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RB 107 Specification
DuraSeal Splices

1.0 Introduction

1.1 Scope

This specification covers a series of one-piece pre-insulated crimp splices having a heat-shrinkable sleeve lined with a meltable adhesive coating.

1.2 Classification

The Duraseal Device shall be as specified in the applicable Raychem Specification Control Drawing (SCD).

1.3 Temperature Rating The continuous operating temperature range shall be from -67°F to 257°F (-55°C to 125°C).

2.0 Applicable Documents

The latest issue of those specifications and standards referenced below or in the applicable Raychem SCD shall form part of this document to the extent specified.

Furnished Documents

ASTM D-471	Standard Test Method for Rubber Property- Effect of Liquids
ASTM B-187	Standard Specification for Copper Rods, Bars and Shapes
P-D-410	Detergent, synthetic, anionic (Alkyl Benzene Sulfonate)
MIL-STD-129	Marking for Shipment and Storage
MIL-STD-202	Test Methods for Electronics and Electrical Components Parts
ANSI/ASQC Z1.4-1993	Sampling Procedures and Tables for Inspection by Attributes
SAE-J-1128	Low Tension Primary Cable, Standard

3.0 Requirements

3.1 Detail Requirements

Detail requirements or exceptions applicable to a particular style of Duraseal splice shall be as specified on the applicable Raychem SCD. In the event of any conflict between requirements of this specification and the SCD, the latter shall take precedence.

3.2 Qualification

A DuraSeal splice furnished under this specification shall be one which has passed, or is a minor modification of a part which has passed, the qualification test specified herein or on the applicable Raychem SCD. A minor modification shall be one which uses the same materials as the qualified part in a different size.

3.3 Material
The material used in the construction of a Duraseal Splice shall be as specified on the applicable SCD and shall meet the requirements set forth herein.

3.3.1 Insulation Sleeve
The insulation sleeve shall be a tubing of the type and color specified in the applicable SCD and shall be free from functional defects.

3.3.2 Metals
The metal crimp splice shall be fabricated from copper conforming to ASTM B-187.

3.3.3 Plating
Unless otherwise specified, the metal crimp splice shall be tin-plated ETP copper.

3.3.4 Sealing Material
The sealing material shall be a thermally stabilized thermoplastic, homogenous and essentially free from flaws, defects, pinholes, seams, cracks and inclusions. The material shall have a melt viscosity suitable to meet the performance requirements when using the recommended installation tooling.

3.4 Design and Construction.
The splice shall consist of a metal crimp, insulated with pre-installed sealing sleeve. The splice shall conform an all respects to the design, dimension and construction specified herein and on the applicable SCD. Each splice size shall be designed for attachment to the wire size range specified on the applicable SCD by having the metal crimp splice reshaped around the conductor and the sealing sleeve recovered over the splice assembly. It shall be possible to perform these operations by means of tooling as specified on the applicable SCD. The splice shall be capable of being crimped in any radial plane and shall exhibit no evidence of fracturing, spalling, or protruding sharp edges as a result of the reshaping operation.

3.4.1 Wire Acceptance
Each size splice shall be designed for attachment to the conductor diameter range specified on the applicable specification sheet. The wire insertion shall be facilitated by a bell mount or chamfer on the metal crimp barrel.

3.4.2 Insulation
The sealing sleeve shall exhibit no evidence of splitting or cracking as a result of crimping or heating.

3.5 Performance
The splice shall conform to the following requirements:

3.5.1 Sealing Sleeve
The sealing sleeve component of the splice assembly shall conform to the dimensions of the applicable SCD.

3.5.2 Splice Assemblies
The splice assemblies shall conform to the following requirements when attached to each of the specified wire sizes with the applicable tooling specified (see 3.4). Maximum tensile values will be attained with a controlled action (ratchet-type) crimping tool.

3.5.2.1 Voltage Drop
The millivolt drop across the splice shall no exceed the millivolt drop of an equivalent length of wire by more than the value specified in Table I (see 4.8.1).

3.5.2.2 Room Temperature Flex Test
A room temperature flex test is included in the sequence to ensure that the splice will remain sealed when the harness encounters bending such as in packaging or routing through the vehicle.

3.5.2.3 Insulation Resistance
The insulation resistance shall be not less than 1000 Mega ohms (see 4.8.3.).

3.5.2.4 Dielectric Withstanding Voltage
The splice shall show no sign of evidence of damage, arcing, or breakdown and the leakage current shall be less than that 2 milliamperes (see 4.8.4).

3.5.2.5 Tensile Strength
The wire shall not break or separate from the splice to which it is attached, nor shall the splice break, before the minimum tensile strength specified in Table I is reached (see 4.8.5).

TABLE I. TEST REQUIREMENTS

A) Metric System

Wire section nominal mm^2	Test current (Amperes)	Tensile strength Pounds minimum	Tensile strength Newton minimum	Maximum voltage drop (mV) millivolt drop of equivalent length of wire plus	
				Initial	After test
0.25	3	12	55	2	4
0.35	4.5	15	70	2	4
0.50	9	18	80	2	4
0.75	11	27	120	2	4
1.00	16	36	160	2	4
1.50	22	45	200	2	4
2.50	32	56	250	2	4
4.00	41	79	350	2	4
6.00	50	112	500	2	4

B) AWG System

Wire Gauge AWG	Test current (Amperes)	Tensile strength Pounds minimum	Tensile strength Newton minimum	Maximum voltage drop (mV) millivolt drop of equivalent length of wire plus	
				Initial	After test
26	3	7	31	2	4
24	4.5	10	45	2	4
22	9	14	61	2	4
20	11	22	99	2	4
18	16	35	154	2	4
16	22	40	178	2	4
14	32	44	195	2	4
12	41	63	282	2	4
10	50	84	374	2	4

3.5.2.6 Environmental Conditioning
Splice assemblies shall meet the applicable performance requirements listed, when tested in groups and sequences shown in Table III. Discoloration of the sealing sleeve materials during these tests shall not be cause for rejection (see 4.8.6).

3.5.2.7 Salt Spray (Corrosion)
Splice assemblies shall show no evidence of exposure of the base metal or blistering of the plated surfaces. After salt spray, the voltage drop and tensile strength shall be in accordance withTable I. For voltage drop, the "after test" requirements shall apply.

3.5.2.8 Vibration
When tested according to the method specified in 4.8.6.5, there shall be no evidence of cracking, breaking, or loosing of the Duraseal splice assembly.

3.5.2.9 Cold Temperature Flex Test
A cold temperature flex test is included in the sequence to take into account the change in flexibility that may occur. A sealing material that becomes too brittle will crack and fail during the test.

3.5.2.10 Fluid Compatibility
Visually inspect for splice insulation integrity. The cross sectional dimensions of applied sealant may not increase by more than 50% due to swell.

3.6 Identification of Product
The splice shall be color coded in accordance with the applicable SCD for identification purposes.

3.7 Workmanship
The metal crimp splice shall be free from blistering, pitting, or peeling of plating, cracks, or other defects which may affect serviceability. Slight burr is permitted on parted surfaces. The metal crimp shall be held within the sleeve with sufficient force to withstand dislodging during normal installation.

4.0 Quality Assurance Provisions

4.1 Responsibility for Inspection
Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as stated. Except as otherwise specified, the supplier may utilize his own facilities or any other commercial laboratory.

4.2 Classification of Inspection
The examination and testing of Duraseal splices shall be classified as follows: Component-Materials inspection (see 4.3) Qualification inspection (see 4.5) Quality conformance inspection (see 4.6)

4.3 Component-Materials Inspection

Component-materials inspection shall consists of verification that the component materials listed in Table II used in fabricating the splices are in accordance with the applicable specifications or requirements prior to such fabrication.

TABLE II. COMPONENTS-MATERIALS INSPECTION

Component Material	Requirement Paragraph	Applicable Specification or Requirement
Metals	3.3.2, 3.3.3	ASTM B-187, ASTM B-545
Insulation Sleeve	3.3.1	As listed
Sealing Inserts	3.3.4	As listed

4.4 Inspection Conditions
Unless otherwise specified herein, all inspections shall be made at ambient temperature, and humidity as specified in the general requirements of MIL-STD-202.

4.4.1 Assembly to Conductors
The splices shall be attached to wire conforming to SAE J1128 SXL, having a temperature rating of 125°C, by the testing activity using the specified tooling(see 3.4). The test specimens shall be one to one inline splices made in accordance with the specified assembly technique. This specified number of sample units for testing shall be selected and divided between the minimum and maximum wire size within the wire range listed on the applicable SCD for he size to be qualified. Unless otherwise specified, the leads shall be at least 12 inches in length.

4.4.2 Temperature Stabilization
Voltage drop measurements shall be made after the temperature of the wire has stabilized. Temperature stabilization shall be determined by three consecutive readings with 1°C at intervals of 3 minutes each. All tests performed after exposure to high or low temperature shall be conducted afterthe splices have been conditioned for at least one hour at the inspection conditions specified (see 4.4).

4.4.3 Water Bath
Unless otherwise specified in the applicable test method, a water bath containing 0.5% of an anionic wetting agent (P-D-410) and 5.0% sodium chloride shall be used whenever immersion is specified. Free ends of the leads shall be a minimum of 4 inches from the top surface of the water.

4.5 Qualification Inspection

4.5.1 Sample
24 splices for each size of each specification sheet (see 3.1) for which qualification is sought shall be submitted for qualification testing.

4.5.2 Test Routine
Sample units shall be subjected to the qualification inspection specified in Table III in the order shown. All sample units shall be subjected to the inspection of Group I .The samples shall then be divided into Groups II through V as shown in Table III and subjected to the inspection for their particular group.

4.5.3 Qualification Test Reports
The Qualification Test Report shall be forwarded to the activity requesting qualification.

4.5.4 Failures
Any failure shall be cause for refusal to grant qualification

4.5.5 Retention of Qualification
A Duraseal splice, once qualified under this specification, shall remain qualified as long as no significant change is made in the materials or design of the splice(see 6.3)

4.6 Quality Conformance Inspection

4.6.1 Inspection of Product for Delivery
Inspection of product for delivery shall consist of visual and dimensional examination.

4.6.1.1 Inspection Lot
An inspection lot, as far as is practical, shall consist of all Duraseal splices of a single size and type, manufactured under essentially the same conditions and offered for inspection at one time.

4.6.1.2 Sampling Plan

Quality conformance sampling shall be in accordance with ANSI/ASQC Z1.4 for normal inspection. The inspection level shall be Level I and the acceptable quality level (AQL) shall be 4.0 for all defects.

4.6.1.3 Non-conforming Lots

Disposition of non-conforming lots shall be in accordance with ANSI/ASQC Z1.4.

4.7 Examination

4.7.1 Duraseal Splice, Uninstalled

The splice shall be examined to verify that the materials design construction, and physical dimensions are in accordance with the applicable SCD.

4.7.2 Visual Examination of Assemblies

Each assembly shall be examined to check that the crimping of the splice has been achieved without damage to the insulation sleeve and that the desired degree of shrinkage of the tubing has been obtained.

4.8 Test Methods, Assemblies

TABLE III: QUALIFICATION INSPECTION

Examination or Test Group	Requirement Paragraph	Method Paragraph
GROUP I		
24 uninstalled splices		
Visual and dimensional examination	3.4	4.7.1
GROUP II		
24 splice assemblies		
(from Group I)		
Visual examination		4.7.2
Insulation resistance	3.5.2.3	4.8.3
GROUP III		
4 splice assemblies		
(from Group II)		
Dielectric withstanding voltage	3.5.2.4	4.8.4
Voltage drop initial	3.5.2.1	4.8.1
Tensile strength	3.5.2.5	4.8.5
GROUP IV		
4 splice assemblies		
(from Group II)		
Salt spray (Corrosion)	3.5.2.7	4.8.6.6
Voltage drop (after test)	3.5.2.1	4.8.1
Tensile strength	3.5.2.5	4.8.5
GROUP V		
12 splice assemblies		
(from Group II)		
Environmental conditioning		
Room temperature flex test	3.5.2.2	4.8.2
Heat ageing		4.8.6.1
Thermal shock	3.5.2.6	4.8.6.2
Temperature humidity cycling	3.5.2.6	4.8.6.3
Vibration	3.5.2.8	4.8.6.5
Old flexion	3.5.2.9	4.8.2.1
Fluid compatibility	3.5.2.10	4.8.6.4
Insulation resistance	3.5.2.3	4.8.3
Dielectric withstanding voltage	3.5.2.4	4.8.4
Tensile strength	3.5.2.5	4.8.5
GROUP VI		
4 splice assemblies		
(from Group II)		
Immersion	3.5.2.6	4.8.6.7
Insulation resistance	3.5.2.3	4.8.3

4.8.1 Voltage Drop

Splices shall be tested as follows:
Test points: Measurements shall be made by puncturing the insulation of the current carrying conductor on each end of splice 1/16 inch back from the ends of the sealing sleeve.

The distance between the two test points shall be noted. Measurement of the current carrying conductor shall be made by puncturing the conductor insulation the same distance between test points as that noted for the splice measurement. The millivolt drop of the equivalent length of wire may be determined by averaging four readings taken on 10 inch lengths of wire selected at random throughout the supply of wire to be used for subsequent tests.

Measurements: The millivolt drop through the crimp termination and the current carrying conductor shall be measured while the specified test current (see Table I) is being applied, and after the temperature of the wire has stabilized. (see 4.4.2)

4.8.2 Flex Test

While at room temperature warp samples around a 2 inch diameter mandrel, bending clockwise. Wrap each sample 5 times in each direction.

4.8.2.1 Cold Flex Test

Wrap each sample around a four inch mandrel and place samples in a clod chamber at –10°C for a period of three

4.8.3 Insulation Resistance

Splices shall be tested in accordance with Method 302 of MIL-STD-202. The flowing details shall apply:

Test condition: A
Conditioning of splices: Splices shall be immersed as specified for at least 1 hour (see 4.4.3) Points of measurement: Between splice leads and water bath.Electrification time: 1 minute.

4.8.4 Dielectric Withstanding Voltage

Splices shall be tested in accordance with Method 301 of MIL-STD-202. The following details shall apply:

Conditioning of splices: Splices shall be immersed as specified (see 4.4.3) Magnitude and nature of potential: 2500 VAC (RMS) Points of measurement: Between splice leads and water bath.

4.8.5 Tensile Strength
The splice shall be placed in a standard tensile-testing machine so that the splice is centered between, and at least 3 inches from the jaws. Sufficient force shall be applied to pull the wire out of the splice or break the wire or the splice. The travel speed of the head shall be 1inch per minute. The clamping surfaces of the jaws may be serrated to provide sufficient force.

4.8.6 Environmental Conditioning
The splice shall be exposed to each condition in the sequence shown in Table III.

4.8.6.1 Heat Ageing
The specimens shall be conditioned in an air circulatory oven at the maximum operating temperature for 168 hours.

4.8.6.2 Thermal Shock
The splices shall be tested in accordance with Method 107, Test condition F of MIL-STD-202. The samples shall be heated to 125°C for ½ hour, followed by -55°C for ½ hour. This will constitute one cycle. The samples shall be submitted to five cycles in total.

4.8.6.3 Temperature Humidity Cycling
The splices shall be tested in accordance with Method 106 of MIL-STD-202 except subcycle 7b shall not be required.

4.8.6.4 Fluid Compatibility
Test 12 samples, 3 in each fluid. Immerse samples for 3 seconds in each fluid at intervals of 30 minutes for 24 hours at 23±3°C to simulate a splash environment. Allow samples to drain between immersions.
Use the following fluids:

ASTM D-471 Fuel C
- Diesel fuel
- SAE J 1703 Brake fluid
- Gunk brand (engine degreaser)

4.8.6.5 Vibration
The splices shall be vibrated in accordance with Method 201A of MIL-STD-202F for 2 hours on each of two axes mutually perpendicular to each other and to the axis of the wire.

4.8.6.6 Salt Spray (Corrosion)
The salt spray test shall be in accordance with Method 101, Test condition B of MIL-STD-202. Splices shall be crimped to 12 inch minimum lengths of wire. Adjoining samples shall be separated by at least ¼ inch. During this test, the samples shall not come in contact with wooden or metallic objects, and the salt spray solution shall be a salt solution concentration of 5% and shall have free access to the samples. The samples shall be removed from the salt spray, washed with distilled water and air dried.

4.8.6.7 Immersion
The splices shall be tested in accordance with Method 104, Test condition C of MIL-STD-202.

5.0 Preparation for Delivery

5.1 Packaging and Packing
Duraseal splices shall be packaged and packed in accordance with standard commercial practices.

5.2 Marking
Packages shall be identified in accordance with MIL-STD-129 with the following information:

- Raychem part number
- Lot control number
- Quantity

6.0 Notes

6.1 Intended Use
Splices covered by this specification are for use in making one-to-one environmentally protected permanent joints on conductors falling within the size range listed on the applicable SCD having insulations compatible with the sealing material. They may be used in applications where the total temperature of the wire insulation does not exceed 125°C.

6.2 Ordering Data
Procurement documents should specify:

- Raychem part number
- Quantity
- Any special marking or packaging requirements

6.3 Design Modification

Raychem reserves the right to make minor product design modifications which do not affect the from, fit, or primary function of a Duraseal splice as measured by his specification and the appropriate SCD, without notification.

6.4 Storage Recommendations

Raychem Duraseal splices may be stored for a period of up to 5 years after the date of manufacture indicated on the label, provided the following conditions are satisfied:

- The products should be kept, unopened, in their original packages.
- Recommended storage temperatures should not exceed +50°C, nor fall below +5°C; relative humidity should not exceed 80%.

If storage exceeds 5 years, or storage conditions are not as described above, the user should carry out tests on installed products to ensure joints have acceptable mechanical and electrical characteristics. Note, application of the product should always conform with Raychem Selection Guide and installation with the recommended installation procedures.