

CHANGE NOTICES ARE NOT  
CUMULATIVE AND SHALL BE  
RETAINED UNTIL SUCH TIME  
AS THE ENTIRE STANDARD  
IS REVISED

FED. TEST METHOD STD. NO. 228  
CHANGE NOTICE 1  
4 January 1984

# FEDERAL TEST METHOD STANDARD

## CABLE AND WIRE, INSULATED; METHODS OF TESTING

The following changes in Fed. Test Method Std. No. 228, dated April 14, 1967 have been approved by the Commissioner, Federal Supply Service, General Services Administration, for the use of all Federal agencies.

1. Remove sections 2, 3, and 4, and replace with new sections 2, 3, and 4.
2. Add the following new methods:
  - Method 2061
  - Method 5031
  - Method 7021
3. Remove Method 2211 and replace with revised Method 2211.1

### MILITARY INTERESTS:

#### Custodians

Army - CR  
Navy - SH  
Air Force - 85

#### Review Activities

Army - AR, AT  
Navy - EC  
Air Force - 11, 14, 15, 80, 85, 99  
DLA - IS

#### User Activities

Navy - YD, MC

#### Agent

DLA - ES

### CIVIL AGENCY COORDINATING ACTIVITY:

GSA - FSS

### PREPARING ACTIVITY:

Army - CR

DOD project 6145-0817

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## CRUSH RESISTANCE

## 1. SCOPE

1.1 This method is intended for use in determining the effect of crush resistance on wire and cable.

## 2. SPECIMEN

2.1 Two 18-inch specimens of the completed wire or cable shall be used for this test.

## 3. APPARATUS

3.1 The apparatus shall be as follows.

3.1.1 Shock test apparatus (see figure 1).

## 4. PROCEDURE

4.1 The specimens shall be freely suspended in an air oven at a temperature of  $+71^{\circ}\text{C} \pm 1^{\circ}\text{C}$  for a period of 72 hours. At the expiration of the 72-hour period, the specimens shall be removed from the oven and allowed to remain at room temperature for 24 hours, after which they shall be subjected to the following test.

4.1.1 The shock shall consist of dropping a  $23 \pm 1$  pound weight a free fall distance of  $6.5 \pm .50$  inch, minus the outside diameter of the test sample on the center portion of the sample while it is clamped flat on a smooth steel plate, free of abrasive contaminants as shown on figure 1. The drops shall be made at the rate of  $25 \pm 2$  per minute. There shall be a continuous current of 100 milliamperes supplied to the conductors under test with a current monitoring device to detect interior short circuit or failure with 1/3 or 1/2 of the conductors of a multi-conductor cable shall be permanently connected in series with the adjacent conductors connected into the load circuit.

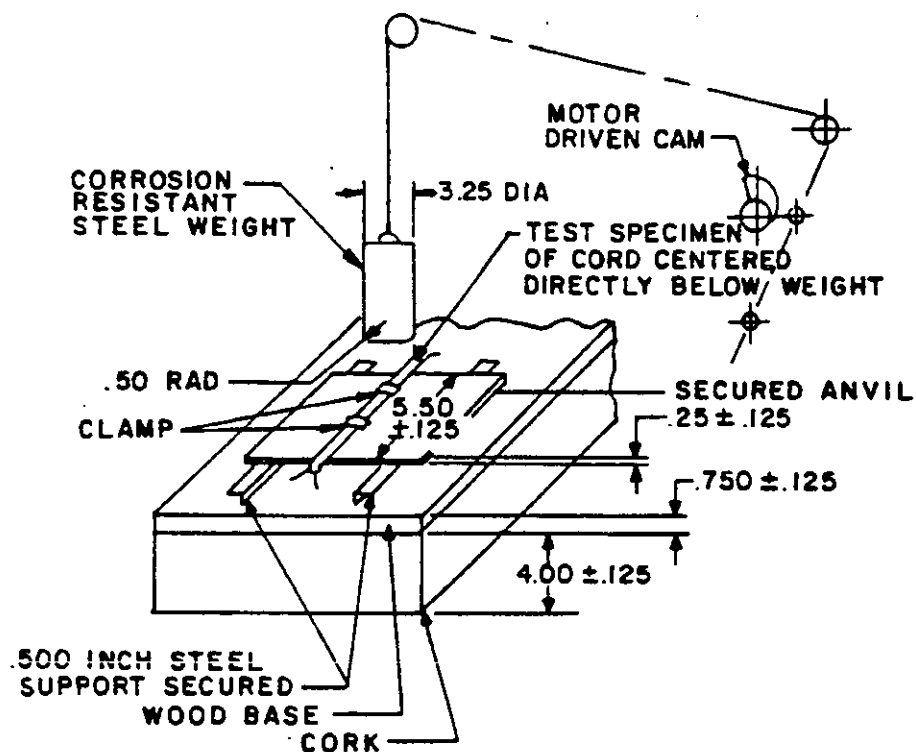
## 5. RESULTS

5.1 Unless otherwise specified in the detail specification, two 18-inch specimens of the completed wire or cable shall be tested, one from each end of the inspection unit.

5.2 Any cracks, tears or distortions in the insulation on the internal and external surfaces shall be recorded.

5.3 Discontinuities in current flow, short outs shall be recorded. Failure of a sample will be considered as the time when current ceases to flow or when the specimen shorts out or grounds.

## METHOD 2061



## NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only and are based upon 1 inch = 25.4 mm.
3. Unless otherwise specified, tolerances are  $\pm .016$  (0.41 mm).

| INCHES | MM     |
|--------|--------|
| .016   | 0.41   |
| .125   | 3.18   |
| .25    | 6.35   |
| .50    | 12.7   |
| .750   | 19.05  |
| 3.25   | 82.55  |
| 4.00   | 101.60 |
| 5.50   | 139.7  |

FIGURE 1. Shock test apparatus.

## METHOD 5031

## HIGH TEMPERATURE

## 1. SCOPE

1.1 This method is intended for use in determining the effect of heat on insulating materials.

## 2. SPECIMEN

2.1 The specimen shall consist of a 24-inch sample. One inch of insulation shall be removed from each end to the bare conductor or conductors.

## 3. APPARATUS

3.1 Mandrel (5 times  $\pm 50$  overall maximum diameter of wire or cable to be tested).

3.2 Weights (see table I).

3.3 Instrument capable of measuring  $\pm 1\%$  diameter of wire or cable.

## 4. PROCEDURE

4.1 Select the proper weight as shown in table I for the applicable size of cable or wire. The weight shall be attached to the exposed conductor at each end. The specimen on the mandrel with the weights freely suspended shall be placed in a circulating air oven maintained at the rated temperature of the wire or cable for a period of 120 hours. The weight shall be removed from the specimen when the specimen has been allowed to cool to room temperature. The bent portion of the specimen shall then be bent not less than  $180^\circ$  around the mandrel in the opposite direction with the opposite side of the cable in contact with the mandrel at a uniform rate for a complete  $180^\circ$  bend in 30 seconds.

TABLE I. Diameter undersheath and weight.

| Diameter under sheath (in.) | Weight (pounds) |
|-----------------------------|-----------------|
| 0.325 and less              | 2               |
| 0.326 to 0.430              | 2               |
| 0.431 to 0.540              | 2               |
| 0.541 to 0.640              | 3               |
| 0.641 to 0.740              | 3               |
| 0.741 to 0.850              | 3               |
| 0.851 to 1.100              | 6               |
| 1.101 to 1.320              | 6               |
| 1.321 to 1.550              | 6               |
| 1.551 to 1.820              | 6               |

## 5. RESULTS

5.1 Unless otherwise specified in the detail specification, one specimen from each end of the inspection unit shall be tested.

5.2 The specimen shall then be subjected to the dielectric test. Following a dielectric test and within 24 hours, the specimen shall be subjected to the abrasion tests. There shall be no evidence of failure.

5.3 The weight, maximum diameter of the cable or wire, and mandrel diameter used shall be recorded.

## METHOD 7021

## FLUID IMMERSION

## 1. SCOPE

1.1 This method is intended for use in determining the ability of cable to resist degradation when exposed to specific fluids they may come in contact with during their service life.

## 2. SPECIMEN

2.1 An individual sample for each applicable fluid 18-inch minimum in length, shall be stripped to the bare conductor on either end for one inch.

## 3. APPARATUS

3.1 The apparatus shall be as follows

- a. A vessel to contain the various fluids in sufficient quantity to completely immerse 2/3 of the wire or cable.
- b. An air circulating oven capable of maintaining temperature within  $\pm 3^{\circ}\text{C}$  of required setting. The maximum test temperature is  $175^{\circ}\text{C}$  ( $347^{\circ}\text{F}$ ).
- c. Table stove or hot plates.
- d. Immersion thermometer covering a range of  $0^{\circ}\text{C}$  to  $+150^{\circ}\text{C}$  ( $32^{\circ}\text{F}$  to  $302^{\circ}\text{F}$ ).
- e. Unless otherwise specified, test fluids shall be in accordance with table 1.

## 4. PROCEDURE

4.1 Before proceeding with the fluid immersion, the sample is to be weighted. The applicable specified test fluid shall be stabilized at the temperature specified in table I. One sample per each fluid shall be immersed to a minimum of 2/3 of the wire or cable. Immersion and cycling shall be as specified in table 1. Following the last immersion, the sample shall be dried.

## METHOD 7021

TABLE I. Test fluids and cycles.

| Fluid  | Test cycles |                                    |  | Number of 1/<br>cycles |
|--|-------------|------------------------------------|--|------------------------|
|  | Time        | Immerse<br>$\pm 3^{\circ}\text{C}$ | Drain  |                        |
| (a) MIL-H-5606 (hydraulic fluid)   | 5 minutes   | 85°C                               | 1 hour<br>minimum in<br>air at room<br>temperature | 7                      |
| (b) Hydraulic fluid 2/   |             | 85°C                               |  |                        |
| (c) MIL-T-5624 (grade JP-5)  |             | 25°C                               |  |                        |
| (d) MIL-L-7808 (lubricating oil)   |             | 125°C                              |  |                        |
| (e) MIL-L-23699 (lubricating oil)  |             | 120°C                              |  |                        |
| (f) MIL-A-8243 (defrosting fluid)  |             | 65°C                               |  |                        |
| (g) MIL-L-25769 (diluted for cleaning)   |             | 65°C                               |  |                        |
| (h) Kerosene, 50 percent aircraft lubricating oil, 50 percent (ASTM Standard D3669 and MIL-L-6082, grade 1100, respectively).                                    | 16 hours    | (48° to 50°C                       | 3 hours  | 1                      |
| (i) MIL-G-3056, type I (gasoline)  | 5 minutes   | 25° C                              | 24 hours<br>in free air                            | 5                      |
| (j) Isopropyl alcohol per TT-I-735, grade A or B, mixed one part by volume with three parts by volume of mineral spirits per TT-T-291, type 1 or P-D-680, type I |             |                                    |  |                        |
| (k) 1-1-1 trichlorethane   |             |                                    |  |                        |
| (l) Azeotrope of trichlorotrifluoroethane (Freon 113 or equal) and methylene chloride  | 4 hours     | 50° C                              | 2 hours  | 1                      |
| (m) (Specification TT-S-735)   |             |                                    |  |                        |
| Isopropyl alcohol  | 4 hours     | 50° C                              | 2 hours  | 1                      |
| (n) (Specification TT-I-735)   |             |                                    |  |                        |
| Carbon tetrachloride   | 4 hours     | 50° C                              | 2 hours  | 1                      |
| (p) (Specification O-C-265)  |             |                                    |  |                        |
| (q) MIL-C-43616, cleaning compound aircraft surface, (diluted for cleaning)  | 1 hour      | 25° C                              |  | 10                     |
| (r) MIL-T-81533, 1, 1, 1, Trichloroethane (Methyl Chloroform) inhibited, vapor decreasing  | 1 hour      | 25° C                              |  | 10                     |

1/ Transition time between steady-state conditions shall be 2 minutes, maximum. Steady-state conditions shall be  $\pm 1$  minute unless otherwise noted. The wire shall be drained by gravity during drainage portions of cycle.

2/ M2-V chevron oil ST0145LB0001 or equivalent.

## 5. RESULTS

5.1 Any change of weight, delamination, softening, swelling (finish diameter of material, reduction of electrical properties e.g., dielectric withstanding voltage and scrape abrasion), and discoloration of material finishes and markings shall be recorded.

## ABRASION RESISTANCE

## 1. SCOPE

1.1 This method is intended for use in determining the abrasion resistant characteristics of the finished wire or cable.

NOTE: Intended for use with neoprene cable.

## 2. SPECIMEN

2.1 This specimen shall consist of 2 samples of finished insulated wire or cable. Each sample shall be 30 inches in length, minimum.

## 3. APPARATUS

3.1 The apparatus shall be as follows:

3.1.1 Abrasion tests (see figure 1).

## 4. PROCEDURE

4.1 Two untested samples 30 inches in length, shall be mounted securely at one end and weights, as specified in table I, freely suspended to the other end with the cable or wire placed over a squirrel cage abrasion tester as shown on figure 1. A suitable tripping circuit shall be arranged to denote failure by stopping the machine when any bar of the squirrel cage comes in contact with the bare conductor of the cable or wire. The specimen shall be subjected to  $20 \pm 2$  oscillations per minute. An oscillation shall consist of 5 bars travel forward and backward from a given point.

TABLE I. Diameter under sheath and weight.

| Diameter under sheath (in.) | Weight abrasion-aging (pounds) |
|-----------------------------|--------------------------------|
| 0.325 and less              | 2                              |
| 0.326 to 0.430              | 2                              |
| 0.431 to 0.540              | 2                              |
| 0.541 to 0.640              | 3                              |
| 0.641 to 0.740              | 3                              |
| 0.741 to 0.850              | 3                              |
| 0.851 to 1.100              | 6                              |
| 1.101 to 1.320              | 6                              |
| 1.321 to 1.550              | 6                              |
| 1.551 to 1.820              | 6                              |

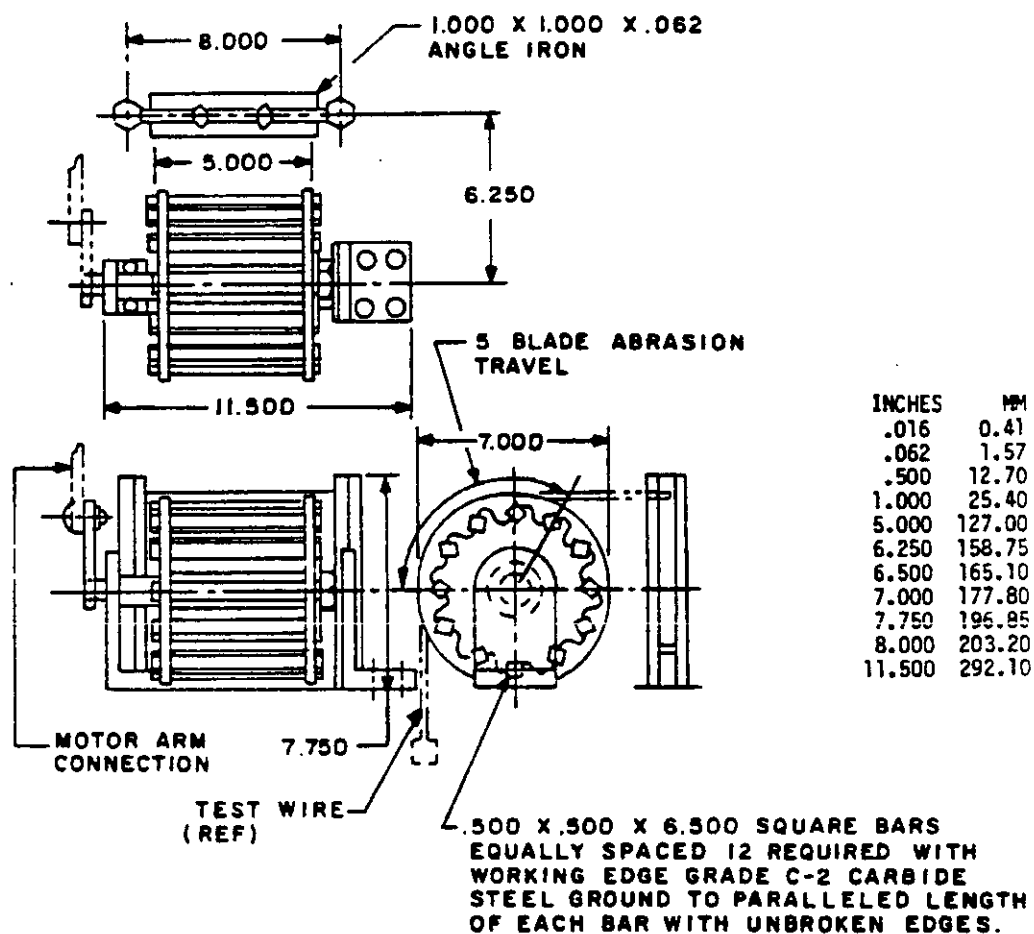
## 5. RESULTS

5.1 Unless otherwise specified in the detail specification or specification sheet, one specimen from each inspection unit shall be tested.

5.2 The weight used shall be recorded.



## METHOD 2211.1



## NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only and are based upon 1 inch = 25.4 mm.
3. Unless otherwise specified, tolerances are  $\pm .016$  (0.41 mm).

FIGURE 1. Abrasion test apparatus.