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Standard Specification for Flexible and Rigid Insulated Temporary By-Pass Jumpers[1]

This standard is issued under the fixed designation F2321; 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 specifications cover the manufacture and testing of flexible insulated temporary By-Pass jumpers (By-Pass jumpers) used on energized power lines and equipment.

1.2 It is common practice for the user of this protective equipment to prepare complete instructions and safety regulations to govern in detail the correct and safe use of such equipment. Also see 4.2.

1.3 The use and maintenance of this equipment are beyond the scope of these specifications.

1.4 These specifications for a system of By-Pass jumpers is covered in four parts as follows:

Title	Sections
Clamps for By-Pass Jumpers	5 – 17
Ferrules for By-Pass Jumpers	18 – 31
Cable for By-Pass Jumpers	32 – 40
By-Pass Jumpers (complete assembly with clamps, ferrules, and cable)	41 – 55

1.5 Each of the four parts is an entity of itself, but is listed as a part of the system for completeness and clarification.

1.6 The values stated in SI units are to be regarded as the standard. See IEEE/ASTM SI 10.

1.7 The following precautionary caveat pertains only to the test method portions, Sections 13, 26, 48, and 55 of ~~these specifications.~~this specification. *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~~ safety, health, and ~~health~~environmental practices and determine the applicability of regulatory ~~requirements~~limitations prior to use.*

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]

B33 Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes

B172 Specification for Rope-Lay-Stranded Copper Conductors Having Bunch-Stranded Members, for Electrical Conductors

B173 Specification for Rope-Lay-Stranded Copper Conductors Having Concentric-Stranded Members, for Electrical Conductors

D2768 Specification for General-Purpose Ethylene-Propylene Rubber Jacket for Wire and Cable (Withdrawn 2007)[3]

D2770 Specification for Ozone-Resisting Ethylene-Propylene Rubber Integral Insulation and Jacket for Wire and Cable (Withdrawn 2007)[3]

D2802 Specification for Ozone-Resistant Ethylene-Alkene Polymer Insulation for Wire and Cable

D2865 Practice for Calibration of Standards and Equipment for Electrical Insulating Materials Testing

E8 Test Methods for Tension Testing of Metallic Materials [Metric] E0008_E0008M

F819 Terminology Relating to Electrical Protective Equipment for Workers

IEEE/ASTM SI 10 American National Standard for Metric Practice

[1] This specification is under the jurisdiction of ASTM Committee F18 on Electrical Protective Equipment for Workers and is the direct responsibility of Subcommittee F18.45 on Mechanical Apparatus.

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[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.

[3] The last approved version of this historical standard is referenced on www.astm.org.

2.2 *ANSI Standards:*[4]
ANSI C39.5 Safety Requirements for Electrical and Electronic Measuring and Controlling Instruments
ANSI C84.1 Voltage Ratings for Electric Power Systems and Equipment (60 Hz)
ANSI C119.4 American National Standard for Electrical Connectors
2.3 *NEMA Standard:*[5]
WC 8 Ethylene-Propylene-Rubber Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (formerly ICEA S-68-516)

3. Terminology

3.1 *Definitions:*
3.1.1 *flexible and rigid insulated temporary By-Pass jumpers*—devices designed and used to keep electric supply circuits effectively continuous (electrically bridged) for short periods of time at work locations when conductors or equipment may otherwise be opened or made electrically discontinuous during work operations.

3.1.1.1 *Discussion*—

The devices are normally installed, used, and removed as part of a protective insulating system composed of insulating covers and/or observances of required minimum safe approach distances for workers.

3.1.2 *voltage, normal design*—a nominal value consistent with the latest revision of ANSI C84.1, assigned to the circuit or system for the purpose of conveniently designating its voltage class.

3.1.3 *voltage, maximum use*—the ac voltage (rms) classification of the protective equipment that designates the maximum nominal design voltage of the energized system that may be safely worked. The nominal design voltage is equal to phase-to-phase voltage on multiphase circuits.

3.1.3.1 *Discussion*—

If there is no multiphase exposure in a system area, and the voltage exposure is limited to phase (polarity on dc systems) to ground potential, the phase (polarity on dc systems) to ground potential shall be considered to be the nominal design voltage.

3.1.3.2 *Discussion*—

If electrical equipment and devices are insulated or isolated, or both, such that the multiphase exposure on a grounded wye circuit is removed, then the nominal design voltage may be considered as the phase-to-ground voltage on that circuit.

NOTE 1—The work practices and methods associated with removing multiphase exposures at any given work site are not addressed in this specification.

3.2 For definitions of other terms, refer to Terminology F819.

4. Significance and Use

4.1 These specifications cover the minimum electrical and physical properties designated by the manufacturer and the detailed procedures by which such properties are to be determined. The purchaser may at his option perform or have performed any of these tests in order to verify the manufacturer's designation. Claims for failure to meet the specification are subject to verification by the manufacturer.

4.2 By-Pass jumpers are devices designed and used to keep electrical circuits effectively continuous (electrically bridged) for short periods of time at work locations when conductors or equipment may otherwise be opened or made discontinuous during work operations. By-Pass jumpers are insulated to temporarily protect personnel from brush or accidental contact only; therefore, when authorizing their use, a margin of safety should be provided between the maximum voltage used on, and the proof-test voltage at which they are tested. The relationship between proof-test voltage and the maximum voltage at which By-Pass jumpers are used is shown in Table 1. **Warning**—Portions of these devices (clamps and ferrules) are not insulated and offer no protection from accidental contact.

CLAMPS FOR BY-PASS JUMPERS

5. Scope

5.1 This specification covers clamps used in the assembly of By-Pass jumpers.

[4] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036.
[5] Available from National Electrical Manufacturers Association (NEMA), 1300 N. 17th St., Suite 1847, Rosslyn, VA 22209.

TABLE 1 Proof Test/Use Voltage Relationship

Voltage Rating	Maximum Use Voltage (rms) V	AC Proof Test Voltage (rms) V	DC Proof Test Voltage (avg) V
15 kV	15 000	20 000	50 000
25 kV	25 000	30 000	60 000
35 kV	35 000	40 000	70 000
69 kV	69 000	74 000	

6. Classification

6.1 Clamps are furnished in, but not limited to, two styles according to their function and method of installation.

6.1.1 *Style I*—Clamps equipped with insulated handles for installation on energized conductors with rubber gloves. See Fig. 1.

6.1.1.1 Insulated handles may be either clear or opaque.

6.1.1.2 Insulating materials used in this specification include thermo-set plastic, elastomers, elastomer compounds, thermoplastic polymers or any combination, regardless of origin.

6.1.2 *Style II*—Clamps equipped with provisions for installation on energized conductors with live line tools. See Fig. 2 and Fig. 3.

6.1.2.1 Clamps are furnished according to mechanical strength and current rating. See Table 2.

6.2 Clamps are furnished in two classes according to the characteristics of the main contact jaws.

6.2.1 *Class A*—Clamp jaws with smooth contact surfaces.

6.2.2 *Class B*—Clamp jaws with serrations, crosshatching or other means intended to abrade or bite through corrosion products on the surface of the conductor being clamped.

7. Sizes

7.1 Clamp size is the combination of the main contact and cable size ranges as listed by the manufacturers.

8. Ordering Information

8.1 Orders for clamps under this specification shall include this ASTM designation and the following information:

8.1.1 Quantity,

8.1.2 Name (By-Pass Jumper Clamp),

8.1.3 Main contact size ranges, conductor descriptions, and type of materials which are to be clamped,

8.1.4 Cable size, material, and description by which clamps are to be assembled,

8.1.5 Style (see 6.1),

8.1.6 Class (see 6.2), and

8.1.7 Clamps for By-Pass jumpers, at the customer's request, shall meet ANSI C119.4.

FIG. 1 Style I Clamp

FIG. 2 Style II "C" Shape Clamp

FIG. 3 Style II Duck Bill Shape Clamp

TABLE 2 Clamp Torque Strength, min—Style II Clamps

Cable Size	Continuous Current	Yield[A]	Ultimate
(AWG)	A, rms, 60 Hz	N-m (lbf in.)	N-m (lbf in.)
#2	200A	32 (280)	37 (330)
1/0	250A	32 (280)	37 (330)
2/0	300A	32 (280)	37 (330)
4/0	400A	37 (330)	45 (400)

[A] Yield shall mean no permanent deformation such that the clamp cannot be reused throughout its entire range of application.

9. Materials

9.1 Current carrying parts of copper base or aluminum base alloy shall meet the material properties shown in Table 3 and in accordance with Test Methods E8.

TABLE 3 Material Properties

	Copper Base Alloy	Aluminum Base Alloy
Tensile Strength, min.	207 Mpa (30 000 psi)	207 Mpa (30 000 psi)
Yield Strength, min.	90 Mpa (13 000 psi)	138 Mpa (20 000 psi)
Elongation, min	6 %	3 %

10. Electrical and Mechanical Properties

10.1 Materials used shall meet the requirements of 9.1.

10.2 Electrical and mechanical properties shall conform to the requirements prescribed in Tables 1-3 and with the following:

NOTE 2—Style II clamps are uninsulated and do not require conformance with the electrical requirements of Table 1.

10.2.1 Clamps shall accept hand assembly of all cables fitted with compatible ferrules as rated per Table 2.

10.2.2 Main contacts shall accept and clamp all conductors according to the manufacturer's recommendation.

10.2.3 Style II clamps shall have the following properties:

10.2.3.1 In the event the clamp is over-torqued during installation, normal fracture shall be such that the attached cable remains under control by being retained with the live line tool. Clamps with an ultimate torque strength exceeding 45 N-m (400 lbf in.) are exempt from this provision.

10.2.3.2 Cable termination shall include a cable support or shall be made to accept a cable supporting ferrule compatible with the clamp. This support shall secure the entire cable over the jacket and is provided in addition to the electrical connection to the strand.

10.2.3.3 Clamps shall be compatible with clamp sticks and shall fit securely inside the 13 mm (½-in.) wide slot in the head of the stick.

10.2.4 Main contacts shall accept and clamp all conductors or structural members in accordance with the manufacturer's rating.

11. Workmanship, Finish, and Appearance

11.1 Components shall be free of structural porosity, fins, sharp edges, splits, cracks and other defects that affect handling or performance.

11.2 All parts shall be formed, machined, and assembled with sufficient accuracy for smooth operation by hand, and shall be free of excessive looseness to the extent detrimental to repeated applications at the recommended installing torque.

11.3 Class A (smooth jaw) clamps shall have smooth contact surfaces free of burrs, fins, or other protuberances that would impair performance.

11.4 Class B (serrated jaw) clamps shall have longitudinally level surface, that, with clamp movement as specified by the manufacturer, will provide a cleaning effect on the surface of the conductor.

11.5 Slag grinding marks, depressions, and other surface irregularities that do not affect strength, performance, or handling are not cause for rejection.

12. Sampling

12.1 A product model represents a manufacturer's design specification standard according to which the production lot is manufactured.

12.2 A production lot shall consist of all clamps of one production model produced at one time.

12.3 A test sample shall consist of two specimens for each different test specified. Specimens are selected at random and shall pass the inspection requirements of Section 14. When a failure occurs in one specimen from the first sample, a second sample from the same lot shall be selected and tested. If the second sample (two specimens) passes, the lot shall be accepted. If one specimen from the second sample fails, the lot shall be rejected.

13. Design Tests

13.1 The design tests that follow shall be made on test samples of each product model to verify that the requirements of this specification are met.

13.2 *Mechanical Torque ~~Strength :~~ Strength:*

13.2.1 Install the clamp on the main conductor of the minimum and maximum size for which the clamp is rated and apply torsion force to the main screw. Force may be applied to other devices designed to secure the clamp on the conductor.

13.2.2 Measure torque by a torque wrench that indicates torque directly or by other manner easily convertible.

13.2.3 The main conductor is defined as the material(s) on which the clamp is rated to be used.

13.2.4 Yield and ultimate strength shall equal or exceed the values shown in Table 2.

13.3 *Continuous Current Rating:*

13.3.1 Test the clamp at the continuous current level for which it is rated. The temperature shall be measured at the warmest spot on clamp and on the metal strand at the midpoint of an attached cable, which is a minimum of 1.5 m (5 ft.) in length. The maximum temperature of the clamp shall be lower than the midpoint temperature of the maximum size copper main or tap cable for which the clamp is rated.

14. Inspection and Product Testing

14.1 The clamps shall be inspected and tested as follows:

14.1.1 Verification of the main contact and cable capacities are in accordance with 10.2.2 and 10.2.3.

14.1.2 Visual inspection and hand operation shall be done to verify workmanship, finish, and appearance, which shall be in accordance with Section 11.

14.1.3 Torque test on a test sample shall be in accordance with 13.2.

15. Acceptance, Rejection and Rehearing

15.1 At the option of the purchaser, a production lot may be subjected to the following:

15.1.1 Inspection in accordance with 14.1 for operation, main contact range, workmanship, and appearance. Individual clamps that do not conform may be rejected.

15.2 Material that fails to conform to the requirements of this specification may be rejected. Rejection should be reported to the producer or supplier promptly and in writing. In case of dissatisfaction with the results of the test, the producer or supplier may make claim for a rehearing.

15.3 If electrical testing, mechanical testing, or both, are required by a user prior to acceptance, it shall be done in accordance with this specification for any part or for all of the tests to be performed.

16. Certification

16.1 When specified in the purchase order or contract, a manufacturer's or supplier's certification shall be furnished to the purchaser that the clamps were manufactured, sampled, tested, and inspected in accordance with this specification and have been found to meet the requirements. When specified in the purchase order or contract, a report of design test shall be furnished.

17. Packaging and Package Marking

17.1 Clamps shall be marked with the name or logo of the manufacturer, identity number, and date code to indicate year of manufacture.

17.2 A packing list indicating manufacturer's product numbers and quantities of each different clamp shall be provided with each shipment.

17.3 Each shipment shall be packaged to provide protection of the contents appropriate for the mode of transportation.

CABLE FERRULES FOR BY-PASS JUMPERS

18. Scope

18.1 This specification covers ferrules used with By-Pass jumpers.

18.2 Two styles of ferrules are available and are designated as shrouded or unshrouded.

19. Classification

19.1 Ferrules are furnished in four types as follows:

19.1.1 *Type I*—Compression ferrule is cylindrical and made for installation on cable stranding by compression.

19.1.2 *Type III*—Plain stud-shrouded compression ferrule has a stepped bore that accepts entire cable and jacket. (See Fig. 4.)

19.1.3 *Type IV*—Threaded stud shrouded compression ferrule has a stepped bore that accepts entire cable over jacket and has male threads at forward end. (See Fig. 5.)

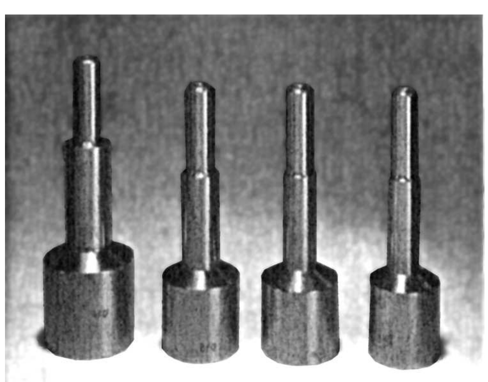

FIG. 4 Type III Plain Stud-Shrouded Compression Ferrule