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An American National Standard

# Standard Specification for Ozone-Resisting Butyl Rubber Insulation for Wire and Cable[1]

This standard is issued under the fixed designation D 1352; 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 This specification covers an ozone-resisting crosslinked rubber insulating compound for electrical wires and cables. The polymer consists substantially of butyl rubber.

1.2 This type of insulation is considered suitable for use at not more than 15 000 V between phases at an insulation level of 133 % or 28 000 V between phases at an insulation level of 100 %. The conductor temperature shall not exceed 85°C for an operating voltage of 15 000 V or less, and shall not exceed 80°C for an operating voltage above 15 000 V.

1.3 Whenever two sets of values are presented, in different units, the values in the first set are the standard, while those in parentheses are for information only.

1.4 In many instances the insulation material cannot be tested unless it has been formed around a conductor or cable. Therefore, tests are done on insulated wire or cable in this document solely to determine the relevant property of the insulation material and not to test the insulated conductor or completed cable.

## 2. Referenced Documents

2.1 *ASTM Standards:*

D 470 Test Methods for Crosslinked Insulations and Jackets for Wire and Cable[2]

D 1711 Terminology Relating to Electrical Insulation[2]

2.2 *ICEA Standard:*

T-24-380 Guide for Partial-Discharge Procedure[3]

## 3. Terminology

3.1 *Definitions:* For definitions of terms used in this specification, refer to Terminology D 1711.

3.1.1 *aging, (act of) n*—exposure of materials to air at 100°C for 168 h.

## 4. Physical Properties

4.1 Requirements for physical properties are listed in Table 1.

4.2 *Thickness of Insulation*—Table number 1A (Conductor Sizes, Insulation Thicknesses and AC Test Voltages for Rubber Insulations) of Test Methods D 470 lists the average thickness for the insulation. The required minimum thickness is at least 90 % of that given in Table number 1A (Conductor Sizes, Insulation Thicknesses and AC Test Voltages for Rubber Insulations) of Test Methods D 470.

## 5. Ozone Resistance

5.1 The insulation shall show no visible cracking after exposure for 3 h to an ozone concentration of not less than 0.025 nor more than 0.030 % by volume, when tested in accordance with Test Methods D 470.

## 6. Accelerated Water Absorption

6.1 The insulated conductor's insulation shall meet the requirements given in Table 2. Conduct the Electrical Method tests in accordance with Test Methods D 470 at 60 Hz with a water temperature of 75 ± 1°C.

## 7. Electrical Requirements

7.1 *Order of Testing*—Perform the partial discharge, ac voltage, insulation resistance, and dc voltage tests in that order when any of these tests are specified. The capacitance and dissipation factor tests are run on a separate sample. The sequence of other testing is not specified.

7.2 *Partial Discharge (Corona) Level*— When tested in accordance with ICEA T-24-380 as modified in Test Methods D 470, each length of completed power cable rated for service at 2001 V and above with insulation shielding on the individual conductors shall meet the minimum requirements given in Table 3.

7.3 *AC Voltage Test*—Test each insulated conductor for 5 min at the ac withstand test voltage given in Table number 1A (Conductor Sizes, Insulation Thicknesses and AC Test Voltages For Rubber Insulations) of Test Methods D 470 under the

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[2] *Annual Book of ASTM Standards*, Vol 10.01.

[3] Available from the Insulated Cable Engineers Assoc., P.O. Box 440, South Yarmouth, MA 02664.

**TABLE 1 Requirements for Physical Properties[A]**

| | |
|---|---|
| Unaged Requirements: | |
| Tensile strength, min, psi (MPa) | 600 (4.1) |
| Elongation at rupture, min, % | 350 |
| Set max, % | 25 |
| Requirements After Aging: | |
| After Air Oven Test at 100 ± 1°C for 168 h: | |
| Tensile strength, min, percentage of unaged value | 60 |
| Elongation at rupture, min, percentage of unaged value | 60 |
| After Air Pressure Heat Test at 80 ± 2.0 psi (0.55 ± 0.01 MPa) and 127 ± 1°C for 40 h: | |
| Tensile strength, min, percentage of unaged value | 50 |
| Elongation at rupture, min, percentage of unaged value | 50 |

[A] The values specified are applicable only to insulation having a nominal wall thickness of 0.030 in. (0.76 mm) or greater.

**TABLE 2 Accelerated Water Absorption Requirements**

| | |
|---|---|
| *Electrical Method:* | |
| Increase in capacitance, max, %: | |
| From 1 to 14 days | 5.0 |
| From 7 to 14 days | 3.0 |
| Stability factor after 14 days, max | 1.0 |
| Alternative: Stability factor difference, 1 to 14 days, max | 0.5 |

**TABLE 3 Minimum Partial Discharge Extinction Level, kV**

| Rated Circuit Voltage Phase to Phase, V | 100 % Insulation Level | 133 % Insulation Level |
|---|---|---|
| 2001 to 5000 | 4 | 5[A] |
| 5001 to 8000 | 6 | 8 |
| 8001 to 1 5000 | 11 | 15 |
| 15 001 to 25 000 | 19 | 26 |
| 25 001 to 28 000 | 21 | |
| 28 001 to 35 000 | 26 | |

[A] Unless otherwise indicated, the cable will be rated 100 %, insulation level.

columns labelled“ Ozone-Resisting Insulations.” Unless otherwise specified, omit this test for nonshielded conductors rated up to 5000 V if the dc voltage test described in 7.6 is to be performed.

7.4 *Insulation Resistance*:

7.4.1 The insulated conductor shall have an insulation resistance value of at least that which corresponds to a constant of 20 000 MΩ-1000 ft at 60°F (15.6°C).

7.4.2 If the temperature at the time measurement was made differs from 60°F (15.6°C), correct the insulation resistance to 60°F. Table 2 (Temperature Correction for Insulation Resistance at 60°F) of Test Methods D 470 contains the correction factors. Each insulation manufacturer can furnish the 1°F coefficient for the insulation material by using the procedure given in Test Methods D 470. Multiply the measured value by the correction factor to obtain the insulation resistance value corrected to 60°F.

7.4.3 If a nonconducting separator is applied between the conductor and insulation or if an insulated conductor is covered with a nonmetallic jacket so that the insulation resistance can be measured only on the completed assembly, the required insulation resistance shall be at least 60 % of that required for the primary insulation based on the thickness of that insulation.

7.5 *DC Voltage Test (Cables Rated at 5001 V and Above)*— After completion of the insulation resistance test, test each insulated power conductor rated for service at 5001 V and above for 15 min at the dc test voltage given in Table number 1B (Conductor Sizes and DC Test Voltages for Rubber Insulations) of Test Methods D 470 under the columns labelled “Ozone-Resisting Insulations.”

7.6 *DC Voltage Test (Cables Rated at 5000 V or Less)*— Unless otherwise specified, omit this test if the ac voltage test described in 7.3 has been performed. After completion of the insulation resistance test, test each nonshielded conductor rated for service up to 5000 V for 5 min at the dc test voltage given in Table number 1B (Conductor Sizes, and DC Test Voltages for Rubber Insulations) of Test Methods D 470.

7.7 *Capacitance and Dissipation Factor*— Test a specimen of insulated conductor rated for service at 2001 V and above for capacitance and dissipation factor. Conduct the test in room temperature water using suitable 60 Hz equipment at the working voltage. The increase in capacitance between the initial reading (within 1 h of immersion) and the 24 h reading shall not exceed 5 %. The dissipation factor shall not exceed 0.035 after 24 h.

## 8. Sampling

8.1 Sample the insulation in accordance with Test Methods D 470.

## 9. Test Methods

9.1 Test the insulation in accordance with Test Methods D 470.

## 10. Keywords

10.1 accelerated water absorption; ac voltage test; butyl rubber; butyl rubber insulation; capacitance; dc voltage test; dissipation factor; insulation; insulation resistance; ozone resistant; partial discharge