Sealed In-Line Miniseal Splices

1.0 INTRODUCTION

1.1 Scope

This specification covers a series of sealed in-lines crimp splice having a heat-shrinkable tubing sleeve with a meltable adhesive ring.

1.2 Classification

The Miniseal Device shall be as specified in the applicable TE Customer Drawing (CD).

1.3 Temperature Rating

The continuous operating temperature range shall be from -55°C to either 150 °C or 200 °C (-67°F to either 302 °F or 392°F).

2.0 APPLICABLE DOCUMENTS

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

Furnished Documents

SAE AS81824	Splice, Electric, Crimp, Copper, Environment Resistant
MIL-STD-202	Test Methods for Electronics and Electrical Components Parts
ASTM B545	Tin, Electrodeposited Coatings
ASTM B75/B75M	Tube, Seamless Copper
AMS-QQ-N-290	Nickel Plating (Electrodeposited)
P-D-410	Detergent, synthetic, anionic (Alkyl Benzene Sulfonate)
AS22759	Wire, Electrical, Fluoropolymer-insulated, copper alloy
ANSI/ASQC Z1.4-1993	Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-129	Marking for Shipment and Storage

3.0 REQUIREMENTS

3.1 Detail Requirements

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

3.2 Qualification

A Miniseal 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 TE CD. A minor modification shall be one which uses the same materials as the qualified part in a different size.

| Indicates Change

3.3 Material

The material used in the construction of a Miniseal Splice shall be as specified on the applicable CD 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 CD and shall be free from functional defects.

3.3.2 Metals

The metal crimp splice shall be copper alloy 101,102 or conforming to ASTM B-75.

3.3.3 Plating

Unless otherwise specified, the metal crimp splice shall be tin-plated per ASTM B545 or nickel plated per SAE AMS-QQ-N-290.

3.3.4 Sealing Material

The sealing material shall be immersion resistance 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 sleeve, and a sealing rings. The splice shall conform an all respects to the design, dimension and construction specified herein and on the applicable CD. Each splice size shall be designed for attachment to the wire size range specified on the applicable CD by having the metal crimp splice reshaped around the conductor and the insulation sleeve with a sealings rings recovered over the splice assembly. It shall be possible to perform these operations by means of tooling as specified on the applicable CD. The splice shall be capable of being crimped in any radial plane and shall exhibit no evidence of fracturing, spalling, or protruding sharp edges because 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 customer drawing (CD) 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 CD.

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 Copper Mirror Corrosion

Unless otherwise specified in detail specification, the sealing sleeve component shall show no corrosion on the copper mirror.

3.5.2.2 Sleeve without adhesive Unrestricted Recovery

The sleeve shall be in accordance with the unsupported sleeve or manual supported requirement.

a. Unsupported sleeve requirement: The maximum ID dimension of the sleeving shall be considered acceptable when the wall of the sleeving is expanded by the insertion of the gage rod, when there is no visible air space between the end of the sleeving and the rod, or when the gage rod cannot be inserted in the sleeving.
b. Manual supported sleeve requirement: The maximum ID dimension of the sleeving shall be considered acceptance only if the sleeving is snug on the mandrel and there is no air space between the mandrel and the sleeving.

3.5.2.3 Sleeve Longitudinal Change

The longitudinal change shall be within +5% and -15% after unrestricted recovery

3.5.2.4 Voltage Drop

The millivolt drop across the splice shall not exceed the millivolt drop of an equivalent length of wire by more than the value specified in Table I (see 4.8.1).

3.5.2.5 Insulation Resistance

The insulation resistance shall be not less than 5000 Mega ohms (see 4.8.3.).

3.5.2.6 Dielectric Withstanding Voltage

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

3.5.2.7 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

Wire Gauge (AWG)	Test current (Amperes)	Tensile strength Pounds (minimum)	Maximum voltage drops (mV) millivolt drop of equivalent length of wire plus	
			Initial	After test
26	3	7	2	4
24	4.5	10	2	4
22	9	15	2	4
20	11	19	2	4
18	16	38	2	4
16	22	50	2	4
14	32	70	2	4
12	41	110	2	4

3.5.2.8 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).

3.5.2.9 Immersion

Splice assemblies shall be tested in accordance with Method 104, test condition C, of MIL-STD-202

3.5.2.10 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 Miniseal splice assembly.

3.5.2.11 Flammability

The splice shall be self-extinguishing within 5 seconds after removal from the flame.

3.6 Identification of Product

The crimp barrel shall be stamp marked with XX on the back of the inspection window. Sealing rings be color coded in accordance with the applicable CD 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.

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 Miniseal 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 consist 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	Copper alloy or ASTM B-75
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 M22759/XX, having a temperature rating at least 135°C, by the testing activity using the specified tooling (see 3.4). The test specimens shall be splice 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 CD for he sizes to be qualified. Unless otherwise specified, the wires 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 after the 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 VIII as shown in Table III and subjected to the inspection for their 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 Miniseal 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 Miniseal 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 Visual and Dimensional Examination

The splice shall be examined to verify that the materials design construction, identification of splice, workmanship, and physical dimension are in accordance with the specification and the applicable detail specification. Dimension shall conform to the applicable detail specification.

Visual Examination

a. Dimension (as specified in CD); Dimension shall be measured with calibrated micrometers using standard laboratory methodology.

b. Identification of splice: Visually examine for color coding.

c. Workmanship: Visually examined with a 3X microscope for pitting, blistering. or peeling of plating, cracks, and other defect which may affect serviceability.

4.7.2 Unrestricted Recovery

a. Unsupported Method: Lay a 6-inch length of the splice sleeving material specified in the detail specification on a tray in an oven at the temperature and for the time specified in the AS23053 detail specification sheet defining that material. If sleeving is not defined by AS23053, refer to detailed specification for testing details. If the sleeving becomes tacky in the oven, a small amount of powdered talc may be used on the tray. Select a smooth gage rod that has a diameter equal (-0, +0.002 inch, or 2%, whichever is less) to the maximum acceptance sleeving ID after unrestricted shrinkage. The maximum ID dimension of the sleeving shall be considered acceptable when the wall of the sleeving is expanded by insertion of the gage rod, when there is no visible space between the end of the sleeving and the rod, or when the gage rod cannot be inserted in the sleeving.

b. Manual Supported method: Select a smooth, clean, metallic mandrel that has a diameter equal to the maximum acceptance sleeving ID (after unrestricted shrinkage) minus 0, plus 0.002 inch or 2%, whichever is less. Slip a 6-inch length of sleeving material specified in the detail specification sheet on the mandrel and heat in an oven at the temperature end for the time specified in the applicable AS23053 detail specification sheet defining that material.

4.7.3 Longitudinal Change

The longitudinal change of the AS23053 sleeving material specified in the detail sheet shall be determined in accordance with ASTM D2673, by measuring in the “as supplied” condition and after the unrestricted shrinkage specified in 4.7.2. If sleeving is not defined by AS23053, refer to detailed specification for testing details.

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	3.5.1	4.7.1
GROUP II (4 uninstalled sealing sleeve)		
Unrestricted Recovery	3.5.2.2	4.7.2
Longitudinal change	3.5.2.3	4.7.3
GROUP III (2 uninstalled sealing sleeve)		
Copper Mirror Corrosion	3.5.2.1	4.9.10
GROUP IV (4 splice assembly)		
Voltage Drop (initial)	3.5.2.4	4.8.1
Current Cycling	---	4.9.1
Voltage Drop	3.5.2.4	4.8.1
GROUP V (4 splice assemblies)		
Environmental conditioning		
Altitude Immersion (3 Cycles)	3.5.2.8	4.9.7
Insulation Resistance	3.5.2.5	4.8.2
Immersion	3.5.2.9	4.9.8
Insulation Resistance	3.5.2.5	4.8.2
Thermal Shock	3.5.2.8	4.9.3
Insulation Resistance	3.5.2.5	4.8.2
Temperature humidity cycling	3.5.2.8	4.9.4
Insulation Resistance	3.5.2.5	4.8.2
Vibration	3.5.2.10	4.9.6
Insulation Resistance	3.5.2.5	4.8.2
Dielectric Withstanding Voltage	3.5.2.6	4.8.3
Tensile strength	3.5.2.7	4.8.4
GROUP VI (4 splice assemblies)		
Insulation Resistance	3.5.2.5	4.8.2
Heat Ageing	3.5.2.8	4.9.2
Insulation resistance	3.5.2.5	4.8.2
GROUP VII (2 splice assemblies)		
Flammability	3.5.2.11	4.9.9
GROUP VIII (4 splice assemblies)		
Fluid Immersion	---	4.9.5
Insulation Resistance	3.5.2.5	4.8.2
Dielectric Withstanding Voltage	3.5.2.6	4.8.3

4.8.1 Voltage Drop

Splices shall be tested as follows:

a. Single Wire Splice Voltage Drop Test (the same wire size): 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)

b. Multiple Wire Splice Voltage Drop Test (various wire size) The required reference voltage drop shall be determined by averaging four specimen of applicable combination wires with soldered crimp splice using an appropriate solder and flux, The reference millivolt measurement shall be made by puncturing the largest wire insulation on both sides of the crimp 1/16 inch back from the ends of the sealing sleeve.

4.8.2 Insulation Resistance

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

Test condition: B 500 Volts

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.

4.8.3 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.

4.8.4 Tensile Strength

a. 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.

b. Multiple Wire Splice (only wire size 26 and 24): The smallest wire on each shall be attached to opposing grip of the pull tester with the splice unattached in the approximate center and pulled with a head speed of 1.00 inch ± 0.25 inch per minute. Sufficient force shall be applied to pull one of the wires out of the splice or break one of the wires or break the splice. If the splice breaks, the tensile value for the smallest wire attached to the pull tester grips will apply.

c. Multiple Wire Splice (wire sizes larger than 24): Two specimens with the smallest wire on each side and two specimens with largest wire on each side shall be attached to opposing grips of the pull tester with the splice unattached in the approximate center and pulled with a head speed of 1.00 inch ± 0.25 inch per minute. Sufficient force shall be applied to pull one of the wires out of the splice or break one of the wires or break the splice. If the splice break, the tensile value for the smallest wire attached to the pull tester grips will apply.

4.9 Environmental Conditioning

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

4.9.1 Current Cycling

a. Single wire splice (same wire size): The test specimens shall be attached to 3 feet length of the largest accommodated wire then subjected to 50 current cycles. Each cycle shall consist of 30 minutes at 125% for the test current specified in Table I, followed by 15 minutes at no load. After the test assembly has returned to room temperature, the voltage drops shall be measured at test current specified in Table I.

b. Multiple wire splice (various): The test specimens shall be attached to 3 feet length of the largest accommodated single wire on one side and the maximum number of wires the splice will accommodate on the other side. This pattern shall alternate to connect the required number of specimens per Table III. The current for the maximum single wire as defined in Table I shall be applied for the number of cycles and duration defined for the single wire splice (see 4.8.2a) Voltage drop shall be measured for the largest wire and compared to the soldered equal configuration as describe for the multiple splice voltage drop test (see 4.8.1b)

4.9.2 Heat Ageing

The specimens shall be conditioned in an air circulatory oven at the maximum operating temperature for 750 hours.

4.9.3 Thermal Shock

The splices shall be tested in accordance with Method 107, Test condition F of MIL-STD-202. The samples shall be heated at the maximum operating temperature per applicable CD, followed by -55°C for ½ hour. This will constitute one cycle. The samples shall be submitted to five cycles in total.

4.9.4 Temperature Humidity Cycling

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

4.9.5 Fluid Compatibility

The splice shall be immersed in the fluids specified in Table II at the temperature and time listed. A separate splice shall be immersed in each of the required fluids.

Specimen Number	Test Fluid Specification	Test Conditions
1 2	MIL-L-7808 MIL-L-23699	a) Immerse for 5 minutes at 120 ± 3°C or at the maximum operating temperature of the SolderSleeve device or wire, whichever is lower. (b) Remove and allow to drain for 1 hour at 23 ± 5°C (c) Place in oven at rated temperature of device or wire, whichever is lower, for 22 hours, (d) Repeat a, b, and c for 7 cycles
3	MIL-H-5606	Same as MIL-L-7808, except 85 ± 3°C for step (a) and 104 ± 3°C for step (c).
4 5	AMS1424 MIL-PRF-87937 pH 10-12	Same as MIL-L-7808, except 65 ± 3°C for step (a).
6	MIL-T-5624 JP-5 or MIL-DTL-83133 JP-8	(a) Immerse at 23 ± 5°C for 20 hours. (b) Remove and allow to drain for 4 hours at 23 ± 5°C

4.9.6 Vibration

The splices shall be vibrated in accordance with Method 201A of MIL-STD-202F for 18 hours on each of two axes mutually perpendicular to each other and to the axis of the wire.

4.9.7 Altitude Immersion

The splice shall be immersed in a solution as specified (4.4.3) shall be placed in a suitable chamber; the free ends shall be within the chamber and shall not be sealed. The chamber pressure shall be reduced to 75,000 feet and maintained for 30 minutes. The specimens shall be bent at 90 degrees minimum of 2 inches away from the splice where the bent wire section) free ends) shall be placed along the side wall of the vessel. The chamber shall then be returned to ambient pressure. This shall constitute 1 cycle. A total of three cycles shall be run.

4.9.8 Immersion

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

4.9.9 Flammability

The splice shall be suspended horizontally is a draft-free enclosure above a Bunsen burner. The tip of a 1-inch natural gas flame with an inner core 1/3 its height shall be applied to the end of the sealing sleeve for a period of 20 seconds. The Bunsen burner shall have a ¼ inch inlet, a nominal bore of 3/8 inch, and a length of approximately 4 inches above the primary inlets.

4.9.10 Copper Mirror Corrosion

Corrosive Effect: (16 ± 0.5 hours at 175° ± 3°C) - Two recovered (after shrinking) terminal caps shall be placed in the bottom of each of two clean 1/2” X 12 test tubes. A third tube shall be used for control. A copper—glass mirror about 1” X 1/4” shall be suspended from 6 to 7 inches above the bottom of each tube by fine copper wire attached to a cork wrapped in aluminum foil. The corks shall tightly seal the test tubes. The lower 2 inches of each tube shall then be placed in an oven or oil bath at the temperature specified. The temperature of that portion of the test tube containing the copper mirror shall be maintained between 40°C and 60°C. After cooling, the mirrors shall be examined in good light against a white background. Evidence of corrosion shall be the removal of copper from a mirror, leaving an area of transparency greater than 10% of its total area and shall be cause for rejection. Discoloration of the copper film or reduction of its thickness shall not be considered corrosion. The mirror shall be vacuum deposited copper with a thickness equal to 10% ± 5% transmission of normal incident light of 5000 angstroms. They shall be stored in a vacuum and shall only be used for test if no oxide film is present, and the copper is not visibly damaged.

5.0 PREPARATION FOR DELIVERY

5.1 Packaging and Packing

Miniseal 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-line crimp splice making environmentally protected permanent joints on conductors falling within the size range listed on the applicable CD having insulations compatible with the sealing material. They may be used in applications where the total temperature of the wire insulation does not exceed CD requirement.

6.2 Ordering Data

Procurement documents should specify:

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

6.3 Design Modification

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

6.4 Storage Recommendations

TE Miniseal 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 TE Selection Guide and installation with the recommended installation procedures.