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**Raychem**

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## **THERMOFIT® ADHESIVE S-1255-04 Flex Fluid Resistant, High Temperature, One Part-Flexible Epoxy**

### **1. SCOPE**

This specification covers the requirements for one type of flexible epoxy for use with heat-recoverable, plastic and elastomeric tubing and molded components. When used as specified with other compatible components, this epoxy is suitable for use in fluid resistant, high temperature harness systems as described herein.

### **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 GOVERNMENT-FURNISHED DOCUMENTS**

##### Military

MIL-H-5606	Hydraulic Fluid, Petroleum Base, Aircraft, Missile and Ordnance
MIL-T-5624	Turbine Fuel, Aviation, Grades JP-4 and JP-5
MIL-L-7808	Lubricating Oil, Aircraft Turbine Engine, Synthetic Base
PC-437	Cleaning Compound, Military engines

#### **2.2 OTHER PUBLICATIONS**

##### American Society for Testing and Materials (ASTM)

ASTM D 149	Standard Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Electrical Insulating Materials at Commercial Power Frequencies
ASTM D 257	Standard Test Methods for D-C Resistance or Conductance of Insulating Material
ASTM D 570	Standard Test Method for Water Absorption of Plastics
ASTM D 910	Standard Specification for Aviation Gasoline
ASTM D2671	Standard Test Method for Heat Shrink Tubing for Electrical Use.
ASTM D2093	Standard Practice for Preparation of Surfaces of Plastics Prior to Adhesive Bonding
ASTM D 2651	Standard Practice for Preparation of Metal Surfaces for Adhesive Bonding
ASTM G 21	Recommended Practice for Determining Resistance of Synthetic Polymer Materials to Fungi
ASTM D792	Measurements for Specific Gravity

(Copies of ASTM Publications may be obtained from the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.)

Raychem Corporation

RT-1146	Viton Tubing
RT-1312	Viton (-12) Molded Components
RT-1148	Viton Polymer Blend (VPB) tubing
RT-1313	Viton Polymer Blend (-50) Molded Components
RT-555	Thermofit® RT-555 Tubing
RT-1330	Thermofit® Fluoropolymer (-55) Molded Components
RT-1334	NSM Nuclear Survivable (-125) Molded Components
Specification 55A	55 Wire and Cable

(Copies of the Raychem Corporation specifications cited above may be obtained from the Literature Department, Raychem Corporation, 300 Constitution Drive, Mail Stop 527/6206, Menlo Park, California 94025-1164.)

### 3. REQUIREMENTS

#### 3.1 MATERIAL

The adhesive shall consist of a one-part modified epoxy resin supplied in tape form with a nominal width of 0.75 inch (*13 mm*) wide and  $0.020 \pm .005$  inch (*0.51 ± 0.13 mm*) thick.

#### 3.2 COLOR

The color as supplied is black.

#### 3.3 PROPERTIES

The adhesive shall meet the requirements of Table 1.

#### 3.4 SYSTEMS PERFORMANCE

The performance of harness systems fabricated with this material shall satisfy the sealing requirements of Chrysler Systems Specification SC-X15110.

### 4. QUALITY ASSURANCE PROVISIONS

#### 4.1 CLASSIFICATION OF TESTS

##### 4.1.1 Qualification Tests

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

##### 4.1.2 Acceptance Tests

Acceptance tests are those performed on each production lot of adhesive. Acceptance tests shall consist of the following:

Visual inspection

Adhesive peel strength (Viton (-12) to Viton tubing at 23°C)

Other tests shall be performed as often as necessary to ensure compliance with all requirements of this specification.

## 4.2 SAMPLING INSTRUCTIONS

### 4.2.1 Qualification Test Samples

Qualification test samples shall consist of not less than 100 ft (30 m) of epoxy tape.

### 4.2.2 Acceptance Test Samples

Acceptance test samples shall consist of not less than 10 ft (3 m) of epoxy from each lot. A lot shall consist of all epoxy from the same production run offered for inspection at the same time.

## 4.3 TEST PROCEDURES

### 4.3.1 Visual Inspection

Visually examine the test specimens for color, uniformity, and the absence of air pockets, foreign particles or other contaminants.

### 4.3.2 Adhesive Peel Strength

Adhesive peel strength is determined by a test procedure described in greater detail in ASTM D 2671 with surface preparation methods based on ASTM D 2093 and ASTM D 2651. In this procedure, an inner and outer substrate of specified materials are bonded together and peel strength is determined in a tensile tester.

#### 4.3.2.1 Tubing or Molded Component to Aluminum

##### 4.3.2.1.1 Substrate Preparation

Abrade the outer surface of a 12 inch length of 1-inch (25-mm) diameter aluminum pipe with a wire brush or dry sandblast and wipe with a lint-free cloth or paper towel moistened with isopropanol (IPA).

Select three sections of 1-1/2 inch (38 mm) Thermofit® tubing or three uniform tubular sections of Thermofit® Molded Components with an expanded internal diameter approximately 1-1/2 inches (38 mm) and a recovered internal diameter of 3/4 inches (19 mm) or less. Cut these sections to a width of 2.5 inches (60 mm) and prepare the inner surface by abrading with a Number 320 Emery cloth followed by wiping with a lint-free cloth or paper towel moistened with isopropanol (IPA).

##### 4.3.2.1.2 Bonding Procedure

Wrap one layer of the S-1255-04 adhesive tape around the inner substrate. Place a 3/4-inch (19-mm) wide piece of masking tape lengthwise to 1) hold the adhesive in place and 2) provide unbonded ends from the outer substrate to insert into a tensile tester.

Place the tubing or molded component substrates over the adhesive-coated inner substrate and rapidly recover with a heat gun in accordance with the applicable installation instructions. Finally, heat in an air circulating oven at 150+5°C (302 + 9°F) for 50 minutes.

#### 4.3.2.1.3 Tensile Testing

After cooling to ambient temperature, cut each of the three bonded outer substrates radially into 1-inch (25-*mm*) wide strips. Then cut each strip axially along the edge of the masking tape to free an unbonded end for rolling drum peel tensile testing.

Test at a jaw separation speed of 2 inches (50 *mm*) per minute. Take peel strength readings at every 1/2-inch (13-*mm*) of incremental jaw separation after 1-inch (25-*mm*) initial separation. Record the average peel strength for each specimen from the first four readings. Report the average peel strength from five specimens as the sample peel strength value.

Additional detail on specimen geometries, tensile test fixtures and calculations is contained in ASTM D 2671.

#### 4.3.2.2 Molded Component to Tubing

##### 4.3.2.2.1 Substrate Preparation

Heat recover a 2.5" length of 1-1/2-inch (38-*mm*) inside diameter Thermofit® tubing onto a metal tube 1 inch in diameter. This recovery requires the application of heat in excess of 250°C (482°F) and can be accomplished with the heat gun described in section 4.3.2.1.2 or an oven.

Allow the recovered tubing to cool to room temperature and prepare the outer surface as described in 4.3.2.1.1.

##### 4.3.2.2.2 Bonding Procedure

Follow the bonding procedure described in Section 4.3.2.1.2 recovering the Thermofit® molded component onto adhesive-wrapped tubing.

##### 4.3.2.2.3 Tensile Testing

Cool the assembly to room temperature and cut lengthwise along one edge of the masking tape to remove the bonded assembly from the mandrel. Cut a 1-inch (25-*mm*) wide specimen suitable for T-peel testing from the center of each double thickness.

Insert the two unbonded ends in the tensile tester, and perform the remainder of the procedure as described in Section 4.3.2.1.3.

#### 4.3.3 Volume Resistivity

Place two 5 x 5 - inch ( 127x 127 mm) sections of 20 mil thick adhesive between two Teflon®\*-based sheets 5 x 5 inch (127 x 127 mm) and seal edges with Teflon tape. Place the assembly between two 5 x 5 - inch (127 x 127 mm) metal plates and cure the assembly for 50 minutes at 150+5°C (302+9°F) in a vacuum oven. Test for volume resistivity in accordance with ASTM D 257.

#### 4.3.4 Copper Contact Corrosion

Individually test three 0.75” x 2.0” specimens cut from the adhesive tape in the thickness supplied for corrosive effect in accordance with ASTM D 2671, Procedure B (Copper contact and Stability ). Prepare three copper plates 1” long x 3 “ wide with a minimum thickness of 0.050 “. Clean and prepare the plate surface in accordance with ASTM D2671. Lay the adhesive specimens on top of the copper plates and cure in an air circulating oven at 150°C for 40 minutes. Condition these specimens for 24 hours at 23°C and 95% humidity. Perform aging on the specimens for 16 hours at 200°C +/-2C (392°F). Remove the specimens from the oven and allow to cool for 4 hours at room temperature. Remove the adhesive from the copper plate and inspect for pitting and blackening of the copper in accordance with paragraph 93.2.3 of ASTM D2671.

#### 4.3.5 Water Absorption

Prepare three 3 x 0.75 x 0.020 inch (75 x 20 x 0.5 mm)strips and condition them as in Para. 4.3.3.. Test for water absorption in accordance with ASTM D 570 at the condition specified in Table 1. Report the average of the three specimens.

#### 4.3.6 Fluid Resistance

The solvent and fluid resistance of the epoxy shall be determined in accordance with ASTM D2671, Procedure 1. The test specimens shall be 1x 0.75x 0.050 +/-0.005 inches. The specimen shall be cut from a spool of finished product and pressed to form the test piece. Each specimen shall be conditioned as in Para. 4.3.3 for 40 minutes at 150°C (302F ). The immersion time shall be 24 hours at the specified temperature. Results shall be reported as a % weight change and significant change of appearance shall be noted.

#### 4.3.7 Rejection and Retest

Failure of any specimen of adhesive to comply with any one of the requirements of this specification shall be cause for rejection of the lot represented. Adhesive which has been rejected may be replaced or reworked to correct the defect and then resubmitted for acceptance.

### 5. **PREPARATION FOR DELIVERY**

#### 5.1 **PACKAGING**

Unless otherwise specified, the adhesive shall be packaged on rolls in sealed packages with a desiccant.

#### 5.2 **MARKING**

Each carton of adhesive, shall be identified with the manufacturer's name or symbol, the product number, the lot number, use before date and other appropriate information.

\*Teflon is a registered trademark of DuPont Corporation

**TABLE 1**  
**Requirements**

PROPERTY	UNIT	REQUIREMENT	TEST METHOD
<b>PHYSICAL</b>			
Visual Appearance		Homogeneous, no foreign particles or contaminants	Section 4.3.1
Color as supplied		Black	
Adhesive Peel Strength at $23 \pm 3^{\circ}\text{C}$ ( $73 \pm 5^{\circ}\text{F}$ ) RT-1330 boot (-55) to aluminum RT-1330 boot (-55) to stainless steel (316) RT-1330 boot (-55) to RT-555 tubing RT-1334 (NSM trans.) to RT-555 tubing	pli ( <i>N/cm</i> )	15 minimum (26)	Section 4.3.2 ASTM D 2671
Viton Boot (-12) to Viton tubing Viton Boot (-12) to Aluminum Viton Boot (-12) to stainless steel (316) VPB Boot (-50) to VPB tubing VPB Boot (-50) to Aluminum			
Specific Gravity		1.50 maximum	ASTM D792
<b>ELECTRICAL</b>			
Volume Resistivity	ohm-cm	$1 \times 10^{11}$ minimum	Section 4.3.3 ASTM D 2671
<b>CHEMICAL</b>			
Corrosive Effect (Copper Contact) 16 hours at $200 \pm 5^{\circ}\text{C}$ ( $392 \pm 9^{\circ}\text{F}$ )	percent	No pitting or blackening of the copper.	Section 93.2, Proc. B, ASTM D 2671
Water Absorption 24 hours at $23 \pm 3^{\circ}\text{C}$ ( $73 \pm 5^{\circ}\text{F}$ )	percent	5 maximum	Section 4.3.5 ASTM D570
Fungus Resistance	---	Rating of 1 or less	ASTM G 21
Fluid Resistance 24 hours at $23 \pm 3^{\circ}\text{C}$ ( $73 \pm 5^{\circ}\text{F}$ ) in: Followed by test for weight change	---	---	Section 4.3.6
JP-5 Jet Fuel	% maximum	5	
Gasoline, Aviation Grade 100 (ASTM D 910)		5	
Kerosene		5	
Heptane		5	
Coolanol* 25		5	
Cleaning Compound (PC-437)		5	
Hydraulic Fluid (MIL-H-5606)		5	
Lubricating Oil (MIL-L-7808)		5	
Transformer Oil		5	

\* Trademark of the Monsanto Company