INTERNATIONAL

Designation: D8019 – 23

Standard Test Methods for Determining the Full Section Flexural Modulus and Bending Strength of Fiber Reinforced Polymer Crossarms Assembled with Center Mount Brackets[1]

This standard is issued under the fixed designation D8019; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope*

1.1 These test methods cover the determination of the flexural modulus and bending strength of both the tangent and deadend Fiber Reinforced Polymer (FRP) composite crossarms loaded perpendicular to the plane of minor and major axes. One method covers testing of assembled tangent crossarms including the tangent bracket and relative hardware. The other method covers testing of assembled deadend crossarms with a deadend bracket and relative phase loading hardware. The failure modes and associated stresses can be used for predicting the phase load capacities of pultruded crossarms specific to certain conductor loading scenarios exerted by conductors.

1.2 The test data described in this standard can be used for predicting the vertical and horizontal component loads of deadend and tangent arms. Both deadend and tangent crossarms shall be tested in the two configurations described in Figures 1 and 2, respectively. This will permit the manufacturers to publish both vertical and horizontal design capacities for deadend crossarm configurations so that two way bending stresses, caused by catenary effects, can be considered when developing the capacity of the deadend crossarms by utility design engineers and manufacturers.

1.3 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in nonconformance with the standard.

1.4 This standard will not address all factors that affect the phase loading capacity.

1.5 This standard does not address the use of core materials that are added to increase the structural capacity of the crossarms. Contribution of core materials shall not be considered within the calculations provided in this standard. Use of core material properties in design computations to identify improvement in design strengths of crossarms is the sole responsibility of the designee in-charge of the project.

1.6 Torsional effects occurring during standard in service usage are not considered within this standard.

1.7 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

NOTE 1—There is no known ISO equivalent to this standard.

1.8 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D883 Terminology Relating to Plastics
D4968 Practice for Annual Review of Test Methods and Specifications for Plastics
E4 Practices for Force Calibration and Verification of Testing Machines
E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods
E456 Terminology Relating to Quality and Statistics
E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method
E2935 Practice for Evaluating Equivalence of Two Testing Processes

[1] This test method is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.18 on Reinforced Thermosetting Plastics.

Current edition approved Nov. 1, 2023. Published November 2023. Originally approved in 2015. Last previous edition approved in 2015 as D8019 – 15. DOI: 10.1520/D8019-23.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

*A Summary of Changes section appears at the end of this standard

3. Terminology

3.1 Terms used in this standard are defined in accordance with Terminology D883, unless otherwise specified. For terms relating to precision and bias and associated issues, the terms used in this standard are defined in accordance with Terminology E456.

3.2 Definitions of variables used in the calculations as shown in Section 11 are as follows:

a = distance from phase hardware to the center mount bolt through the crossarm, in. (m),
A_w = area of the webs in shear in.^{2} [m^2],
E = flexural modulus, psi (Pa),
I = moment of inertia about the neutral axis of the crossarm, in.^{4} [m^4],
L = support span, in. [m],
M = moment at failure, lbf-in [N•m],
P = ultimate or failure load acting through a single center mount bolt, lbf [N],
S_x = section modulus about the neutral axis of the crossarm, in.^{3} [m^3],
V = in-plane shear force, lbf [N],
σ = bending stress at failure, psi [Pa],
δ = deflection relative to the applied load, in. [m],
τ_{max} = maximum transverse shear stress, psi [Pa],
Q = static moment of area in.^{3} [m^3],
t = thickness of region or regions under consideration in. [m].

4. Summary of Test Methods Including Deadend and Tangent Crossarm Configurations with Commercial Hardware Attached

4.1 *Deadend Crossarms:*

4.1.1 The assembled deadend crossarm, including two phase single sided position hardware and a center mount bracket fabricated to the specifications as detailed by the manufacturer, is positioned in a bend apparatus and loaded until failure occurs.

4.1.2 A center mount bracket or a fabricated test bracket, matching the bolt size and dimensional specifications of the manufacturer's commercial bracket, is attached to the arm as detailed by the manufacturer.

4.1.3 The bracket is to be loaded or constrained, depending on the load apparatus, such that no eccentric loading occurs.

4.1.4 Load is induced into the crossarm assembly until a structural failure of the hardware or crossarm occurs.

4.1.5 Load and deflection data are to be recorded at set intervals or continuously until failure occurs.

4.2 *Tangent Crossarms:*

4.2.1 The assembled tangent crossarm, including a center mount tangent bracket fabricated to the specifications as detailed by the manufacturer, is positioned in a bend apparatus and loaded until failure occurs.

4.2.2 A tangent bracket, matching the specifications of the manufacturer's commercial bracket, is attached to the arm as detailed by the manufacturer, and schematically shown in Figs. 3 and 4.

4.2.3 The bracket is to be loaded or constrained, depending on the load apparatus, such that the load produces eccentric loading into the bracket and arm mimicking the tangent connection to a wood, fiberglass, steel or concrete pole.

4.2.4 A load is induced into the crossarm assembly such that the bracket and phase hardware is loaded until failure.

4.2.5 Load and deflection data are to be recorded at set intervals or continuously until failure occurs.

5. Significance and Use

5.1 Determination of the flexural modulus, beam bending strength and full assembly strength, by this test method is especially useful for product validation, design and specification purposes.

5.2 Calculated values for flexural modulus, bending strength and full assembly strength will vary with specimen depth, span length, hole configurations, loading rate, and ambient test temperature. A minimum span to depth ratio of 16:1 is required for establishing the flexural modulus, wherein shear deformation effects are neglected.

5.3 *Validity*—Stress at failure, σ, is only valid for crossarm failures due to local compression buckling. Other controlling modes of failure will dictate the ultimate phase loading capacities. For example, in-plane shear, fastener pin bearing, position hardware, center mount failures and fastener pull out will dictate the failure mode and the crossarm capacity.

6. Apparatus

6.1 *Testing Machine*—A properly installed and operated load actuator, ideally one which can be operated at constant rates of load or deflection, used in combination with a properly calibrated load cell. Error in the load measuring system shall not exceed ±1 % of the maximum load expected to be measured. The test setup shall also be equipped with deflection measuring devices. The stiffness of the testing apparatus shall be such that the total elastic deformation of the load frame does not exceed 1 % of the total deflection of the test specimen during testing, or appropriate corrections shall be made. The accuracy of the testing machine shall be calibrated and verified in accordance with Practices E4.

6.2 *Loading Noses and Supports*—The crossarms shall be either loaded through the center mount, or through the phase hardware. The test fixture shall allow for various lengths of crossarms to be evaluated. The crossarm length range shall be dictated by typical industry requirements. Spreader bars used throughout the testing shall be doubly symmetric steel sections. The spreader bar shall be oriented to induce bending about the major axis. Additionally, the spreader bar shall be designed to allow for in-plane movement parallel to its minor axis.

6.3 *Deadend Crossarm Loaded Through the Center Mount:*

6.3.1 *2-Conductor Locations*—When loading through the center mount, the manufacturer's deadend crossarm shall be assembled with a production center mount bracket or fabricated replica. Load shall be applied through the back of the center mount bracket. The deadend crossarm shall be fully fabricated, representing the finished product, with the phase position deadend hardware attached. The crossarm test fixture supports shall connect directly to the phase position hardware. Load is applied through the center mount bracket, into the arm