Chapter 21
Dry Arc-Propagation Resistance

21.1 Purpose

The Dry Arc-Propagation Resistance Test for wire insulation provides an assessment of the ability of an insulation to prevent damage in an electrical arc environment. In service, electrical arcs may originate from a variety of factors, including insulation deterioration, faulty installation, and chafing. It has been documented that results of an arc-propagation test may vary slightly due to the method of arc initiation. Therefore, a standard test method must be selected to evaluate the general arc-propagation resistance characteristics of an insulation. This test method initiates an arc with a vibrating blade. The arc-propagation resistance is defined by the length of arc-propagation damage along the wires in contact with the blade and by the extent of damage to all adjacent wires undamaged by the vibrating blade. The test also evaluates the ability of the insulation to prevent further arc-propagation when the electrical arc is re-energized. The power supply, test current, circuit resistances, and other variables are optimized for testing 20-gauge wires. The use of other wire sizes may require modification of test variables.

21.2 Test Equipment

The following equipment shall be used.

21.2.1 An abrader blade made from 6061-T6 aluminum material. Use a 60-grit size grinding wheel or a 60-grit sanding belt to sharpen the blade. A typical abrader blade is shown in figure 21-1. Use the blade sharpening fixture shown in figure 21-2.

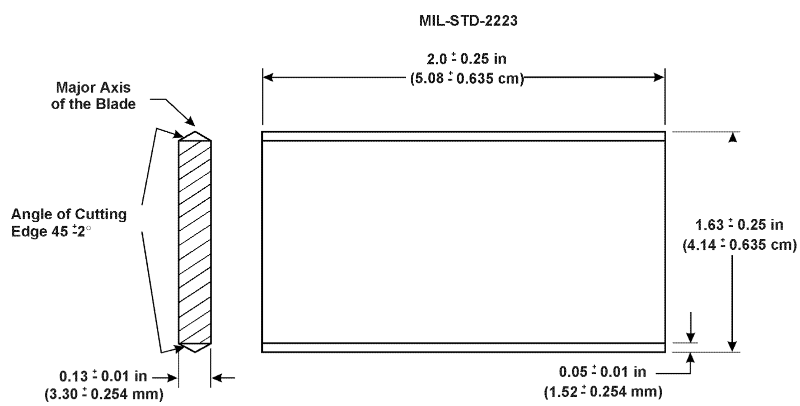

Figure 21-1. Typical Abrader Blade

21.2.2 A transparent screen to protect laboratory personnel from molten metals, UV radiation, and other debris that may be ejected from the test specimen.

21.2.3 An oscillating mechanism to which the abrader blade is connected. The oscillating mechanism will provide a stroke of 3.81 cm (1.5 inches) at a frequency of 0.5 ± 0.05 cycles per second.

21.2.4 A test fixture that includes a test block to hold the wire at right angles to the abrading blade. The block is made from 6061-T6 aluminum.

21.2.5 A three-phase Wye connected power supply, grounded at Wye, derived from a rotary machine or solid-state power supply of not less than 20 KVA rating, delivering 208 volts line-to-line at 400 Hz.

21.2.6 A mechanical stop constructed of stainless steel.

21.2.7 MS3320-7.5 (7.5 amp) and MS25244-50 (50 amp) protective circuit breakers.

21.2.8 Variable load and fixed load resistors.

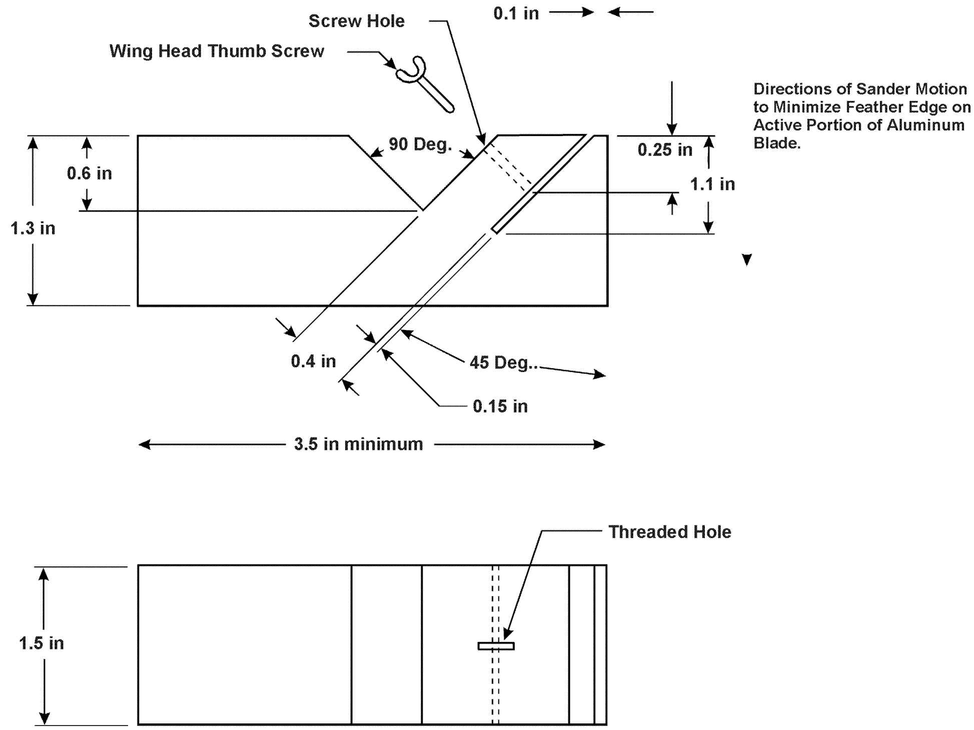

Figure 21-2. Aluminum Blade Sharpening Fixture

21.2.9 MIL-T-43435 (Type V) lacing tape.

21.2.10 MS25231 plastic clamps.

21.3 Test Samples

A test sample will consist of 15 bundles of wire. Each bundle is composed of seven wires and will be of sufficient length, 35.6 cm (14 inches) minimum, to allow the bundle to be installed in the test fixture. A minimum of 37.3 meters (122.5 feet) of wire is required. It is recommended that 20-gauge wire be used for the test.

21.4 Procedure

21.4.1 Preparation of Bundles

Conduct a 2500 volt Wet Dielectric test on 100 percent of the wire in accordance with the Wet Dielectric test procedure described in MIL-STD-2223, method 3005, before the arc-propagation resistance test is performed. Discard any failed sections of wire. Cut seven wire segments at least 35.6 cm (14 inches) in length for each of the 15 bundles. Clean the cut wires using a cloth saturated with Isopropyl alcohol. Strip both ends of five of the seven-wire segments. Use these stripped ends for making electrical connections. These five-wire segments will be called “active wires.” Form the bundle by laying the seven segments straight and geometrically parallel. Assemble the wires to form the six-around-one configuration shown in figure 21-3. Use MIL-T-43435 lacing tapes to hold the test bundle together. Clean the assembled bundle using a cloth saturated with Isopropyl alcohol prior to installation in the test fixture.

21.4.2 Bundle Installation

A test fixture will be used to hold the wire bundle in place perpendicular to the abrader blade. Details of a suggested test fixture are shown in figure 21-4. Before installation, the wire bundle will be tied with MIL-T-43435 lacing tape at 0.635 cm (0.25 inch) on each side of where the abrader

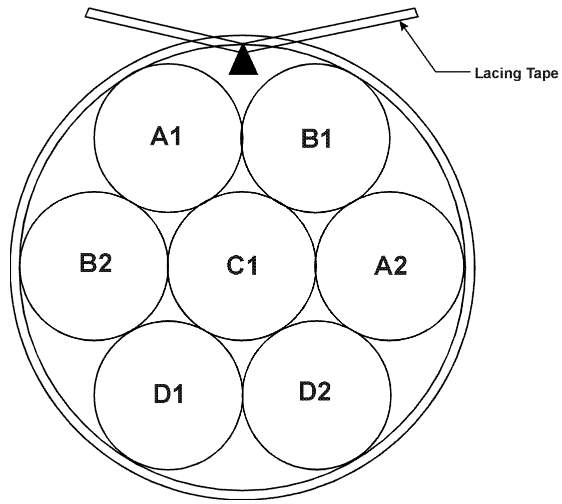

Figure 21-3. Bundle Configuration

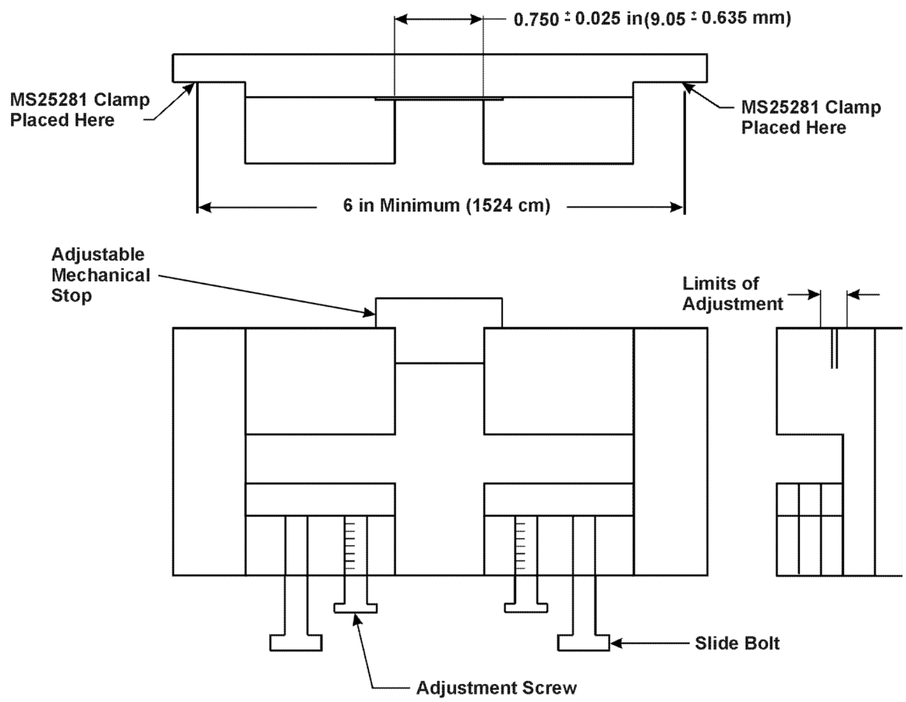

Figure 21-4. Test Fixture

blade is to be applied; then secured to the test fixture. The wire bundle is clamped with MS25281 plastic clamps at two points on the fixture at a minimum distance of 15.24 cm (6 inches). The clamp points are equidistant from the point of application of the abrader. The slide bolt allows the adjusting screw to move the holding plates snugly against the bundle. Ensure that the active wires A1 and B1 are parallel with the top plane of the test fixture and that the passive wires D1 and D2 are in complete contact with the base of the test fixture. The bundle must not be allowed to move while the abrader blade is cutting wires A1 and B1. The test fixture will contain an adjustable mechanical stop, which may be set to allow for various penetration depths of the vibrating blade.

21.4.3 Electrical Connection

Connect the test bundle to the power supply and circuit resistance using the schematic circuit shown in figure 21-5. Connect one end of each active wire to the appropriate phase of the power supply, as shown in table 21-1. Use an MS3320-7.5 (7.5 amp) circuit breaker and a circuit resistance in series with each of the active wires. Use the circuit resistance values shown in table 21-2. Connect the other end of the five active wires under test to variable resistance loads. Adjust the resistance to limit the current flowing through each wire to 1 ± 0.2 ampere. Protect the test circuits with MS25244-50 (50 amp) circuit breakers connected on the supply side of the test setup. Connect the abrader blade to the neutral of the generator. Connect the generator neutral to ground.

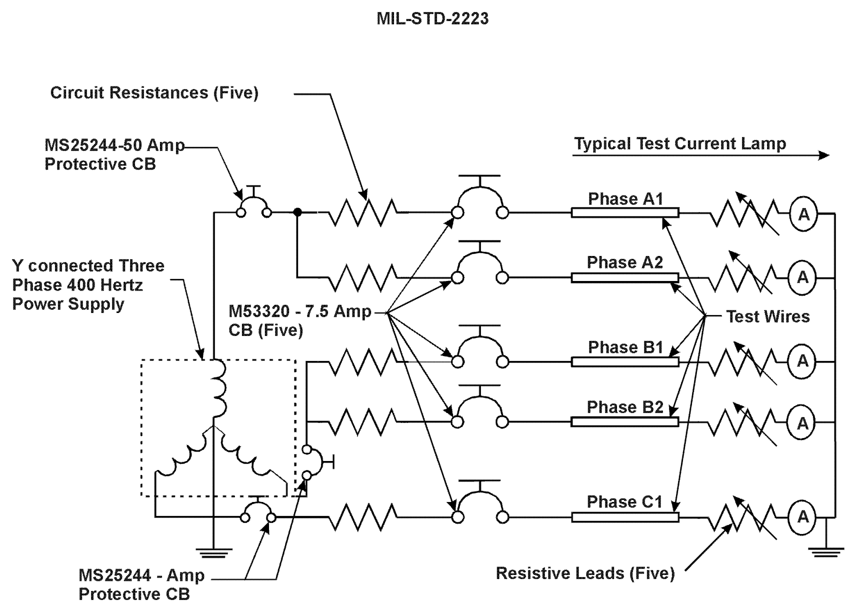

Figure 21-5. Electrical Connection

Table 21-1. Electrical Connection

Wire Identification	Power Supply	Layer
A1	Phase A	Top
B1	Phase B	Top
C1	Phase C	Middle
A2	Phase A	Middle
B2	Phase B	Middle
D1	None	Lowest
D2	None	Lowest

Table 21-2. Circuit Resistance

Test Number	Circuit Resistance (ohm)
1	0.0
2	0.5
3	1.0
4	1.5
5	2.0

21.4.4 Initiation of Test

Test three bundles for each of the five circuit resistances. Install the oscillating mechanism, which may use a reciprocating arm or vertical and horizontal precision linear ball-slides (a suggested ball-slide apparatus is shown in figure 21-6). Adjust the mechanical stop to ensure that the abrader blade penetrates into the A1 and B1 wires a distance of 0.87 times the radius of the seven wire bundles. Close all circuit breakers. Apply a nominal load of 250 grams (0.551 pounds) to the abrader at the point of contact with one wire. Adjust the blade to ensure that the major plane of the blade lies perpendicular to the longitudinal axis of the bundle. Apply the abrader blade on the test bundle. Position the protective screen to shield the operator from ejecting objects and UV radiation. Apply three-phase, 400 Hz power. Actuate the abrader. Allow the abrader blade movement to continue.

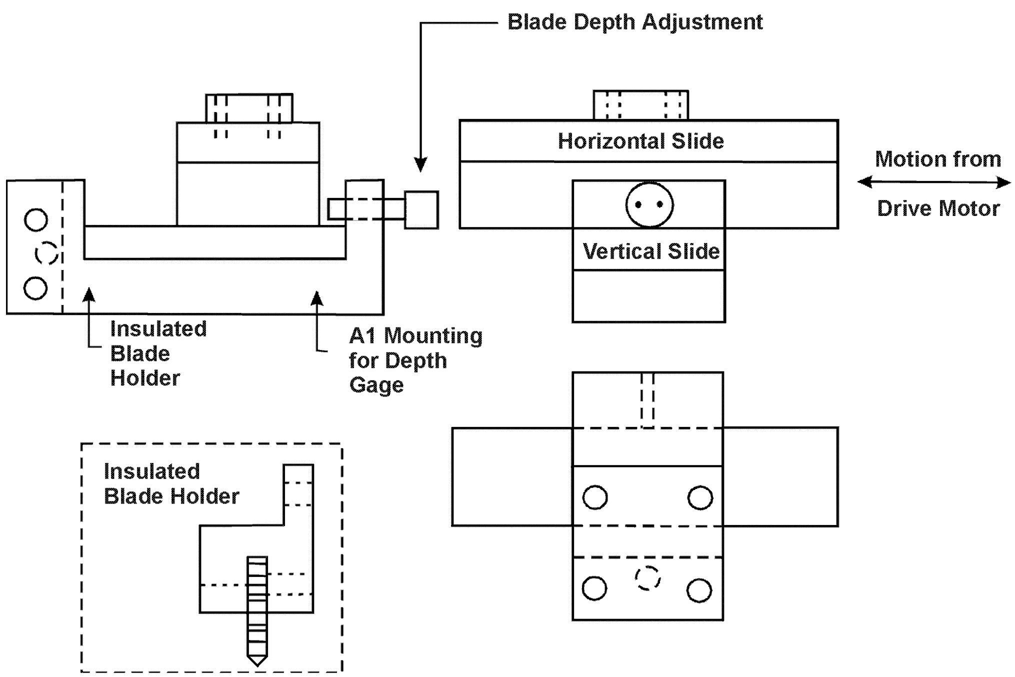

Figure 21-6. Ball-Slide Blade Fixture

21.5 Results

Use one of the following conditions to conduct and complete the test.

21.5.1 If the abrader cuts through A1 and B1 wires without tripping phase A1 or phase B1 circuit breakers, stop the abrader movement. Disconnect the power.

21.5.2 Conduct the 1000 volt Wet Dielectric test on wires A2, B2, C1, D1, and D2 in accordance with the Wet Dielectric procedure of MIL-STD 2223, method 3005. Record the number of wires that fail. Measure and record the total length of physical damage to each wire (including phase A1 and B1 wires) in inches.

21.5.3 If a circuit breaker in any of the phases A2, B2, or C1 trips at any time during the test, stop the abrader and disconnect the power. Perform tests as listed in 21.5.2.

21.5.4 If either phase A1 or phase B1 circuit breaker trips at any time during the test, stop the abrader. Disconnect the power and determine if the conductor wires A1 or B1 are open. If both wires are open, conclude the test by performing tests as listed in 21.5.2. If wire A1 or wire B1 are not open, wait 3 to 4 minutes, reset the circuit breaker, restart the abrader, and then immediately reapply the power. Continue the test until either phase A1 or phase B1 circuit breaker has tripped a second time, phases A1 and B1 are open, or the blade movement is stopped by the mechanical stop. CAUTION: DO NOT RESET A CIRCUIT BREAKER THAT TRIPS TWICE. Perform the tests as listed in 21.5.2. Use a new abrader blade edge for each test bundle if any damage is present or if circuit breakers A1 or B1 trip during the test.

21.5.5 Circuit breakers should be periodically tested to ensure they still meet the overload requirements of the applicable military specification sheet. Circuit breakers outside their overload trip requirements should be replaced.

21.6 Information Required in the Individual Specification

Specifications will list the minimum number of wires that must pass the dielectric test after the bundle has been energized and, also, the maximum allowable length of physical damage to the individual wires in the bundle.