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Standard Specification for FRP Composite Utility Poles

FIRST EDITION

ACMA
American Composites Manufacturers Association

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American National Standard

Standard Specification for FRP Composite Utility Poles

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Approved: September 13, 2018

American National Standards Institute, Inc.

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Prepared by

American Composites Manufacturers Association
Utility & Communication Structures Council

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PREFACE

Over the past 25 years, a significant amount of progress has been made toward the integration of Fiber Reinforced Polymer (FRP) composite pole and crossarm products into the electric distribution and transmission infrastructure in North America. FRP composite materials have been demonstrated to have many benefits and advantages such as: lightweight, corrosion resistant, highly reliable, capable of excellent dielectric strength, and long service life. However, despite the advantages and progress toward FRP composite pole adoption in many areas, composites are still not well understood within many standards organizations, utilities and other end-user applications. Another barrier to widespread acceptance of composite poles is the lack of guidance in the form of a national standard, similar to what is used for wood poles and crossarms. Consultation with electric utilities, as well as national electric utility organizations, such as Electric Power Research Institute, Edison Electric Institute, National Utility Regulators Association, Rural Utility Service and American Public Power Association, led to the following conclusion. The lack of a national standard for FRP utility poles is a barrier to further use or implementation. Therefore, a *Standard Specification for FRP Composite Utility Poles* provides information and guidance to end-users at investor-owned, municipal and rural electric utilities, allowing them to readily adopt composite products in response to the use of this specification document.

This standard specification is consistent with the UCSC mission to improve power delivery and communication infrastructure by promoting the use and understanding of composite utility poles and crossarms for electrical distribution, transmission and communication structure applications. This specification focuses on the cradle to grave life cycle of the FRP utility pole; including the design, material properties, manufacturing processes, quality control, assembly, and installation, and inspection parameters of direct embedded FRP utility poles. The objective of the standard is to provide a uniform and consistent reference document for all FRP utility poles, enabling more widespread applications.

End-users will better understand all the facets specific to FRP utility poles to ease the process of approval and implementation within the electric infrastructure. The standard will educate users on the design, materials and processing aspects of FRP utility poles so they can select the best product solution for their application. This standard will help them understand the differences relative to wood, concrete and steel when considering the application and use, as well as the important aspects of attachments and pole installation specific to FRP materials. As a result of studying and applying this standard, the end-user will be more confident and knowledgeable in the final design decision for FRP utility poles, which will lead to more consistent and proper specification of FRP utility poles. With this new understanding, utilities and end-users will be able to specify composites in applications of benefit, when composites are compared to alternative grid infrastructure materials. A brief summary of FRP utility poles benefits is provided here:

Alternative to Wood for Making Challenging Installations Safer – Although wood is the current predominant choice, composites present an alternative for applications where installation, environment or other unfavorable circumstances present challenges for wood. The inherently lightweight FRP utility poles enable faster and safer installations in limited access areas.

Service Life – FRP utility poles and crossarms are engineered to last 80+ years on average in the harshest of environments. They will not rot, are impervious to insects and woodpeckers and can withstand severe weather events and environments. FRP utility poles and crossarms typically require no scheduled maintenance. Periodic inspection by utilities should be completed as required, but no treatment or regular maintenance is required for FRP composite utility poles.

Safety – FRP utility poles are typically 33 – 50% lighter than steel or wood poles. The lightweight poles are ideal for tight urban installations where limited equipment or manual labor is necessary for project completion. The absence of treatment chemicals from the pole surface make handling, installation, and disposal of FRP utility poles safer and do not require any special handing compared to treated wood poles and cross arms. FRP composites have additional safety benefits over wood including high dielectric strength, reduced worker injury during handling and installation and reduced occupancy hazards due to vehicular pole strikes (Foedinger2002).

Durability, Reliability, and Resilience – Engineered FRP utility poles harden the grid by offering improved reliability and resilience in the presence of high-load situations, such as ice storms and high-wind surge events, when compared to traditional pole materials. Due to the high strain capability of FRP utility poles, an increasing amount of FRP utility pole installations have occurred in existing wood pole lines, to mitigate cascade failures and absorb expected shock. FRP utility poles also contribute to increased grid reliability by reducing pole replacement frequencies and implementing improved durability in applications where traditional pole materials are corroding, decaying and are not expected to be functional for the full calculated service length.

Environmental Sustainability – FRP composite utility poles benefit the environment by replacing chemically treated wood poles that leach hazardous chemicals into the soil. By using FRP utility poles, there is absolutely no leaching of chemicals into groundwater or watersheds and FRP composite materials are considered inert so they create no adverse impact to the environment where they are installed. This is especially important in environmentally sensitive areas in direct contact with water installations such as wetlands, in an around swamps, streams, coastal areas, playgrounds, and in wild and remote locations that can impact local tributaries and streams. Waste management of dimensional lumber that is treated with chromated copper arsenate (CCA) for residential application is considered hazardous waste, however old wood poles treated with CCA are exempted from management as a hazardous waste under the Resource Conservation and Recovery Act in the United States (Scientific Certification Systems 2013). FRP composite materials are inert and therefore can be disposed in conventional landfills, or can be recycled or repurposed into other products at the end of their service life. FRP composite utility poles reduce greenhouse gas (GHG) emissions and total embodied energy each year over the 60-year life of a composite pole (Wood et al. 2008). That same period will require 2 wood poles to be consumed and hazardous wastes disposed of each time with an average life of only 30 years each. FRP composite poles represent the most environmentally sustainable choice for utility structures.

Transportation Savings – Due to the lightweight and/or modular design and configuration of FRP utility poles, more poles can be transported per truck, typically double the quantity of traditional wood poles, thereby reducing transportation costs.

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1.1 Scope

This specification encompasses the design, materials, properties, manufacturing, quality control, assembly and installation, and inspection of directly embedded FRP utility poles. Applications include cantilevered, framed and combined structures. This specification does not cover crossarms, lattice structures, conductors, insulators, stand-offs or other FRP components used in the electrical grid.

For transmission applications, a civil engineer and a geotechnical expert must authorize the foundation requirements for a given loading criteria.

1.2 Definitions

Certificate of Conformance – Test reports, furnished by the Manufacturer that demonstrate the constituent materials used in the FRP utility poles are determined to be in compliance with the applicable material specifications, by the Manufacturer.

Contract Documents – Set of documents that provide the basis for a construction project; these documents may include the Owner-Contractor Contract, Project Specifications, Project Drawings and addenda.

FRP – Fiber Reinforced Polymer composite or Fiberglass Reinforced Polymer.

Fiber Reinforcement – Fiber reinforcing materials are typically E or E-CR Glass manufactured per ASTM D578. The fiber reinforcement can be converted into various forms; including roving, stitched fabrics, continuous filament or woven mats.

Manufacturer – The party responsible for producing the FRP utility pole and any associated components.

Polymer Resin – The FRP resin system includes the base resin, additives, fillers, catalysts, UV protection agents, fire retardants, pigments, release agents and other compounds added to this resin and used in the manufacturing process. Commonly used thermoset resin systems include polyesters, vinyl esters, phenolic, polyurethane and epoxies that are compatible with the fiber reinforcement to develop desired mechanical and structural properties.

1.3 Reference Specifications and Standards

American National Standards Institute (ANSI)

ANSI O5.1 – 2017	American National Standard for Wood Products – Specifications and Dimensions (for Wood Poles)

American Society of Civil Engineers (ASCE)

MOP 111	Reliability-Based Design of Utility Pole Structures
MOP 104	Recommended Practice for Fiber-Reinforced Polymer Products for Overhead Line Utility Structures
LRFD	Pre-Standard for Load & Resistance Factor Design (LRFD) of Pultruded Fiber Reinforced Polymer (FRP) Structures

ASTM International (ASTM)

D1036	Standard Test Methods of Static Tests of Wood Poles
D570	Standard Test Method for Water Absorption of Plastics
D578	Standard Specification for Glass Fiber Strands
D635	Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position
D5379	Standard Test Method for Shear Properties of Composite Materials by the V-Notched Beam Method
D8019	Standard Test Methods for Determining the Full Section Flexural Modulus and Bending Strength of Fiber Reinforced Polymer Crossarms Assembled with Center Mount Brackets
F711	Standard Specification for Fiberglass-Reinforced Plastic (FRP) Rod and Tube Used in Live Line Tools
G154	Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials

Institute of Electrical and Electronics Engineers (IEEE)

NESC 2017	National Electric Safety Code (NESC) – C2-2017

Occupational Safety and Health Standards

1910.269	Electric Power Generation, Transmission, and Distribution

Underwriter Laboratories (UL)

UL 94	Standard for Safety of Flammability of Plastic Materials for Parts in Devices and Appliances Testing