1.0 Introduction

1.1 Scope

This specification covers BNC and TNC connectors for splicing 50Ω and 75Ω transmission lines, or connecting them to electronic equipment. These connectors use a solder inside heat-shrinkable insulation technique to terminate the center conductor and shield of a coaxial cable.

1.2 Classification

The connector shall be as specified in the applicable Specification Control Drawing (SCD) and all mechanical, electrical and radiofrequency performance shall be in accordance with requirements described herein in paragraph 3.6.

1.3 Part Numbers

Part numbers shall have the following general configuration:

R x D - yy - z - ww

Where:

Interface :	**x**	=	B	for BNC interface
		=	T	for TNC interface
Impedance:	**yy**	=	50	for 50-ohm cable accommodation
		=	75	for 75-ohm cable accommodation
Size:	**z**	=	S	for small size cable accommodation
		=	M	for medium size cable accommodation
		=	L	for large size cable accommodation
Type:	**ww**	=	00	for straight plug
		=	01	for right angle plug
		=	02	for bulkhead jacket (jamnut)
		=	03	for straight jack (cable mount)
		=	04	for straight panel jacket (square flange)

Other part numbers shall be as defined on the relevant SCDs.

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2.0 Applicable Documents

2.1 Issues of Documents

The following documents, of the issue in effect on the date of order or request for proposal, form a part of this specification to the extent specified herein.

2.2 Referenced Documents

The following documents form part of this specification to the extent specified here:

MIL-F-14256F	Flux, soldering, liquid, paste flux, solder paste and solder paste flux (for electronic and electrical use), general specification for.
ISO 9453	Soft solder alloys (chemical compositions and forms).
MIL-I-23053D	Insulation sleeving, electrical, heat shrinkable, general specification for.
MIL-PRF-39012D	Performance specification - Connectors, coaxial, radio frequency - General Specification for
MIL-STD-105E	Sampling procedure and table for inspection by attributes.
MIL-STD-129L	Marking for shipment and storage.
MIL-STD-202F	Test methods for electronic and electrical component parts.
MIL-STD-348A	Radio frequency connector interfaces for MIL-PRF-39012D.

3.0 Requirements

3.1 Individual parts

The individual part detail requirements shall be as specified herein or in accordance with the applicable Specification Control Drawing (SCD). In the event of conflict between specifications, the following order of precedence shall apply:

* Raychem Specification Control Drawings

* This specification

* Referenced specifications and standard

3.2 Classification of requirements

Requirements are classified herein as follows:

Requirements	Paragraph
Qualification	3.3.
Material	3.4.
Design and construction	3.5.
Performance	3.6.
Marking	3.7.
Workmanship	3.8.

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3.3 Qualification

Connectors covered by this specification shall be products which have been tested and have passed the qualification test specified herein.

3.4 Material

All material used in the manufacturing of connectors shall be of the quality and form best suited for the intended purpose. Unless otherwise specified (see 3.1) materials shall conform to the following requirements.

3.4.1 Solder

The solder shall be in accordance with ISO 9453. The composition shall be as specified in the applicable specification sheet.

3.4.2 Flux

The flux shall be in accordance with MIL-F-14256F as specified in the applicable specification sheet.

3.4.3 Insulation sleeve

The insulation sleeve shall be a heat-shrinkable tubing of the type and color specified in the applicable specification sheet and free from functional defect.

3.4.4 SolderShield * device

The connection to the outer conductor consists of a braid impregnated with solder and flux as specified in the applicable specification sheet.

3.4.5 Finish

Unless otherwise specified (see 3.1) and in case of gold plating, the thickness shall be .0001 inch. Silver shall not be used for under plating. All other parts shall be finished so as to provide a connector which meets the corrosion requirement.

3.4.6 Dissimilar metals

Dissimilar metals shall not be placed in contact with each other.

3.5 Design and construction

The connector device shall conform in all respects to the design dimensions and construction specified in the applicable Specification Control Drawing.

3.6 Performance requirements

Connector and associated fittings shall conform to the requirements specified herein when tested in accordance with the procedure of paragraph 4.5.

3.6.1 Visual and mechanical examination

Connector and associated fittings shall be examined as described in 4.5.1 and shall meet the requirements indicated herein.

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3.6.2 Coupling and torque

When tested as specified in 4.5.2, the connector shall be easy to insert and the finger torque shall not exceed natural hand operation. In case of dispute regarding the manual coupling, the torque shall be lower than 2.5 inch-pounds.

3.6.3 Longitudinal force (mating characteristics)

When connectors are tested as specified in 4.5.3, the longitudinal force shall not exceed the specified value:

Insertion force: 20 Newton's maximum

Retention force: 2 Newton's minimum

3.6.4 Insulation resistance

When connectors are tested as specified in 4.5.4, the insulation resistance shall not be less than 5000 MΩ.

3.6.5 Center contact retention

When uncabled connectors are tested as specified in 4.5.5, the center contacts shall not be permanently displaced from the reference interface plan more than 10 µmeter when subjected to 26 Newton axial force.

3.6.6 Corrosion

When connectors are tested as specified in 4.5.6, there shall be no exposure of the base metal on the interface or mating surfaces, and they shall meet the requirements of 3.6.2.

3.6.7 Voltage standing wave ratio (VSWR)

Connectors shall be tested as specified in 4.5.7 on cables referenced in Table I with a characteristic impedance of 50 ohms. The minimum bandwidth that meets a maximum VSWR of 1.3 for each cable and connector type is 1 GHz.

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Table I: RF Performance

Coaxial cable	Connector Size	Connector Configuration
RG 316	S	Straight
		Right Angle
RG 142	M	Straight
		Right Angle
RG 58	M	Straight
		Right Angle
5021D1331	M	Straight
		Right Angle
RG 214	L	Straight
		Right Angle
5012M3612	L	Straight
		Right Angle

3.6.8 Connector durability

When connectors are tested as specified in 4.5.8, they shall show no evidence of severe mechanical damage and the coupling device shall remain functional without excess torque. The connectors shall meet the applicable requirements of 3.6.3 (longitudinal force).

3.6.9 Contact resistance

When connectors are tested as specified in 4.5.9, the electrical contact resistance values shall be lower than specified in table II below:

Table II: Maximum electrical contact resistance

	STRAIGHT CONNECTOR		RIGHT ANGLE CONNECTOR	
	INITIAL	AFTER COND	INITIAL	AFTER COND
Center contact	1.5 mΩ	2.0 mΩ	2.5 mΩ	3.0 mΩ
Outer contact	1.0 mΩ	Not applicable	1.5 mΩ	Not applicable
Braid to body	0.2 mΩ	Not applicable	0.2 mΩ	Not applicable

3.6.10 Dielectric withstanding voltage

When connectors are tested as specified in 4.5.10 under 1500 V rms test voltage, there shall be no evidence of breakdown or flashover.

3.6.11 Thermal shock

After testing as specified in 4.5.11 there shall be no evidence of visual mechanical damage to the connector.

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3.6.12 Cable retention force

When connectors are tested as specified in 4.5.12.1, under specified test load (see Table III), there shall be no evidence of mechanical failure, loosening parts or electrical discontinuities. The resistance continuity shall be monitored during tests shall not show abnormal permanent deviations.

Table III: Testing and breaking loads

Size S		Sizes M and L	
Test load (N)	Breaking load (N)	Test load (N)	Breaking load (N)
150	195	180	235

When connectors are tested in 4.5.12.2, the breaking load of the solder joint shall be at least 30 per cent above the test load value (see Table III) and there shall be no electrical discontinuity until the test load value is reached.

3.6.13 Vibration

When connectors are tested as specified in 4.5.13, there shall be no evidence of mechanical failure or loosening of parts and no electrical discontinuities exceeding 1 µsecond. Monitoring on outer contacts is not be required if test support and test samples are connected in common grounding mode.

3.6.14 Mechanical shocks

When connectors are tested as specified in 4.5.14, there shall be no evidence of mechanical failures or loosening of parts and no electrical discontinuities exceeding 1 µsecond. Monitoring on outer contacts is not be required if test support and test samples are connected in common grounding mode.

3.7 Marking and Identification

If specified, the connectors shall be permanently and legibly marked (Raychem part name or Customer references). The marking location is optional.

3.8 Workmanship

Connectors and associated fittings shall be processed in such a manner as to be uniform in quality.

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4.0 Quality Assurance Provisions

4.1 Responsibility for Inspection

Supplier is responsible for the performance of all inspection requirements specified herein. Except as otherwise specified, the supplier may use his own or outside inspection facilities as required. Inspection records of the examination and tests shall be kept complete and will be available upon written request.

4.2 Classification of Inspection

The inspection specified herein is classified as follows:

a) Qualification inspection paragraph 4.3.

b) Acceptance inspection paragraph 4.4.

4.3 Qualification Inspection

Qualification inspection shall consist of all the tests of this specification as required by the applicable specification sheet, performed on sample units produced with equipment and procedures normally used in production.

4.3.1 Qualification sample

The number of qualification samples required is dependent upon which qualification test groups are required by the applicable specification sheet. The tests required for each group are performed in the sequence stated. For a specific assembly (cables, connectors) the sample size should be no less than 3 for each configuration. An experiment test plan should be applied in case of numerous specific assemblies.

4.3.2 Qualification inspection test sequences

See Table IV for the qualification inspection test sequences. Except on Group 1, all tests described on other groups shall be made in order of sequence

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Table IV: Qualification inspection test sequences

TEST	REQUIREMENT	TEST METHOD
GROUP 1		
Visual and mechanical examination	3.6.1	4.5.1.
Material	3.4.	4.5.1.
Design and construction	3.5.	4.5.1.
Marking and identification	3.7.	4.5.1.
Workmanship	3.8.	4.5.1.
Coupling and torque	3.6.2.	4.5.2.
Longitudinal force (mating characteristics)	3.6.3.	4.5.3.
Contact resistance	3.6.9.	4.5.9. a),b) & c)
GROUP 2		
Center contact retention	3.6.5.	4.5.5.
Corrosion	3.6.6.	4.5.6.
Center contact resistance	3.6.9.	4.5.9. a) & b)
GROUP 3		
Insulation resistance	3.6.4.	4.5.4.
VSWR	3.6.7.	4.5.7.
Durability	3.6.8.	4.5.8.
GROUP 4		
Center contact resistance (cable assembly)	3.6.9.	4.5.9. a)
Dielectric withstanding voltage	3.6.10.	4.5.10.
Thermal shock	3.6.11.	4.5.11.
Center contact resistance (cable assembly)	3.6.9.	4.5.9. a)
Dielectric withstanding voltage	3.6.10.	4.5.10.
Cable retention force	3.6.12.	4.5.12.1.& 4.5.12.3.
GROUP 5		
Contact resistance (cable assembly)	3.6.9.	4.5.9. a) & c)
Vibrations	3.6.13.	4.5.13.
Mechanical shocks	3.6.14.	4.5.14.
Contact resistance (cable assembly)	3.6.9.	4.5.9. a) & c)
Cable retention force	3.6.12	4.5.12.2.

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4.4 Acceptance Inspection

4.4.1 Inspection of products for delivery

Acceptance inspection shall consist of the examination and tests listed in table V. Acceptance inspection shall be performed on every batch of connectors procured under this specification. A batch shall consist of all connectors of the same size and types (see 3.1.) made under essentially the same condition and submitted for inspection at the same time. In-process examinations may be used for acceptance inspection.

TABLE V: Acceptance Inspection

Property / test	Connector Types	Requirement	Test method
Product examination	All	3.6.1	4.5.1.
Dielectric Withstanding. Voltage	Right angle	3.6.10	4.5.10
Center contact resistance	Right angle	3.6.9.	4.5.9. a)

4.4.2 Acceptance sampling

Acceptance sampling shall be in accordance with inspection level 1 of MIL-STD-105E. The maximum acceptable quality level (AQL) shall be 2.5 Statistical process control techniques may be used in lieu of acceptance inspection.

4.4.3 Non conforming batches

Disposition of non conforming batches shall be in accordance with MIL-STD-105E.

4.5 Methods of Examination and Tests

4.5.1 Visual and mechanical examination (see 3.6.1)

Connectors and associated fittings shall be examined to verify that the material, design and construction, marking and identification, and workmanship are in accordance with the applicable requirements (see 3.4, 3.5, 3.7, 3.8). At the beginning and at the end of each environmental and mechanical test group, the test samples shall be subjected to visual examination in order to detect wrong assembly or failure events.

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4.5.2 Coupling and torque (see 3.6.2)

The connector under test shall be engaged with its mating standard part. A threaded coupled connector is fully engaged with its mating standard part when their reference interface plans coincide (torque change on coupling nut). A bayonet coupled connector is fully engaged with its mating standard part when the bayonet studs have passed the detent. The coupling torque shall be applied by fingers without any other tool or subsequent system to increase the finger torque efficiency than previous nut shape.

4.5.3 Longitudinal force (mating characteristics) (see 3.6.3)

The connectors shall be conditioned by inserting and extracting minimum test gauge once and then by inserting and extracting the maximum test gauge twice. Test gauge dimensions shall be in accordance with figure 2 of MIL-STD-348A specification. The insertion and extraction speeds shall be limited to 50 mm per minute. After conditioning, the force required to insert and extract the maximum test gauge for a third time shall be measured.

4.5.4 Insulation resistance (see 3.6.4)

The connectors with or without cable (when applicable) shall be tested in accordance with paragraph 4.7.8 of MIL-PRF-39012D and method 302, test condition B of
MIL-STD-202F. All measurements shall be taken between the center contact and body.

4.5.5 Center contact retention (see 3.6.5)

An axial force shall be applied to the center contact of an uncabled connector. The inner contact displacement shall be measured during the loading and unloading cycle. The permanent displacement measured at the end of loading and unloading cycle shall not exceed the specified value. The connector fixture shall not be influenced by the testing load more than 10 percent of specified value.

4.5.6 Corrosion (see 3.6.6)

Unmated and uncabled connectors shall be tested in accordance with paragraph 4.7.10 of MIL-PRF-39012D and method 101 of MIL-STD-202F.

The following details shall apply:

a) Test condition B (48 hours exposure)

b) Salt solution: 5 % in mass of NaCl

After exposure, the connectors shall be washed in distilled water, shaken and lightly brushed as specified in method 101 of MIL-STD-202F and then permitted to dry for 24 hours at 40°C. Connectors shall then be examined for evidence of corrosion, or pitting.

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4.5.7 Voltage standing wave ratio (see 3.6.7)

The test sample shall consist of a cable assembly of 8 inches in length, terminated to male connector on one cable end and female version of the same connector on another cable end. The VSWR shall be measured in accordance with the following procedure:

4.5.7.1 Measuring equipment

The tests shall be made on network analyzer in the frequency range up to 1 GHz. The network analyzer shall be operated in a single port mode and shall determine the S11 or S22 scattering parameter when one end of the cable assembly is connected to the measurement port and the other end is terminated in the appropriate matching load.

4.5.7.2 Calibration procedure

The network analyzer must be calibrated with open, short circuit and the appropriate matched load (50Ω) or using approved E-Calibration unit.

4.5.7.3 Measurement procedure

Each assembly shall be measured twice, first with one connector attached to the measurement port and then again with the other connector attached to the measurement port.

4.5.8 Connector durability (see 3.6.8)

Test performed in accordance with paragraph 4.7.12 of MIL-PRF-39012D (500 cycles performed). Each connector under test shall be mated with a typical production connector per this specification. The connector shall be subjected to the specified number of mating and demating cycles. The connector and its mating part shall be completely engaged and completely disengaged during this cycle. Lubrication of the threads or rotational parts shall not be used for this test unless specified. It is allowed to shake or blow debris from the threads or interface surfaces at intervals of 50 cycles minimum. Solvents or tools shall not be used for cleaning.

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4.5.9 Contact resistance (see 3.6.9)

All electrical contact resistance tests shall be performed in accordance with paragraphs 4.7.13 and 4.7.13.1 of MIL-PRF-39012D. A milliohmmeter may be used in place of equipment shown in figure 2 of MIL-PRF-39012D provided the following conditions are met:

Test current: one Ampere

Open circuit voltage: limited to 50 millivolts

The contact resistances to be measured are:

a) The contact resistance of the mated inner conductor contacts.

b) The contact resistance of the mated outer conductors contacts. This measurement shall include the body resistances.

c) The contact resistance between the cable braid and body at the point of contact.

Note for tests group 5: the inner contact resistance shall include the inner conductor resistance and the solder joint of cable assembly. The inner conductor resistance shall be subtracted from measured result. The same procedure shall be applied for outer contact resistance.

4.5.10 Dielectric withstanding voltage (see 3.6.10)

Connectors shall be tested in accordance with paragraph 4.7.14 of MIL-PRF-39012D and method 301 of MIL-STD-202F. The following details shall apply:

a) The center contact of plug connectors and receptacle connectors shall be positioned in such a manner that actual assembly conditions are simulated.

b) Magnitude of test voltage: 1500 V rms instantaneously applied.

c) Application test voltage points: between the center contact and body.

4.5.11 Thermal shock (see 3.6.11)

Connectors shall be subjected to thermal shocks in accordance with paragraph 4.7.17 of MIL-PRF-39012D and method 107 of MIL-STD-202F, Test Condition B (Low temperature: - 65 °C, High temperature: + 125 °C). For lower temperature test cables, the high test temperature shall be the maximum operating temperature of the cable.

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4.5.12 Cable retention force (see 3.6.12)

4.5.12.1 Tensile test

The connector shall be assembled to its standard test cable and mated on opposite connector (gauge) firmly fixed in tensile test machine jaw. The cable shall be fixed on opposite jaw or test fixture at 150 / 220 mm from the connector.

The specified load (see Table III) shall be gradually applied and held for 30 seconds. The assembly shall then be examined for mechanical failure or loosening parts. During the tensile test, the braid continuity resistance shall be monitored with a low current circuit for events of abnormal resistance evolution.

4.5.12.2 Tensile test - breaking load

The connector shall be fitted as specified above in 4.5.12.1 then shall be subjected to tensile test until complete breakdown. During the tensile test, the braid continuity resistance shall be monitored with a low current circuit for events of abnormal resistance evolution. The jaws separation speed shall be 20 mm per minute, maximum.

4.5.12.3 Flex test

When applicable, the connector still fixed in tensile test machine jaw shall be subjected to the following sequence:

The cable shall be bent at a radius of ten times the diameter of the cable starting at the end of the connector at an angle of 90° +/- 5° from the axis of the connector, then reversed 180° +/- 10°. Repeat this procedure four times, then test again and reexamine as outlined above in paragraph 4.5.12.1.

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4.5.13 Vibration (see 3.6.13)

Connectors shall be tested in accordance with paragraph 4.7.15 of MIL-PRF-39012D and method 204, test condition B of MIL-STD-202F. The specimens shall be subjected to sine vibration for 4 hours in each of 3 major axes (a total of 12 hours).

The following details shall be applied on test set up:

a) The connector assemblies shall be plugged on normal receptacle connector rigidly assembled on the test fixture. No safety wire or device shall be used in addition to normal mating.

b) Test cables shall be clamped on main connector axis at a minimum of 210 mm (8 inches) from the rear part of the connector, outside the vibration table.

c) Test cables shall not be pre-stressed by clamping.

d) The inner conductors shall be monitored during test for events of discontinuity. Serial circuit may be only used on identical specimens.

4.5.14 Mechanical shock (see 3.6.14)

Connectors shall be tested in accordance with paragraph 4.7.16 of MIL-PRF-39012D and method 213, test condition G of MIL-STD-202F. The test set up shall be similar to 4.5.13 except for the clamping cable that could be dependent on the testing machine.

The following details shall be applied on test set up:

a) The connector assemblies shall be plugged on normal receptacle connector rigidly assembled on the test fixture. No safety wire or device shall be used in addition to normal mating.

b) Test cables shall not be pre-stressed by clamping.

c) The inner conductors shall be monitored during test for events of discontinuity. Serial circuit may be only used on identical specimens.

d) Gravity shock machine (if used): all cables must be held on moving test support at a minimum radius of ten times the diameter of the cable. The monitoring wires shall be long enough to follow the moving support displacement.

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