures shall provide an aesthetically pleasing appearance while still meeting all strength, deflection, serviceability and cost requirements. The composite poles and crossarms shall also be symmetrical about their transverse and longitudinal axes.

6.4 Design Calculations

The Manufacturer shall certify that the composite poles, crossarms or H-Frame structures meet or exceed the loading or other requirements as specified by the Engineer and/or the Owner, in accordance with the applicable provisions of NESC, CSA, ANSI/TIA/EIA or other relevant standards, and as confirmed by design calculations and/or full-scale testing. All design calculations are considered proprietary and as such are maintained by the Manufacturer, but may be provided to the Engineer and/or Owner upon request.

6.5 Embedment Depth

As a general rule of thumb, and unless otherwise specified, composite poles are typically embedded to a depth of 10% of total pole length plus 2 feet. The Engineer may decide to adjust the embedment depth based upon specific local soil parameters or other foundation conditions.

6.6 Typical Procedure to Determine Appropriate Composite Poles for a Given Application

The following procedure is typically used for determining the appropriate composite pole for a given utility or communication structure application:

6.6.1 Utility Structures

- 6.6.1.1 Establish the Factored Loads on the composite pole, crossarm or H-Frame structure:
 - a. Directly from loading trees provided by the Engineer or Owner, or;
 - b. Through calculations. For the NESC, select the applicable load cases from Rule 250B for combined ice and wind, from Rule 250C for extreme wind loading, and/or from Rule 250D for extreme ice with concurrent wind, multiplied by the appropriate Load Factors from Table 253-1 of the NESC for Grade B or Grade C Construction.
- 6.6.1.2 Determine the required composite pole, crossarm, or H-Frame structure strength by multiplying the rated ultimate strength of the composite pole, crossarm or H-Frame structure by the appropriate Strength Factor from Table 261-1A of the NESC for Grade B or Grade C Construction.
- 6.6.1.3 Ensure that the required composite pole, crossarm or H-Frame structure strength meets or exceeds the Factored Loads.
- 6.6.1.4 In addition, there may be other design considerations specified by the Engineer or Owner such as maximum pole top deflection under unfactored (i.e., working) loads, construction loads, or longitudinal loads that may also need to be checked.

6.6.2 Communication Structures

- 6.6.2.1 Establish the Factored Loads on the composite pole structure:
 - a. Directly from loading trees provided by the Engineer or Owner, or;
 - b. Through calculations, by using the applicable loading from Section 2 of the ANSI/TIA/EIA-222-G-2006 standards.
- 6.6.2.2 Determine the required composite pole strength by multiplying the rated ultimate strength of the composite pole by the applicable strength and appropriate allowable stress increase factors from Section 3 of the ANSI/TIA/EIA-222-G-2006 standard or from the comparable section of the ANSI/TIA/EIA-222-G-2006 standard.

6.6.2.3 Ensure that the required composite pole structure strength meets or exceeds the Factored Loads.

6.6.2.4 In addition, there may be other design considerations specified by the Engineer or Owner such as maximum pole top deflection under unfactored (i.e., working) loads, construction loads, or longitudinal loads that may also need to be checked.

6.7 “Wood Pole Class Equivalency” for Composite Poles

Utilities have been using wood poles for more than 100 years, and when ordering poles they are comfortable in specifying standard wood pole classes, even for non-wood pole materials such as steel and composite. The most efficient and cost-effective way to select an appropriate composite pole is to match its rated strength capacity to the required Factored Loads. However, utilities often specify wood pole class equivalents since they are familiar with this approach, and may feel this is quicker and easier than selecting composite poles to meet the actual loads.

It is important to recognize that “equivalency” between composite poles and standard wood pole classes is strictly based on the resultant groundline bending moment capacities of the poles from a horizontal load applied two feet from the pole top, after adjusting for the applicable Strength Factors for each pole material type, loading criteria, and Grade of Construction.

It should also be noted that there are appreciable differences in material and sectional properties between composite poles and wood poles, which affect the structural capacities of the respective poles (i.e., pole top deflections, P-Delta secondary moment effects and localized stresses at hardware and other attachment locations). There are many situations such as different Grades of Construction (i.e., NESC Grade B vs. C), extreme ice, extreme wind or longitudinal loading, or guyed angle or dead-end structures, which may result in other design load requirements and therefore may affect the selection of appropriate composite poles, crossarms and H-Frame structures.

Example:

To determine the required composite pole horizontal Factored Load, multiply the ANSI O5.1 wood pole class horizontal load by the ratio of Strength Factors to Overload Factors as follows:

$$\text{CHFL} = \text{WHL} \times [\text{CSF}/\text{WSF}] / [\text{COF}/\text{WOF}]$$

For NESC Grade B Construction the composite pole horizontal Factored Load which is “equivalent” to a Class 1 wood pole would be:

$$\text{CHFL} = 4,500 \text{ lb.} \times [2.5/2.5] / [1.0/0.65] = 2,925 \text{ lb.}$$

Similarly, for NESC Grade C Construction the composite pole horizontal Factored Load which is “equivalent” to a Class 1 wood pole would be:

$$\text{CHFL} = 4,500 \text{ lb.} \times [2.5/2.5] / [1.0/0.85] = 3,825 \text{ lb.}$$

Where:

CHFL = Composite Horizontal Factored Load

WHL = Wood Horizontal Load

COF = Composite Overload Factor

WOF = Wood Overload Factor

CSF = Composite Strength Factor

WSF = Wood Strength Factor

The following chart details wood pole class loads per the ANSI O5.1 Standard and the “equivalent” composite pole horizontal Factored Loads applied at two feet from pole top for various pole classes:

ANSI O5.1 Wood Pole Class	ANSI O5.1 Wood Pole Horizontal Load		Duratel Pole NESC Grade B Factored Load		Duratel Pole NESC Grade C Factored Load	
	(lbs.)	(kN)	(lbs.)	(kN)	(lbs.)	(kN)
H6	11,400	50.71	7,410	32.96	9,690	43.10
H5	10,000	44.48	6,500	28.91	8,500	37.81
H4	8,700	38.70	5,655	25.15	7,395	32.89
H3	7,500	33.36	4,875	21.69	6,375	28.36
H2	6,400	28.47	4,160	18.50	5,440	24.20
H1	5,400	24.02	3,510	15.61	4,590	20.42
1	4,500	20.02	2,925	13.01	3,825	17.01
2	3,700	16.46	2,405	10.70	3,145	13.99
3	3,000	13.34	1,950	8.67	2,550	11.34
4	2,400	10.68	1,560	6.94	2,040	9.07
5	1,900	8.45	1,235	5.49	1,615	7.18

Note: Composite pole strengths are based on 5 percent Lower Exclusion Limit values.

6.8 Connection Joints

The composite poles may be single-piece or sectional. For sectional poles, adjacent pole sections shall be joined by means of connection joints utilizing internal and/or external fittings. Once the sectional composite poles are assembled the strength of the connection joints shall meet or exceed the strength of the adjacent pole sections.

6.9 Grounding

Composite poles can be grounded like wood poles, except that instead of using staples, ground wire clips and self-drilling screws can be used to secure the ground wire to the outer surface of the pole. Another option is to place the ground wire on the inside of the composite pole. When placing the ground wire on the inside of the pole, the ground wire may exit through a hole drilled just below groundline, or may exit at the pole bottom and be wrapped around the pole butt, and in either case would then be connected to a driven ground rod. Copper-clad or galvanized ground rods may be used with composite poles, since composites do not have the same potential galvanic corrosion issues that can occur with steel poles.

The Engineer or Owner may choose to specify the grounding provisions on the composite poles or H-Frame structures.

6.10 Top Cap

Each composite pole shall be equipped with a top cap that is permanently attached to the pole. UV inhibitors shall be incorporated into the top cap material to extend the life of the cap material.

6.11 Base/Bottom Plate

All direct-buried composite poles shall be equipped with a base/bottom plate securely attached to the bottom of the pole. The base/bottom plate shall be of sufficient size to adequately cover the base of the pole, and shall be provided with a drainage hole at least four inches in diameter. The base/bottom plate shall be of sufficient strength and rigidity to withstand the effects of vertical loads transferred from the pole into the soil or foundation.

6.12 Provisions for Pole Attachments

When designing for attachments to the composite pole, internal bushing tubes or other protective measures shall be provided to distribute the loads sufficiently to protect the pole wall from localized stresses.

7. Materials

7.1 Resin Materials

Thermoset resin material shall be used in the manufacture of composite poles and crossarms. Polyester and vinyl-ester resins are the only acceptable thermoset resin materials. Thermoplastic resin materials and resins are not acceptable for use in the composite poles, crossarms, or H-Frame structures.

7.2 Fiber Reinforcement

“E-Glass” is the only acceptable fiber reinforcement used in the manufacture of the composite poles, crossarms, and H-Frame structures. Acceptable forms of fiber reinforcement include rovings and mats.

8. Fabrication

Manufacturing shall be performed as indicated on the composite pole detail drawings. No deviations from the approved drawings or material substitutions shall be made without prior written approval by the Engineer or Owner.

8.1 Acceptable Fabrication Methods

The composite poles may be manufactured using pultrusion or filament winding processes. Composite crossarms and crossbraces shall be manufactured using pultrusion methods.

8.2 Holes for Attachments

8.2.1

Unless otherwise specified, no holes will be provided for attachments.

8.2.2

Where required, holes shall be drilled perpendicular to the plane of the pole. Holes shall be circular and shall not vary in diameter by more than 1/16 inch.

8.2.3

Drilling requirements for hardware, climbing steps, crossarms, or other attachments shall be detailed on a drawing(s) provided by the Engineer or Owner.

8.2.4 Field-Drilling of Holes

There may be situations in the field where new holes may have to be added, or existing holes may have to be relocated. In either case it is recommended to use carbide-tipped spade bits to drill any such holes. The drill bit diameter should be at least 1/16 inch larger than the bolt or hardware being installed to ensure the hole size is sufficient to allow for the bolt or hardware to be readily installed.

8.2.5 Minimum Spacing Between Holes, and From End of Pole to a Hole

As a general rule of thumb, the minimum center-to-center spacing between holes in any direction should be $6D$, with “D” being the diameter of the larger of the two holes in question. Similarly, the minimum edge distance from the end of a pole or pole section shall be $5D$, with “D” being the diameter of the hole in question.

8.2.6 Precautions When Field-Drilling Holes

When field-drilling holes in composite poles or crossarms, it is standard and recommended practice to wear a particle mask, long sleeves, and gloves as a precaution against possible contact with fiberglass dust. While fiberglass dust is not a serious health concern, it can be a temporary irritant if breathed in or if in contact with the skin.

9. Climbing Provisions

9.1 Intent

Climbing steps, step bolts and removable ladders are intended for climbing and working on the composite pole structures. These items are not designed to replace a worker’s fall arrest system.

Unless otherwise specified, no provisions shall be made on the composite pole structures for climbing. When required, climbing provisions shall generally meet the requirements indicated below.

9.2 Design Loads

In accordance with NESC Rule 261N all climbing steps, step bolts, removable ladders and associated equipment shall be designed to support a minimum of a 300 pound worker and equipment, multiplied by a Load Factor of 2.0 as defined in paragraph 5.10.3. The load shall be applied at the outer edge of the climbing step, step bolt or removable ladder.

9.3 Location of Holes for Climbing Steps and Step Bolts

Unless otherwise specified, holes for climbing steps or step bolts shall start at approximately 8 feet above the groundline, extend to within approximately 4 feet from the pole top, be spaced approximately 15 inches apart vertically, and be oriented to allow for maximum ease of climbing.

To allow for ease of movement around the pole at strategic locations, four holes for climbing steps or step bolts can be placed at 90 degrees apart at the desired height on the composite pole.

For ladder access provisions, two holes for climbing steps or step bolts can be placed at 180 degrees apart at a distance of approximately 8 feet above the groundline.

The climbing steps or step bolts shall be located such that interference with other attachments is eliminated or minimized.

9.4 Surface Finish

Unless otherwise specified, all climbing steps, step bolts and removable ladders shall have a hot-dip galvanized finish.

10. UV and Weathering Protection

10.1 General

The composite poles, crossarms, and H-Frame structures shall be designed and manufactured utilizing a protection system proven to be effective against degradation from weathering effects and UV (Ultra-

Violet) light. The preferred UV and weathering protection system shall incorporate UV inhibitors throughout the resin, and shall be supplemented by a protective veil cloth on the surface of the product.

10.2 UV and Weathering Testing

Accelerated aging tests in accordance with the procedures detailed in ASTM G154 for UV exposure shall be used to verify the UV and weathering resistance of the composite poles, crossarms and H-Frame structures. Coupon samples, which are representative of the composite poles or crossarms, shall be continuously exposed to UV light, high humidity and high temperature for a minimum of 8,000 hours. At the required times indicated in ASTM G154, a visual inspection shall be completed and the composite pole or crossarm coupons shall be checked for chalking, cracking, blistering, flaking, or other deterioration. Once the visual inspection is complete, the coupons will undergo mechanical testing to verify whether there have been any changes in mechanical properties.

11. Physical Testing

11.1 Full-Scale Composite Pole Bending Tests

To verify the actual composite pole strengths, full-scale bending tests shall be conducted on representative composite pole samples in accordance with a modified ASTM D1036 test procedure. With this procedure, each composite pole is tested in a cantilevered horizontal position, with the bottom end of the pole held securely inside a rigid test frame. Horizontal loading is applied at 2 feet from the pole top and increased at a constant rate up to a pre-defined test load, the ultimate load, or to failure as appropriate. Throughout the test procedure the loads and corresponding deflections are measured and recorded.

11.2 Composite Crossarm Bending Tests

Composite crossarms shall be tested in accordance with ASTM D198-09 standard test procedures to verify specified crossarm strengths and deflections.

11.3 Attachment and Pole Wall Loading Tests

Pole wall loading effects from attachments such as crossarms, crossbraces, horizontal post insulators, davit arms, transformers and guying hardware should be analyzed through full-scale testing conducted on representative composite pole samples. Testing of pole wall loading effects can include the following:

- 11.3.1 Bolt bearing on the holes due to axial shear loads;
- 11.3.2 Bolt pull-through; and
- 11.3.3 Deformation or ovaling of the pole wall due to compressive loads.

11.4 Optional Tests

If agreed between the Engineer or Owner and the Manufacturer, other tests may also be considered.

12. Markings on Composite Poles

Each composite pole or pole section shall be identified with pertinent information as appropriate. When several pole sections are being supplied to meet a specific total pole length and strength requirement, an I.D. tag shall also be provided for the complete pole that may include, but not be limited, to the following information: Manufacturer, length, class and month/year of manufacture. Additional information may be included on the I.D. tag, as mutually agreed by both the Engineer and the Manufacturer prior to fabrication. Unless otherwise specified, the I.D. tag shall be located at approximately 5 feet above, and at a minimum of 3 feet above the groundline.

13. Quality Assurance and Control

13.1 Quality Assurance

13.1.1

The Manufacturer shall manufacture the composite poles, crossarms and H-Frame structures in accordance with a comprehensive Quality Assurance Program.

13.1.2

The representatives of the Owner or Purchaser shall be granted reasonable access to the manufacturing equipment by the Manufacturer in order to verify that the finished products and materials being furnished are in accordance with the requirements.

13.2 Quality Control

13.2.1 Visual Inspection

Each composite pole or crossarm shall be visually inspected for conformance to the manufacturing drawings and customer drill patterns. The inspection shall include, but not be limited to:

- 13.2.1.1 Dimensional checks to verify that specified manufacturing tolerances are being met;
- 13.2.1.2 Verification that drilled holes are drilled cleanly, without ragged or torn edges; and
- 13.2.1.3 Overall appearance, including color consistency and surface roughness.

13.2.2 Rejection of Material

Any issues pertaining to delivered composite pole, crossarm or H-Frame structure material which does not meet the requirements set forth in this specification shall be resolved in a manner satisfactory to and mutually agreed between the Manufacturer and the Owner or Purchaser.

14. Shipping and Delivery

14.1

All reasonable care and attention shall be taken to avoid damage to the composite poles, crossarms or H-Frame structures during handling and transportation.

14.2

The Manufacturer or its representatives shall take all reasonable precautions to ensure that the composite poles, crossarms and H-Frame structures provided under this specification shall be delivered to the designated storage facility of the Owner or Purchaser within the time period specified in the Bid Proposal, unless otherwise agreed between the Manufacturer or its representatives and the Owner or Purchaser.

14.3

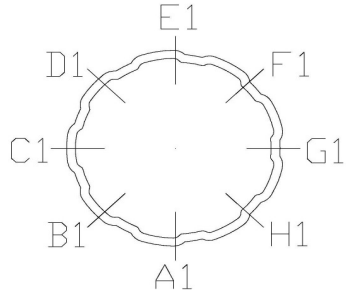
In the event of any change in the delivery schedule of the composite poles, crossarms or H-Frame structures the Engineer and/or Owner or Purchaser shall be notified immediately.

14.4

All correspondence and transmittals relating to this specification shall be addressed to:

15. Warranty

The Manufacturer of the composite poles, crossarms or H-Frame structures shall warrant that product will be free of manufacturing defects and that each product will meet the physical properties published by the Manufacturer at the time of purchase. The Manufacturer shall further warrant that each composite pole, crossarm or H-Frame structure will not peel, rot, blister, corrode, delaminate, or suffer termite or fungal damage as a result of manufacturing defects. The warranty shall apply only to the structural serviceability of the composite poles, crossarms or H-Frame structures and does not apply to superficial blemishes, discoloration and/or other defects that occur with aging and normal use. The warranty shall be prorated for a period of thirty (30) years from the date of purchase and shall extend only to the original purchaser.



COMPOSITE POLE FRAMING DIAGRAM

POLE LENGTH -				POLE LENGTH -			
QUADRANT - A1 & E1				QUADRANT - C1 & G1			
DIST. FROM TOP		DIA.	DETAILS	DIST. FROM TOP		DIA.	DETAILS
	0' - 0"	1"			0' - 0"	1"	
	0' - 0"	1"			0' - 0"	1"	
	0' - 0"	1"			0' - 0"	1"	
POLE LENGTH -				POLE LENGTH -			
QUADRANT -				QUADRANT -			
DIST. FROM TOP		DIA.	DETAILS	DIST. FROM TOP		DIA.	DETAILS

Special Instructions:
