

## **Thermofit<sup>®</sup> Adhesive and Sealant**

### **1. SCOPE**

This specification covers the requirements for various types of adhesives and sealants for bonding with Thermofit heat-shrinkable plastic and rubber tubing, molded components and other suitable substrates. Individual descriptions and properties appear in the applicable specification sheet.

### **2. APPLICABLE DOCUMENTS**

This specification takes precedence over documents referenced herein. Unless otherwise specified, the latest issue of referenced documents applies. The following documents form a part of this specification to the extent specified herein.

#### **2.1 OTHER SPECIFICATIONS**

American Society for Testing and Materials (ASTM)

C 509	Cellular Elastomeric Preformed Gasket and Sealing Material
D 15	Compound and Sample Preparation for Physical Testing of Rubber Products
D 149	Dielectric Breakdown Voltage and Dielectric Strength of Electrical Insulating Materials at Commercial Power Frequencies
D 256	Impact Resistance of Plastics and Electrical Insulating Materials
D 543	Resistance of Plastics to Chemical Reagents
D 570	Water Absorption of Plastics
D 746	Brittleness Temperature of Plastics and Elastomers by Impact
D 792	Specific Gravity and Density of Plastics by Displacement
D 1084	Viscosity of Adhesives
D 1146	Blocking Point of Potentially Adhesive Layers
D 1238	Measuring Flow Rates of Thermoplastics by Extrusion Plastometer
D 1693	Environmental Stress-Cracking of Ethylene Plastics
D 2671	Methods of Testing Heat-Shrinkable Tubing
E 28	Softening Point by Ring-and-Ball Apparatus
G 21	Determining Resistance of Synthetic Polymeric Materials to Fungi

### 3. REQUIREMENTS

#### 3.1 MATERIAL

Each adhesive or sealant shall be described in the individual specification sheet. Each material shall be homogeneous and free of foreign particles or other contaminant materials. The adhesive or sealant shall be essentially free of voids, pin-holes or air entrapment.

#### 3.2 PROPERTIES

The adhesive or sealant shall meet the requirements listed in the individual specification sheet.

### 4. QUALITY ASSURANCE PROVISION

#### 4.1 CLASSIFICATION OF TESTS

##### 4.1.1 Qualification Tests

Qualification tests are those performed on adhesive or sealant submitted for qualification as a satisfactory product and shall consist of all tests listed in the applicable specification sheet.

##### 4.1.2 Acceptance Tests

Acceptance tests are those performed on adhesive or sealant submitted for acceptance under contract. Acceptance tests of each material are listed on each individual specification sheet.

#### 4.2 SAMPLING INSTRUCTIONS

##### 4.2.1 Test Sample Preparation

###### 4.2.1.1 Solid Materials

Test samples in the form of compression-molded sheets shall be prepared from solid adhesives or sealants. The sheets shall be 6 x 6 x .075 inch (nominal) as described in ASTM D 15, except where other wise specified. Sheets shall be prepared in a heated press at the temperature indicated in the individual specification sheet. The sheets shall be homogenous and free from voids.

###### 4.2.1.2 Liquid One-Part Materials

The solvent of the liquid one-part adhesive shall be evaporated by pouring the adhesive into a shallow pan and heating in an air circulating oven at 52 C (125 F) for 24 hours. Sheets shall be prepared according to the procedure described in paragraph 4.2.1.1.

###### 4.2.1.3 Two-Part Materials

The two components shall be thoroughly mixed immediately prior to testing. In cases where sheets are required, the material shall be mixed and cast into sheets which are 6 x 6 x .075 inch (nominal). The sheets shall be cured as indicated in the individual specification sheet. The cast sheets shall be homogenous and free from voids.

##### 4.2.2 Qualification Test Samples

Sufficient adhesive or sealant must be prepared to satisfy all the test requirements listed on the individual specification sheets.

##### 4.2.3 Acceptance Test Samples

Acceptance test samples shall be taken from each lot of material. A lot shall consist of all the adhesive or sealant from the same production run offered for inspection at the same time. Acceptance tests shall consist of visual examination and adhesive T-Peel strength to a steel mandrel.

### 4.3 TEST PROCEDURES

#### 4.3.1 Physical

##### 4.3.1.1 Visual Inspection

The test specimens shall be visually examined to insure that the material is homogenous and free of foreign particles or other contaminants.

##### 4.3.1.2 Specific Gravity

The specific gravity shall be determined in accordance with ASTM D 792.

##### 4.3.1.3 Viscosity

###### 4.3.1.3.1 *Brookfield Viscometer*

The viscosity of the material shall be determined in accordance with ASTM D 1084, Method B, using the Brookfield viscometer

###### 4.3.1.3.2 *Brookfield Thermosel Viscometer*

The viscosity of the material shall be determined in accordance with ASTM D 1084, Method B, using the Brookfield Thermosel viscometer. The temperature of the test shall be indicated on the individual specification sheet.

##### 4.3.1.4 Melt Index

The melt index of the material shall be determined in accordance with ASTM D 1238, Method B.

##### 4.3.1.5 Softening Point

The softening point shall be determined by the ring-and-ball method, in accordance with ASTM E 28.

##### 4.3.1.6 Low Temperature Flexibility

The low temperature flexibility shall be determined in accordance with ASTM C 509, Method A-1. (Note: This method was formerly ASTM D 736.)

##### 4.3.1.7 Low Temperature Impact Brittleness

The brittleness shall be determined in accordance with ASTM D 746, Procedure B.

##### 4.3.1.8 Blocking Test

The thermoplastic blocking point shall be determined in accordance with ASTM D 1146. Cohesive blocking shall be determined on thermoplastic adhesives; adhesive blocking shall be determined on sealants using a release paper. The release paper shall be Edgewater Paper Co. #60-24-UBL-28-1 polyethylene coated kraft paper or equivalent. The test specimens shall be cut from sheet material prepared in accordance with 4.2.1.1. The test specimens shall be free to first degree blocking at the temperature indicated in the individual specification sheet.

#### 4.3.1.9 Adhesive Peel Strength

Peel strength shall be determined using an uncoated Thermofit Pipe Sleeve (TPS) recovered and adhered to a mandrel approximately 2-1/2 inches in diameter. Mandrel materials shall be one or more of the following materials: polyethylene telephone cable jacket, rigid PVC pipe, lead cable jacket, commercial neoprene cable jacket, steel pipe or other specified materials. The specific mandrel materials with each respective surface preparation and bonding techniques are described in the Appendices "Peel Specimen Preparation." The Appendices describes preparation of substrates. After cooling to room or other specified temperature, the tubing shall be cut into 1 inch wide sections as illustrated in Figure 1. Each specimen shall be cut along the edge of the adhesive free areas as illustrated in Figure 1. The specimen shall be placed in a tensile testing machine, with the specimen around the positioning mandrel and the free end of the specimen inserted into the tensile testing machine jaw as illustrated in Figure 2. The holding fixture shall be constructed so that the yoke is free to rotate during testing. Testing shall be with a jaw-separation speed of 2 inches per minute. Readings of peel strength shall be taken at every 1/2 inch of jaw separation after 1 inch initial separation. The average of five readings shall define peel strength.

#### 4.3.2 Chemical

##### 4.3.2.1 Water Absorption

The water absorption shall be determined in accordance with ASTM D 570. The samples shall be immersed 24 hours at  $25 \pm 3$  C ( $77 \pm 5$  F).

##### 4.3.2.2 Corrosive Effect

The corrosive effect shall be determined in accordance with ASTM D 2671, Appendix A.1.5.2. Uncoated TPS heat-shrinkable tubing (2 inch diameter) shall be used to hold the adhesive or sealant in contact with 1 inch bright copper tubing. The heat-shrinkable tubing shall be recovered over the copper tubing and adhesive or sealant material. The samples shall be heated in an air-circulating oven for 16 hours at  $121 \pm 2$  C ( $250 \pm 3$  F). If removal for audit is difficult, specimens may be immersed in toluene at 52 C (125 F) for two hours or other appropriate solvents as specified to aid in the release from the copper tubing.

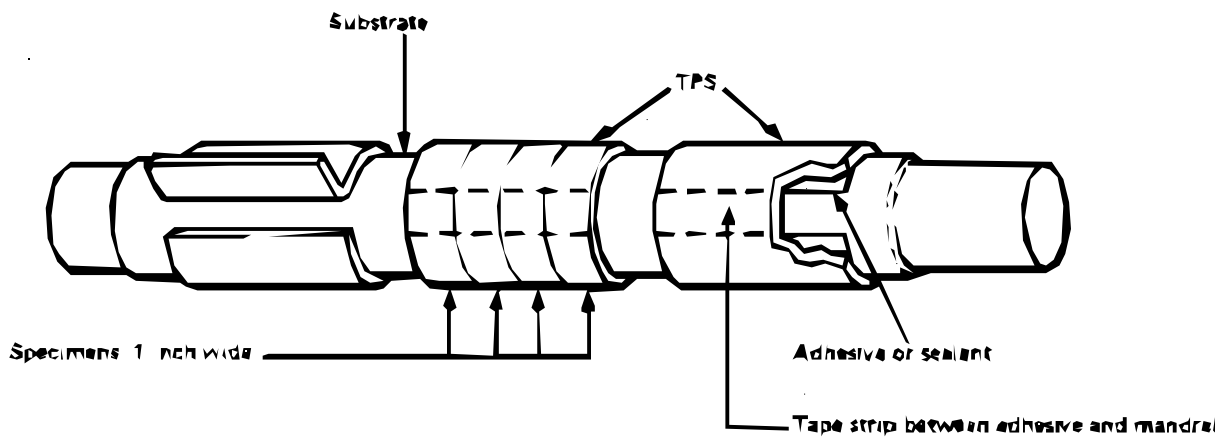


Figure 1. Part Specimen Preparation

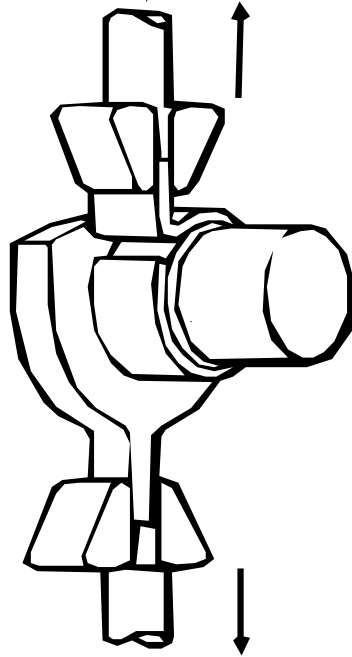


Figure 2. Part Specimen in Tensile Tester

- 4.3.2.3 **Environmental Stress-Crack Resistance**  
Environmental stress-crack resistance of the adhesive shall be determined in accordance with ASTM D 1693. The stress-cracking initiator shall be a 10% solution of Igepal CO-630. The exposure shall be specified on individual specification sheets.
- 4.3.2.4 **Environmental Stress-Cracking of Substrate**  
Environmental stress-cracking shall be determined on substrates used with adhesives and sealants. Testing shall be in accordance with ASTM D 1693, except the stress-cracking initiator shall be the adhesive or sealant of test. Substrates listed in the individual specification sheet shall be prepared and mounted in the test fixture. Molten adhesive shall be applied to each specimen at the bend. These specimens shall be maintained at the temperature and time specified in the individual specification sheets. DYNH\* shall be used as a control substrate.
- 4.3.2.5 **Fungus Resistance**  
The fungus resistance of the adhesive and sealant shall be determined in accordance with ASTM G 21. The specimen size shall be 2 x 2 x .075 inch and shall be exposed for a period of 28 days.
- 4.3.2.6 **Solvent and Fluid Resistance**  
The solvent and fluid resistance of the adhesive and sealant shall be determined in accordance with ASTM D 543, Procedure 1. The test specimens shall be 3 x 1 x .125 inch. The specimens shall be cut from sheets prepared according to paragraph 4.2.1.1. Each specimen shall have four cut edges and the edges shall be smooth and clean. The immersion time shall be 7 days at  $23 \pm 2$  C ( $74 \pm 3$  F). Results shall be reported as % weight change and significant change of appearance shall be noted.
- 4.3.3 **Electrical**
- 4.3.3.1 **Volume Resistivity**  
The volume resistivity shall be determined in accordance with ASTM D 257. The specimen as described in paragraph 4.2.1.1, shall be prepared using silver-paint electrodes.
- 4.3.3.2 **Dielectric Strength**  
The dielectric strength shall be determined in accordance with ASTM D 149. Measurements shall be made under oil using 1 inch electrodes on a 6 x 6 x .075 inch sheet specimen prepared according to paragraph 4.2.1.1. The rate of rise shall be 500 volts per second. Thickness measurements shall be made at the point of breakdown for the purpose of calculating dielectric strength. Five readings shall be determined for dielectric strength.
- 4.3.4 **Rejection and Retest**  
Failure of any sample of adhesive or sealant to conform to any one of the requirements of this specification shall be cause for rejection of the lot represented. Material which has been rejected may be replaced or reworked and resubmitted for acceptance. Before resubmitting, full particulars concerning previous action taken to correct the defects shall be furnished the inspector.

\*Union Carbide-Low density polyethylene (Sp. Grav. = 0.915, melt index = 2.0)

**5. PREPARATION FOR DELIVERY****5.1 PACKAGING**

Unless otherwise specified, the adhesive or sealant shall be in packages containing a measured quantity of material, in conformance with good commercial practice.

**5.2 MARKING**

Unless otherwise specified, each package of adhesive or sealant shall be marked with the product designation, the batch or lot number and manufacturing data.



**APPENDIX A**  
**PEEL SPECIMEN PREPARATION OF POLYETHYLENE JACKETED CABLE**

**A.1 SAMPLE DESCRIPTION**

The mandrel specimen shall be an 18 inch length of Western Electric Co. ALPETH sheath telephone cable, approximately 2.7 inches in diameter.

**A.2 SPECIMEN PREPARATION**

A.2.1 Clean cable mandrel, wipe and dry with a clean cloth.

A.2.2 Lightly abrade cable mandrel with No. 320 emery paper.

A.2.3 Wipe particles from abrasion off cable mandrel with a clean dry cloth.

A.2.4 Preheat cable mandrel (flame brush) 30 seconds by passing the yellow portion of a flame lightly over entire specimen (not to a glossy finish).

A.2.5 Assemble TPS and adhesive or sealant over the cable mandrel.

A.2.6 Completely recover the TPS sleeve over the cable mandrel, leaving no chill marks on the sleeve.

A.2.6.1 Postheat adhesive assembly 30 seconds after complete recovery.

A.2.6.2 Postheat sealant assembly 10 seconds after complete recovery.

**APPENDIX B**  
**PEEL SPECIMEN PREPARATION OF LEAD JACKETED CABLE**

**B.1 SAMPLE DESCRIPTION**

The mandrel specimen shall be an 18 inch length of Western Electric Co. lead sheath telephone cable, approximately 2.7 inches in diameter.

**B.2 SPECIMEN PREPARATION**

B.2.1 Clean cable mandrel, wipe and dry with a clean cloth.

B.2.2 Lightly abrade cable mandrel with No. 320 emery paper to expose a new surface, removing all metal oxides from the mandrel.

B.2.3 Wipe particles from abrasion off cable mandrel with a clean dry cloth.

B.2.4 Preheat cable until warm (approximately 50 C) (122 F).

B.2.5 Assemble TPS and adhesive over the cable mandrel.

B.2.6 Completely recover the TPS sleeve over the cable mandrel, leaving no chill marks on the sleeve.

B.2.6.1 Postheat adhesive assembly 30 seconds after complete recovery.

B.2.6.2 Postheat sealant assembly 10 seconds after complete recovery.

**APPENDIX C**  
**PEEL SPECIMEN PREPARATION OF NEOPRENE JACKETED CABLE**

**C.1 SAMPLE DESCRIPTION**

The mandrel specimen shall be an 18 inch length of General Electric Vulkene polychloroprene jacketed cable (approximately 2.0 inch O.D.) rated at 5-8 kV.

**C.2 SPECIMEN PREPARATION**

C.2.1 Clean cable mandrel, wipe and dry with a clean cloth.

C.2.2 Abrade cable mandrel with card file or equivalent over the bonding area.

C.2.3 Wipe particles from abrasion off cable mandrel with a clean dry cloth.

C.2.4 Preheat cable mandrel until there is a slight "smoking" of the jacket material.

C.2.5 Immediately assemble TPS and adhesive over the cable mandrel.

C.2.6 Completely recover the TPS sleeve over the cable mandrel, leaving no chill marks on the sleeve.

C.2.6.1 Postheat adhesive assembly 30 seconds after complete recovery.

C.2.6.1 Postheat sealant assembly 10 seconds after complete recovery.

**APPENDIX D**  
**PEEL SPECIMEN PREPARATION OF PVC PIPE**

**D.1 SAMPLE DESCRIPTION**

The mandrel specimen shall be an 18 inch length of standard 1-1/2 inch rigid polyvinylchloride plastic pipe.

**D.2 SPECIMEN PREPARATION**

- D.2.1 Clean mandrel, wipe and dry with a clean cloth.
- D.2.2 Lightly abrade mandrel with No. 320 emery paper to expose a new surface.
- D.2.3 Wipe particles from abrasion off mandrel with a clean dry cloth.
- D.2.4 No preheat is required.
- D.2.5 Assemble TPS and adhesive or sealant over the mandrel.
- D.2.6 Completely recover the TPS sleeve over the mandrel, leaving no chill marks on the sleeve.
  - D.2.6.1 Postheat adhesive assembly 30 seconds after complete recovery.
  - D.2.6.2 Postheat sealant assembly 10 seconds after complete recovery.

**APPENDIX E**  
**PEEL SPECIMEN PREPARATION OF STEEL PIPE**

**E.1 SAMPLE DESCRIPTION**

The mandrel specimen shall be an 18 inch length of steel, A.S.A. -B 36.10-1939 pipe.

**E.2 SPECIMEN PREPARATION**

E.2.1 The mandrel shall be prepared to expose a smooth, uniform surface.

E.2.2 Solvent wipe the mandrel surface with methyl ethyl ketone (MEK) or equivalent.

E.2.3 Wipe clean and dry.

E.2.4 Preheat mandrel until warm (approximately 50 C) (122 F).

E.2.5 Assemble TPS and adhesive or sealant over the mandrel

E.2.6 Completely recover the TPS sleeve over the mandrel, leaving no chill marks on the sleeve.

E.2.6.1 Postheat adhesive assembly 30 seconds after complete recovery.

E.2.6.2 Postheat sealant assembly 10 seconds after complete recovery.

**APPENDIX F**  
**PEEL SPECIMEN PREPARATION, GENERAL METHOD**

**F. 1 SAMPLE DESCRIPTION**

Other unspecified materials may be tested for adhesive peel strength but shall not be required for qualification testing. Samples may be either flat sheets or tubing of the appropriate materials.

**F.2 SPECIMEN PREPARATION**

F.2.1 Clean material, wipe and dry with a clean cloth.

F.2.2 Lightly abrade entire bonding area with No. 320 emery paper.

F.2.3 Wipe particles from abrasion off specimens with a clean dry cloth.

F.2.4 Assemble substrates and adhesive or sealant together.

F.2.5 Heat assembly to 150 C for 5 minutes and allow to cool to room temperature while under contact pressure.