

# PRODUCT DATA



143-078

## Scotch 33+ Vinyl Plastic Electrical Tape

### 1. Product Description

"SCOTCH" Brand Electrical Tape No. 33+ is a conformable 7 mil thick vinyl plastic insulating tape which can be applied under all weather conditions and is designed to perform in a continuous temperature environment up to 105°C (220°F). It has excellent resistance to: abrasion, moisture, alkalis, acid, corrosion, and varying weather conditions (including sunlight). 33+, with its combination of memory (elasticity), adhesion characteristics and 7 mil thickness provides moisture tight electrical and mechanical protection with minimum bulk. "SCOTCH" No. 33+ passes Underwriters' Laboratory tests for plastic electrical tape.

#### Tape Features are:

- Polyvinyl chloride (PVC) backing.
- Pressure sensitive rubber based adhesive.
- Flexibility and adhesion at 0°F, allowing conformance to almost any substrate.
- Memory of the tape allows it to hold tightly and provide pressure to underlying substrate without slipping or flagging.
- Highly resistant to physical abuse, chemical attack and ultraviolet light.
- Compatible with all solid dielectric cable insulations.
- Usable for either indoor or outdoor applications.
- Compatible with rubber and synthetic splicing compounds as well as epoxy and polyurethane resins.
- Meets U/L requirements for 80°C.
- Meets proposed 105°C (220°F) rating requirements\*.
- Maintains high voltage protection despite high moisture concentrations.

\*See test method in — Section 5 "Characteristics and Test Data."

### 2. Applications

- Primary electrical insulation (especially in moisture and solvent vapor areas) for all wire and cable splices up to 600 volts and 105°C (220°F).
- Forms a protective jacket (excellent abrasion resistance for high voltage cable splices and terminations).
- For fixture wire splices up to 1000 volts.
- For wire and cable harnessing.

### 3. Data

#### Average Properties

|                                    |            |
|------------------------------------|------------|
| <b>Physical Properties No. 33+</b> |            |
| Normal Temperature Rating —        |            |
| UL                                 | 80°C       |
| 3M                                 | 105°C      |
| See Section 5                      |            |
| Color                              | Black      |
| Thickness                          |            |
| ASTM D-1000-69                     | 7 mils     |
| Adhesion to Steel                  |            |
| ASTM D-1000-69                     |            |
| 72°F                               | 18 oz./in. |
| 0°F                                | 50 oz./in. |
| Adhesion to Backing                |            |
| ASTM D-1000-69                     |            |
| 72°F                               | 18 oz./in. |
| 0°F                                | 45 oz./in. |
| Breaking Strength                  |            |
| ASTM D-1000-69                     |            |
| 72°F                               | 15 lbs/in. |
| Flammability                       |            |
| UL                                 | 1 sec.     |
| Accelerated Aging                  |            |
| MIL I 7798A                        | 100%       |
| Resistance to Penetration          |            |
| at elevated temp.*                 | 60°C       |
| ASTM D-1000-69                     |            |
| Ultimate Elongation                |            |
| ASTM D-1000-69                     |            |
| 72°F                               | 200%       |
| 0°F                                | 100%       |

### Electrical Properties No. 33+

|                         |                   |
|-------------------------|-------------------|
| After Standard          |                   |
| Conditions              | 10,000            |
| ASTM D-1000-69          | volts/mil         |
| After Water             | 90% of            |
| Immersion               | standard          |
| ASTM D-1000-69          | conditioning      |
|                         | value             |
| Direct Method of        |                   |
| Electrolytic Corrosion  |                   |
| 3M, See Section 5       | 1.0 ratio         |
| Insulation Resistance** |                   |
| ASTM D-1000-69          | 1x10 <sup>6</sup> |
|                         | Megohms           |

### Chemical Properties No. 33+

|                           |           |
|---------------------------|-----------|
| Water Absorption          |           |
| ASTM D-570-63             | 1%        |
| Resistance to Ultraviolet |           |
| Light                     |           |
| 3M, See Section 5         | Pass      |
| Copper Corrosion          |           |
| MIL I 7798A               | Pass      |
| Resistance to Alkalies    | Excellent |

\*Also specified in MIL I 7798A  
\*\*Direct method of electrolytic corrosion

### 4. Specifications

#### Product

The plastic tape is based on poly vinyl chloride (PVC) and/or its copolymers and has a rubber based pressure sensitive adhesive. The tape must be applicable at temperatures ranging from 0°F through 100°F without loss of physical or electrical properties. The tape must not crack, split, slip or flag when exposed to various environments (indoor or outdoor). The tape must also be compatible with all synthetic cable insulations as well as cable splicing compounds.

#### Engineering/Architectural Specifications

Primary electrical insulation branch wiring in wet or dry locations). All splices for 600 volt wire rated 105°C (220°F) and below shall be insulated with a minimum of two half-lapped layers of "SCOTCH" Brand No. 33+ Vinyl

Plastic Electrical Tape. All connectors having irregular surfaces shall be padded with "SCOTCHFIL" Brand Putty or "SCOTCH" Brand No. 23 Tape prior to insulating with "SCOTCH" Brand No. 33+ Tape.

Forms a protective jacket for High Voltage Cable Splices and Terminations.

All rubber and thermoplastic insulated high voltage cable splices and terminations shall be overwrapped with at least two half-lapped layers of "SCOTCH" Brand No. 33+ Vinyl Plastic Electrical Tape.

Fixture Wiring: All splices up to 1000 volts and 105°C (220°F) or less, requiring insulation shall be overwrapped with a minimum of two half-lapped layers of "SCOTCH" Brand No. 33+ Vinyl Plastic Electrical Tape.

## 5. Characteristics and Test Data

The Added + of 33+

### Low Temperature

A plastic tape, to be easily handled at any temperature, must have good elongation and adhesion. "SCOTCH" No. 33+ has 100% elongation and very high adhesion even at temperatures as low as 0°F. No. 33+ Tape will adhere to irregular surfaces and to most substrates under very extreme temperatures.

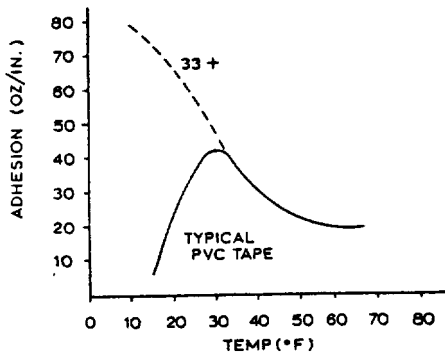


FIGURE 1.

### Room Temperature

No. 33+ Tape has been designed to be easily applied by any workman. At room temperature the tape can be elongated easily while the force required to break the

tape has been lowered. This means that less effort is required to produce a smooth, well wrapped splice.

### Room Temperature +

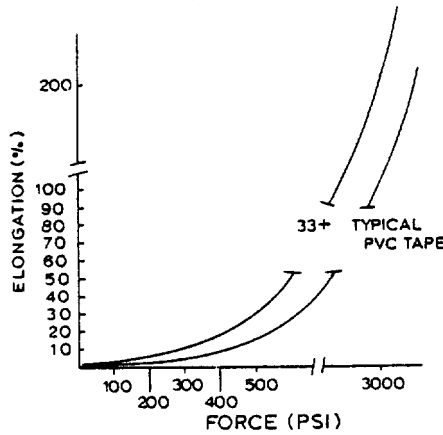


FIGURE 2.

NOTE: Lower force is required with No. 33+ Tape, as shown, to obtain initial elongation. Some elongation (10 to 15%) is required to obtain conformance. The force required for No. 33+ Tape is at a level which allows easier taping and thus provides maximum protection in the shortest possible time.

### High Temperature

Thru specialized compounding and unique processing techniques a more temperature stable plastic tape has been produced. No. 33+ Tape outperforms other plastic tapes when tested as shown in following paragraphs, "Exposure to Heat."

A maximum temperature rating of 80°C can be given to a plastic tape. This temperature rating is in accordance with Underwriters' Laboratories specification. 3M has raised the test temperature to simulate a 105° rating. No. 33+ Tape was designed to meet the stringent requirements of this test.

### Exposure to Heat

1. A thermoplastic insulating tape shall not crack when flexed, or otherwise be adversely affected, after being subjected to a temperature of 113°C (235°F) for 60 days.
2. To determine whether a tape complies with the requirements in the preceding paragraph, four tape insulated splices are to be made with

Type T, TW, THW, or THWN wire and four with Type R, RH, RW or RHW wire, as described in the succeeding paragraph. The conductor is to be No. 12 AWG solid copper and the solid copper conductor of a Type R, RH, RHW, or RW wire is to be metal coated.

3. For each splice, use two 12 inch (304.8MM) lengths of insulated conductors and strip a 2 inch (50.80MM) length of insulation from one end of each. Connect the two bared conductors together by means of an inline (Western Union) splice (see Figure 3 below). The ends of the conductor shall be crimped down with pliers to avoid sharp projections.

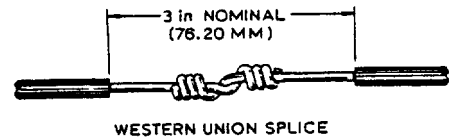


FIGURE 3.

4. While supporting a weight of 2-1/2 pounds, a strip of tape of suitable length is to be held vertically with the upper end of the tape held against the insulated wire just adjacent to the splice. Initially, the major axis of the splice is located approximately horizontally, and the tape is caused to wrap the wire and splice by rotating the splice about its major axis. The major axis of the splice is tipped from the horizontal so that each turn of the tape is to overlap the preceding turn by one-half the width of the tape. After the bared conductors and approximately one tape width of the wire insulation have been completely wrapped, a second wrapping is to be similarly applied, with direction of advance of the turns of tape reversed from that of the first wrapping. Finally, a third wrapping of tape is to be similarly applied with the direction of advance opposite to that of the second wrapping. Thus six thicknesses of tape will result at each point along the splice.

The insulated splices are then to be placed in an oven maintained at 113°C (235°F). After 24 hours, two of the splices employing thermo-plastic insulated T wire and two of those employing rubber insulated R wire are to be removed from the oven and subjected to flexing as described below. If failure occurs after 24 hours, the test shall be terminated and the 60 day samples removed from the oven. The other four samples are to remain in the oven for a total of 60 days, and are then to be removed from the oven and flexed. In each case, the samples are to be cooled at room temperature (23±2.0°C) for no less than 16 nor more than 96 hours before being flexed.

4A. The flexing is to be performed by holding the wire of the assembly approximately 1 inch to the left of the splice firmly against a horizontally fixed 1/2 inch diameter steel mandrel. The end of the assembly which includes the splice is then wrapped tightly around the mandrel in a clockwise direction until approximately one inch of the wire to the right of the splice is wrapped around the mandrel. The direction of the wrap is then reversed and continued in the counter-clockwise direction until approximately one inch of the wire to the right of the splice is wrapped around the mandrel. Five clockwise operations and five counter-clockwise operations followed by a clockwise unwrap completes the flexing procedure.

All operations shall be conducted at a uniform rate such that the full flexing procedure is completed in 20 ± 5 seconds.

The tape shall not crack or bubble after being flexed.

The conductor shall show no adverse effects after removal of the tape from the splices

## Electrolytic Corrosion

In insulating wires, electrolytic

corrosion caused by insulating tape can result in failure. When subjected to stress under high humidity, an insulating material serves as an electrolyte or a medium for the solution of copper wire when leakage current exists. The 3M electrolytic corrosion test is a scientific method of measuring the effect of corrosion caused by an insulating tape on a copper wire. It is based on tensile strength measurement of a copper wire which has been exposed to electrolytic corrosion.

A preparation board is made by wrapping No. 32 gauge copper wire so that sets of two wires are spaced 1/4" apart. Additional sets may be placed 1/2" apart. The wires should be snug, but must not be stretched or kinked.

The tape is applied over the two wires and firmly rolled down with a rubber roller. The wires are cut flush at one end of the board with two inches of wires extended at the other end. The board is then hung in a conditioning chamber maintained at 95±1% R.H. One wire from each sample is connected to the positive side of a 250 Volt DC supply and the other wires are connected to the negative side.

250 Volts DC are applied across the samples for 24 hours. See Figure 4.

The samples are then removed, the tapes removed from the wires and the wires are tested for tensile strength. The corrosion factor is found by calculating:

$$\frac{\text{Tensile of positive wire}}{\text{Tensile of negative wire}}$$

Electrolytic corrosion will not affect the copper wire connected to the negative side of the DC supply. However, any electrolytic corrosion caused by the tape will result in the dissolving of a small amount of the wire connected to the positive side of the DC supply resulting in a lower tensile strength.

A tape whose electrolytic corrosion factor is less than one could be considered to be damaging any copper wires it comes into contact with at high relative humidities. "SCOTCH" No. 33+ Tape has an electrolytic corrosion factor of 1.00.

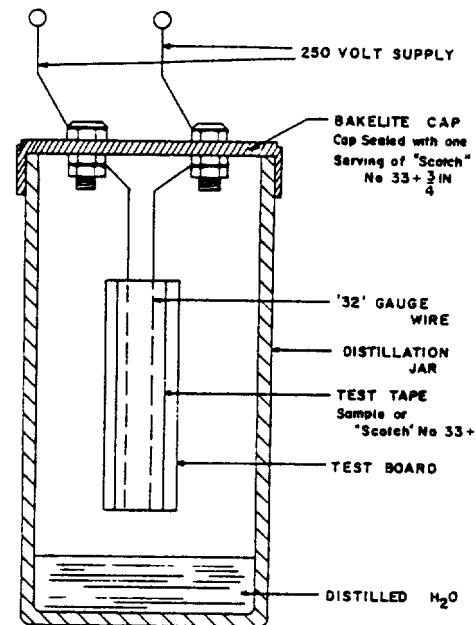


FIGURE 4.

## Cross Section of Corrosion Chamber

### Conformability

Type "A" tape is a strong oriented film type product. It is difficult to elongate and when stretched beyond the low yield point it does not recover. Consequently, it does not conform to irregular surfaces and provide adequate splice protection from moisture even though it is "moisture resistant tape."

The "SCOTCH" No. 33+ Tape curve illustrates that when the tape is applied with normal tension a neat, self-snugging splice is obtained. The result is a good looking, moistureproof, splice that provides excellent physical and electrical protection. See Figure 5.

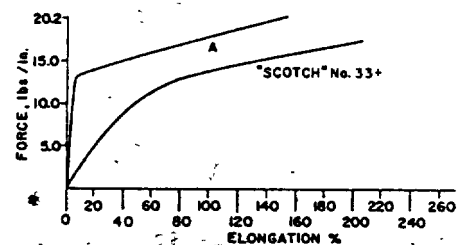


FIGURE 5.

## 6. Installation Techniques

The tape shall be applied in half-lapped layers with sufficient tension to reduce its width to 5/8 of its original width. On pigtail

splices, the tape shall be wrapped beyond the end of the wires and then folded back — leaving a perfect protective cushion which will resist wire cut-through. Always wrap tape uphill. DO NOT STRETCH LAST INCH.

**CAUTION:** The adhesive of No. 33+ Tape is not oil resistant. It should not be used for sole insulation on cables which contain oil or slipper compounds. The tape should not be used where oil can attack and soften the adhesive.

## 7. Maintenance

No. 33+ Tape is stable under normal storage conditions. Special slitting techniques result in a tape which will not telescope. A specially formulated rubber based adhesive remains stable under all weather conditions.

## 8. Availability

“SCOTCH” Brand Vinyl Plastic Electrical Tape No. 33+ is available in the following roll sizes from your electrical distributor:

- 3/4 in. x 66 ft.
- 3/4 in. x 44 ft.
- 3/4 in. x 20 ft.
- 3/8 in. x 20 ft.

3/4 in. x 66 ft. is also available in a handy, plastic dispenser.

Other lengths and widths are available by special request.

Complete Product and Use Specifications are available through the ELECTRO-PRODUCTS DIVISION, 3M COMPANY.

### IMPORTANT NOTICE TO PURCHASER:

All statements, technical information and recommendations contained herein are based on tests we believe to be reliable, but the accuracy or completeness thereof is not guaranteed, and the following is made in lieu of all warranties, express or implied: Seller's and manufacturer's only obligation shall be to replace such quantity of the product proved to be defective. Neither seller nor manufacturer shall be liable for any injury, loss or damage, direct or consequential, arising out of the use of or the inability to use the product. Before using, user shall determine the suitability of the product for his intended use, and user assumes all risk and liability whatsoever in connection therewith. No statement or recommendation not contained herein shall have any force or effect unless in an agreement signed by officers of seller and manufacturer.

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