


	Tyco Electronics Corporation 300 Constitution Drive Menlo Park, CA 94025 USA		No: C-6114 Rev: B Date: August 2, 2004 Page: 1 of 23
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MTC Quick-Disconnect Connectors with Removable Contacts

1.0 INTRODUCTION

1.1 Scope. This specification covers the design, performance and qualification requirements for Raychem MTC connectors with a quick-disconnect coupling mechanism and using rear-insert rear-release contacts. This specification forms a part of Master Specification C-6100 for the Raychem Integrated Inter-connection System.

1.2 Description. The Raychem MTC connectors and shield grounding accessories covered by this specification are rectangular connectors used to interconnect round wires. Connectors and shield grounding accessories are designed to function in the environments detailed in ARINC Specification 600 for Class B connectors (semi-environment resisting for continuous operation with the temperature limits -65°C to $+125^{\circ}\text{C}$). Connectors consist of environment-resistant plug and receptacle shells. Connector shells assure proper orientation of the mating halves and electrical continuity between shells prior to contact engagement. Connectors covered by this specification have inserts holding removable size 20-22, size 16, or size 12 contacts arranged in rows. The requirements for size 20-22 contacts are specified in this document. Shield grounding accessories accept size 22 contacts and provide a common grounding plane for wire shielding.

1.3 Classification. Connectors covered by this specification are classified in accordance with 1.3.1 and 1.3.2.

1.3.1 Connectors.



- a. Series: MTC PQ: Size 20-22 contacts on 0.1 inch centers
 Size 16 contacts on 0.2 centers
 Size 12 contacts on 0.25 inch centers

- b. Types: Plugs for cable mounting
 Receptacles, unflanged for panel mounting
 Receptacles, flanged for panel mounting

- c. Classes: Standard
 With shield grounding accessories

- d. Shell Finish: Electroless nickel

- e. Shell Size: Size 1: 1-inch nominal insert width
 Size 2: 2-inch nominal insert width

	Tyco Electronics Corporation 300 Constitution Drive Menlo Park, CA 94025 USA		No: C-6114 Rev: B Date: August 2, 2004 Page: 2 of 23
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1.3.2 Inserts.

- a. Types: Removable for size 20-22 contacts
 Removable for size 16 contacts
 Fixed for size 12 contacts

- b. Contact Style: Pin
 Socket

- c. Contact Size: Size 20-22 blade and tuning fork configuration
 Size 16 for contacts compatible with MIL-C-38999, Series II
 Size 12 for contacts compatible with MIL-C-83723, Series III

1.3.3 Shield Grounding Accessories.

- a. Types: 1 inch with fingers, for use with 1 inch plug shells.
 1 inch without fingers, for use with 1 inch receptacle shells.
 2 inch with fingers, for use with 2 inch plug shells.
 2 inch without fingers, for use with 2 inch receptacle shells.

- b. Contact Size: Size 22

1.4 Temperature Range. Connectors covered by this specification are suitable for use over the temperature range -65°C to +125°C. Connectors are rated for 1000-hour service when the operating temperature of the connector is the maximum rated temperature. Operating temperature is the maximum temperature reached by any point of the connector as a result of electrical current flow and ambient temperature.

1.5 Units. SI units in parentheses are for information only.

2.0 APPLICABLE DOCUMENTS


2.1 Issues of Documents. The following documents, of the issue in effect on date of order or request for proposal, form a part of this specification to the extent specified herein. This specification takes precedence over the referenced documents.

2.2 Department of Defense.

SPECIFICATIONS

Military

- | | |
|---------------|--|
| MIL-C-5541 | Chemical Conversion Coatings on Aluminum and Aluminum Alloys |
| MIL-H-5606 | Hydraulic Fluid, Petroleum Base; Aircraft, Missile and Ordnance |
| MIL-DTL-18240 | Fastener Element, Self-Locking, Threaded Fastener, 250°C Maximum |
| MIL-L-23699 | Lubricating Oil, Aircraft Turbine Engine, Synthetic Base |
| MIL-C-26074 | Coatings, Electroless Nickel |

	Tyco Electronics Corporation 300 Constitution Drive Menlo Park, CA 94025 USA	Raychem	No: C-6114 Rev: B Date: August 2, 2004 Page: 3 of 23
--	--	----------------	---

MIL-C-38999	Connectors, Electrical Circular, Miniature, High Density Quick Disconnect (Bayonet, Threaded, and Breech Coupling), Environment Resistant, Removable Crimp and Hermetic Solder Contacts
MIL-G-45204	Gold Plating, Electrodeposited
MIL-C-83723	Connectors, Electrical Circular, Environment Resistant, Receptacles and Plugs
MIL-P-83800	1,2 Propanediol (Propylene Glycol, Industrial Grade)
Federal	
QQ-P-35	Chemical Passivation Treatments for Stainless Steel Parts
P-D-680	Dry Cleaning and Degreasing Solvent
TT-I-735	Isopropyl Alcohol
A-A-2904	Thinner, Paint, Mineral Spirits, Regular and Odorless

STANDARDS

Military

MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-202	Test Methods for Electronic and Electrical Component Parts
MIL-STD-454	Standard General Requirements for Electronic Equipment
MIL-STD-810	Environmental Test Methods and Engineering Guidelines
MIL-STD-1344	Test Methods for Electrical Connectors
MIL-STD-45662A	Calibration Systems Requirements

Federal

FED-STD-H28	Screw-Thread Standards for Federal Services
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(Copies of Department of Defense documents may be obtained from the Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120-5099.)

2.3 **American Society for Testing and Materials (ASTM).**

A693	Precipitation Hardening Stainless Steel and Heat Resisting Steel Plate Sheet and Strip
B85	Aluminum Alloy Die Castings

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

2.4 **Aeronautical Radio, Inc. (ARINC).**

Specification 600-8	Air Transport Avionics Equipment Interfaces
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(Copies of ARINC publications may be obtained from Aeronautical radio, Inc., 2551 Riva Road, Annapolis, MD 21401.)

	Tyco Electronics Corporation 300 Constitution Drive Menlo Park, CA 94025 USA		No: C-6114 Rev: B Date: August 2, 2004 Page: 4 of 23
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- 2.5 Raychem Corporation.
 C-6100 System Overview and General Requirements for Integrated Interconnection System Components

(Copies of Raychem documents may be obtained from Raychem Corporation, 300 Constitution Drive, Menlo Park, CA 94025.)

- 2.6 International Standards Organization (ISO).
 ISO 10012-1 Quality Assurance Requirements for Measuring Equipment, Part 1.

(Copies of ISO documents may be obtained from International Organization for Standardization, Case Postale 56, CH-1211 Geneve, Switzerland.)

- 2.7 Metal Powder Industries Federation (MPIF).
 Standard 35 Materials Standards for Metal Injection Molded Parts

(Copies of MPIF documents may be obtained from Metal Powder Industries Federation, 105 College Road east, Princeton, New Jersey 08540-6692.)

3.0 **REQUIREMENTS**



- 3.1 Specification Control Drawings. The requirements for connectors under this specification shall be as specified herein and in the applicable specification control drawing. In the event of conflict between the requirements of this specification and those of the specification control drawing, the latter shall govern.

- 3.2 Classification of Requirements. The requirements for the connectors are classified herein as follows:



<u>Requirement</u>	<u>Paragraph</u>
Qualification	3.3
Materials	3.4
Design and Construction	3.5
Performance	3.6
Product Identification	3.7
Workmanship	3.8

- 3.3 Qualification. Connectors furnished under this specification or listed on Qualified Products List C-6114-QPL shall be products, which are qualified to this specification in accordance with the requirements of Specification C-6100.

- 3.4 Materials Requirements. All materials used in the manufacture of these connectors shall be of the quality and form best suited for the purpose intended.

	Tyco Electronics Corporation 300 Constitution Drive Menlo Park, CA 94025 USA		No: C-6114 Rev: B Date: August 2, 2004 Page: 5 of 23
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- 3.4.1 Dissimilar Metals. When dissimilar metals are used in intimate contact with each other, protection against electrolytic corrosion shall be provided as specified in MIL-STD-454, Requirement 16.
- 3.4.2 Fungus Resistance. Finishes and materials shall be fungus-inert in accordance with MIL-STD-454, Requirement 4, and encompassing the fungus species listed in MIL-STD-810, Method 508.
- 3.4.3 Hydrolytic Stability. All nonmetallic materials shall be selected to meet the hydrolytic reversion resistance requirements specified in MIL-STD-454, Requirement 47.
- 3.4.4 Component Materials. Materials for specific components of the connector shall be as follows:
- 3.4.4.1 Contacts. Size 20-22 contact material shall be copper-based. Mating surfaces shall be gold-plated per MIL-G-45204, Type I, Grade C, Class 1, over a suitable underplate. Silver underplate shall not be used. Size 16 and size 12 contacts shall comply with the relevant contact specification. Grounding contacts shall be copper based with a suitable plating material per the applicable specification control drawing.
- 3.4.4.2 Connector Shell. Connector shells shall be die-cast aluminum per ASTM B-85. Shell finish shall be in accordance with 3.4.4.2.1.
- 3.4.4.2.1 Shell Finish. Connector shells shall be plated with electroless nickel in accordance with MIL-C-26074 Class 3 or 4, Grade B.
- 3.4.4.3 Mounting and Mating Hardware. Connector mounting and mating hardware shall be 17-4 PH corrosion-resistant steel per ASTM A693 or MPIF Standard 35. Grounding shield accessories shall be mounted with corrosion-resistant fasteners. Hardware shall be passivated per QQ-P-35 or plated for compatibility with 3.4.4.2.1.
- 3.4.4.4 Elastomeric Seals. Elastomeric seals shall be resilient dielectric material per the applicable specification control drawing.
- 3.4.4.5 Connector Inserts. Connector inserts shall be rigid polymeric dielectric material per the applicable specification control drawing.
- 3.5 Design and Construction Requirements. Connectors and shield grounding accessories shall be designed and constructed to withstand handling during installation and maintenance. Complete connectors shall consist of a rectangular plug or receptacle shell; fixed or removable insert(s) with removable pin or socket contacts; mounting mating hardware, a cable clamp, and where specified shield grounding accessories.
- 3.5.1 Shells. Plug and receptacle shells shall meet the following requirements:

	Tyco Electronics Corporation 300 Constitution Drive Menlo Park, CA 94025 USA		No: C-6114 Rev: B Date: August 2, 2004 Page: 6 of 23
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- 3.5.1.1 Provision for Shield Grounding Accessories. Plug and receptacle shells shall have two 4-40 UNF tapped mounting holes for the attachment of shield grounding accessories. Plug shells shall have the provision for the inclusion of spring fingers as part of the shield grounding accessory, which contact the receptacle shell prior to engagement of the contacts.
- 3.5.1.2 Coupling. Coupling between mating connectors shall be accomplished by means of two captive helices on the plug shell engaging keyed posts on the receptacle shell. The mating hardware shall provide sufficient force to effect a moisture seal between the socket contact insert and the elastomeric interfacial seal on the pin contact insert. Complete coupling shall occur when the helices are rotated 120 degrees. A detent shall be provided on each helix.
- 3.5.1.3 Polarization. Shell polarization shall prevent the mating of any plug and receptacle shells if the connectors are not in the correct mating position. Polarization of shells shall occur before connector keying.
- 3.5.1.4 Connector Keying. Insertable keying pins shall provide a minimum of 16 different keying combinations. Keying shall prevent the mating of any plug and receptacle not properly keyed. Connector keying shall occur before engagement of contacts or coupling hardware.
- 3.5.1.5 Insert Retention. Shells shall retain inserts by mechanical means.
- 3.5.1.6 Cable Clamps. Receptacle shells suitable for cable mounting and all plug shells shall have provisions for attachment of cable clamps. Cable clamp screws shall have threads conforming to FED-STD-H28 and shall be self-locking per MIL-DTL-18240, Type P.
- 3.5.1.7 Mounting Hardware. Mounting hardware shall be provided with each receptacle shell. Mounting hardware screw threads shall conform to FED-STD-H28 and shall be self-locking per MIL-DTL-18240, Type P.
- 3.5.2 Inserts. Connector inserts for size 20-22 and size 16 contacts shall be removable from the shells. Connector inserts for size 12 contacts shall be fixed in the shell. Removable inserts shall have polarizing keyways to ensure proper orientation within the shell. Inserts shall contain cavities for pin or socket contacts and the cavities shall contain locking devices. Pin contact inserts shall have an elastomeric interfacial seal bonded to the mating face.
- 3.5.2.1 Contact Arrangement. Inserts shall contain one or two rows of contacts. Contact arrangement shall be in accordance with the applicable specification control drawing, and is shown in Table I for reference only.

TABLE I: Contact Arrangement

	Tyco Electronics Corporation 300 Constitution Drive Menlo Park, CA 94025 USA	Raychem	No: C-6114 Rev: B Date: August 2, 2004 Page: 7 of 23
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Contact Size	Center-to-Center Contact Spacing	Rows of Contacts	Contacts per Connector	
			Shell Size 1	Shell Size 2
22	0.1	2	20	40
16	0.2	1	5	10
12	0.25	1	4	Not available

3.5.3 Contacts. Contacts shall be designed to withstand termination and repeated mating and demating of connectors. Mating surfaces shall be smooth and uniform and shall provide a wiping action during mating. Mating portions of size 20-22 contacts shall be of blade (pin contact) and tuning fork (socket contact) design. Size 20-22 socket contacts shall have a corrosion resistant steel hood to protect the spring member from handling damage. Size 16 and size 12 power or shielded contacts shall conform to the applicable specification sheets and be compatible with the circular connectors shown in Table II.


TABLE II: Contact Compatibility

Contact Size	Circular Connector Compatibility
16	MIL-C-38999, Series II
12	MIL-C-83723, Series III

3.5.3.1 Contact Termination. Size 20-22 contacts shall crimp style. Size 16 and size 12 contacts shall be crimp or solder style.

3.5.4 Seals.

3.5.4.1 Interfacial Seal. The elastomeric interfacial seal shall be designed to eliminate leakage paths between adjacent contacts and between contacts and the shell when the connector is fully mated. The interfacial seal shall be permanently bonded to the mating face of the pin insert. Suitable marking shall be provided on the mating face of the interfacial seal to identify the contact positions.

	Tyco Electronics Corporation 300 Constitution Drive Menlo Park, CA 94025 USA		No: C-6114 Rev: B Date: August 2, 2004 Page: 8 of 23
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3.5.4.2 Wire Seal. The rear of each insert shall have an elastomeric wire seal. The wire seal shall be designed to meet the requirements of this specification using wire having an outer diameter within the ranges specified in Table III.

TABLE III: Wire Diameter

Contact Size	Finished Wire Outside Diameter	
	inch	(mm)
20-22	.030 to .065	(.82 to 1.65)
16	.065 to .109	(1.65 to 2.77)
12	.097 to .158	(2.46 to 4.01)

3.5.4.3 Sealing Plug. Plugs for sealing the rear openings of unused contact cavities shall be provided when specified. Sealing plugs shall conform to MS27488.

3.5.5 Interchangeability. All components having the same part number shall be completely interchangeable with each other in regard to installation and performance.

3.5.6 Intermateability. All plug and receptacle connectors of the same series, type and shell size and containing the appropriate inserts and keying pin combinations shall mate with each other.

3.5.7 Shield grounding accessories. Shield grounding accessories may be mounted to the surface of the MTC connector as provided in section 3.5.1.1 using fasteners as defined in section 3.4.4.3. Shield grounding accessories mounted on plug shells shall include spring fingers as defined in section 3.5.1.1.

3.6 Performance Requirements. Connector components and assemblies shall conform to the requirements specified herein and on the applicable specification control drawings. Requirements specified at 25°C may be satisfied by measurements obtained between 20 and 25°C. Unless otherwise specified, room temperature shall be 25°C. Values given as "after conditioning" values refer to requirements after any of the environmental exposures of Table X. All contact requirements are for signal and power contacts, shielded contact requirements are in accordance with the applicable specification sheets.

3.6.1 Insulation Resistance. When connector assemblies are tested as specified in 4.5.3, the insulation resistance at 25°C between any pair of contacts and between any contact and the shell shall be 5000 megohm minimum, unless otherwise specified. The insulation resistance at 125°C shall be 1000 megohm minimum.

3.6.2 Dielectric Withstanding Voltage. When connector assemblies are tested as specified in 4.5.4, there shall be no evidence of breakdown or flashover. The leakage current shall be 1.0 milliampere maximum.

3.6.3 Contact Resistance.

3.6.3.1 Contact Resistance at Specified Current. When connector assemblies are tested as specified in 4.5.5.1 or 4.5.5.2, mated contacts shall meet the requirements of Table IV.

TABLE IV: Contact Millivolt Drop at Rated Current

Contact Size	Wire Size	Test Current	Millivolt Drop, max.		
			at Room Temperature		at 125°C
			Initial Value	After Conditioning	After Conditioning
20-22	24	3	45	54	68
20-22	22	5	73	88	110
20-22	20	7.5	55	66	83
16	16	13	50	65	81
12	12	23	45	60	75

3.6.3.2 Low Signal Level Contact Resistance. When connector assemblies are tested as specified in 4.5.5.3, mated contacts shall meet the requirements of Table V.

TABLE V: Low Signal Level Contact Resistance

Contact Size	Wire Size	Resistance, milliohm, max. at Room Temperature	
		Initial Value	After Conditioning
20-22	24	15	18
20-22	22	15	18
20-22	20	8	10
16	16	4	5
12	12	2	3

3.6.4 Shell-to-Shell Conductivity. When mated connectors are tested as specified in 4.5.6, the measured voltage drop shall be as shown in Table VI.

TABLE VI: Shell-to-Shell Conductivity

Parameter	Voltage Drop, millivolt, max.	
	Initial	After Conditioning
Receptacle shell to panel	1	2
Plug shell to receptacle shell	10	20
Shield ground to shield ground	20	40

3.6.5 Electrical Engagement. When connector assemblies are tested as specified in 4.5.7, the electrical engagement shall be as shown in Table VII.

TABLE VII: Electrical Engagement

Contact Size	Electrical engagement, min.	
	inch	(mm)
20-22	.050	(1.27)
16	.034	(0,86)
12	.040	(1.02)

3.6.6 Contact Engagement and Separation Forces. When socket contacts are tested as specified in 4.5.8, the largest value of the engagement force and the smallest value of the separation force measured on any contact shall be as shown in Table VIII.

TABLE VIII: Contact Engagement and Separation Forces

Contact Size	Initial		After Conditioning	
	Engagement Force Ounce, max.	Separation Force Ounce, min.	Engagement Force Ounce, max.	Separation Force Ounce, min.
20-22	12	0.7	14	0.6
16	30	2	36	1.5
12	30	3	36	2.5
Ground Socket	64	0.7	64	0.6



3.6.7 Durability. After conditioning as specified in 4.5.9, connector assemblies shall meet the subsequent performance requirements of Table X and shall show no evidence of damage detrimental to performance or handling.

3.6.8 Termination Tensile Strength. When individual contacts are tested as specified in 4.5.10, the tensile load required to separate each wire from its terminal shall be in accordance with Table IX.



TABLE IX: Termination Tensile Strength

Wire Size	Termination Strength , pounds, min.		
	Silver or Tin Plated Copper Wire	High Strength Copper Alloy Wire	Nickel Plated Copper Wire
24	8	15	6
22	12	-	8
20	20	-	15
16	50	-	29
12	110	-	100



3.6.9 Insert Retention. When connector assemblies are tested as specified in 4.5.11, the inserts shall not be damaged or dislocated from their fully seated positions. The inserts shall retain their normal positions in the shell for at least 5 seconds at the specified load.

	Tyco Electronics Corporation 300 Constitution Drive Menlo Park, CA 94025 USA		No: C-6114 Rev: B Date: August 2, 2004 Page: 11 of 23
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- 3.6.10 Contact Retention. When terminated inserts are tested as specified in 4.5.12, the axial displacement of signal and power contacts shall not exceed 0.015 inch while the load is applied. Shield grounding accessories shall show no evidence of damage detrimental to performance or handling.
- 3.6.11 Coupling Torque. When terminated connector assemblies are tested as specified in 4.5.13, the torque required to fully operate the helix shall be 20 in-lb., maximum.
- 3.6.12 Coupling Mechanism Proof Test. When terminated connector assemblies are tested as specified in 4.5.14, there shall be no evidence of mechanical damage to shells or mating hardware.
- 3.6.13 Maintenance Aging. After conditioning as specified in 4.5.15, connector assemblies shall meet the subsequent performance requirements specified in Table X, and shall show no evidence of damage detrimental to performance or handling.
- 3.6.14 Random Vibration. When terminated, mated connector assemblies are tested as specified in 4.5.16, there shall be no electrical discontinuities and no evidence of cracks, breaks or loosening of parts.
- 3.6.15 Mechanical Shock. When terminated, mated connector assemblies are tested as specified in 4.5.17, there shall be no electrical discontinuities exceeding 1 microsecond and no evidence of cracks, breaks, or loosening of parts.
- 3.6.16 Thermal Cycling. When terminated, mated connector assemblies are tested as specified in 4.5.18, there shall be no evidence of damage detrimental to performance or handling.
- 3.6.17 Temperature Life. When terminated, mated connector assemblies are tested as specified in 4.5.19, the insulation resistance at 125°C shall be 1000 megohm minimum.
- 3.6.18 Humidity. When terminated, mated connector assemblies are tested as specified in 4.5.20, the insulation resistance shall be 1 megohm minimum within 1 to 2 hours after humidity and greater than 5000 megohm after 24 hours conditioning at room ambient.
- 3.6.19 Seal Leakage. When terminated, mated connector assemblies are tested as specified in 4.5.21, the insulation resistance shall be 100 megohm minimum, and the mated connectors shall meet the dielectric withstanding voltage requirements of 3.6.2.
- 3.6.20 Polarization Lockout. When connectors are tested in accordance with 4.5.22 the force required to overcome the polarization keys shall be 50 lb., minimum.

	Tyco Electronics Corporation 300 Constitution Drive Menlo Park, CA 94025 USA		No: C-6114 Rev: B Date: August 2, 2004 Page: 12 of 23
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- 3.6.21 Salt Spray. When terminated, mated connector assemblies are tested in accordance with 4.5.23, the specimens shall show no evidence of damage detrimental to performance or handling.
- 3.6.22 Ozone Exposure. When terminated, unmated connector assemblies are tested as specified in 4.5.24, the connectors shall show no evidence of damage detrimental to performance or handling.
- 3.6.23 Fluid Immersion. Connector assemblies shall be tested as specified in 4.5.25.
- 3.6.23.1 Seals. When terminated connector assemblies are tested as specified in 4.5.25.1, the connectors shall show no evidence of damage detrimental to performance or handling.
- 3.6.23.2 Retention system. When unmated connectors are tested as specified in 4.5.25.2, they shall meet the contact retention requirements of 3.6.10 and the insert retention requirements of 3.6.9.
- 3.6.24 Magnetic Permeability. When components, with the exception of mating and mounting hardware, are tested as specified in 4.5.26, the relative permeability shall be 2.0 maximum.
- 3.6.25 Contact Inductive Load Switching. When terminated, mated connector assemblies are tested as specified in 4.5.27, size 20-22 contacts shall meet the room-temperature, after-conditioning, contact resistance requirements of Table IV.
- 3.6.26 Circuit Breaker Compatibility. When terminated, mated connector assemblies are tested as specified in 4.5.28, the connectors shall meet the room-temperature, after-conditioning, contact resistance requirements of Table IV.
- 3.6.27 Engaging Force with Contacts. When terminated connector assemblies are tested in accordance with 4.5.29 the maximum force required to position the second helix prior to mating shall be 25 lb. The maximum force required to position both helices prior to mating shall be 40 lb.
- 3.6.28 Ground Pin Insertion Force. When shield grounding accessories are tested as specified in 4.5.30, contacts shall typically be capable of being inserted without the use of insertion tools.
- 3.6.29 Ground Pin Probe Damage. Shield grounding accessories shall be tested as specified in 4.5.31.

	Tyco Electronics Corporation 300 Constitution Drive Menlo Park, CA 94025 USA		No: C-6114 Rev: B Date: August 2, 2004 Page: 13 of 23
---	--	---	--

3.6.30 Contact Walkout. When tested as specified in 4.5.32, contacts shall not become dislodged from their normal position.

3.6.31 Post Test Examination. Connector assemblies shall be inspected as specified in 4.5.33. Any evidence of the effects described in 4.5.33 shall constitute failure.

3.7 Product Identification. All marking shall be in accordance with the applicable specification control drawing. The marking shall remain legible after completion of the test sequences in Table X.

3.7.1 Shell Identification. Connector shells shall be marked on an external surface with the shell part number, date code, and the Raychem logo. Every shell shall be permanently marked at the wire termination end to identify proper insert orientation.

3.7.2 Removable Insert Identification. Removable inserts shall be marked with the part number, date code, the Raychem logo or manufacturer's logo, and an orientation indicator as specified in the applicable specification sheet.

3.7.3 Contact Cavity Identification. The number "1" contact position, as a minimum, shall be marked on the engaging face of each insert. The identification of at least four contacts shall be permanently identified on the wire seal.



3.7.4 Shield Grounding Accessories Identification. Shield grounding accessories shall be marked on an external surface with the shell part number, date code, and the supplier's name. The number "1" contact position, as a minimum, shall be marked on the same surface.

3.8 Workmanship. Connectors and accessories shall be processed in such a manner as to be uniform in quality; they shall be free from burrs, cracks, voids, chips, blisters, sharp cutting edges, and other defects that would adversely affect life or serviceability.

4.0 **QUALITY ASSURANCE PROVISIONS**

4.1 Responsibility for Inspection. The supplier is responsible for the performance of all inspection tests specified herein. The supplier may utilize his own or any other suitable testing facility. Inspection records of the tests shall be kept complete and available to the buyer as specified in the contract or order.

4.1.1 Test Equipment and Inspection Facilities. Test and measuring equipment and inspection facilities of sufficient accuracy, quality, and quantity to permit performance of the required inspection shall be established and maintained by the supplier. A calibration system to control the accuracy of the measuring and test equipment shall be maintained in accordance with MIL-STD-45662A or ISO 10012-1.

	Tyco Electronics Corporation 300 Constitution Drive Menlo Park, CA 94025 USA		No: C-6114 Rev: B Date: August 2, 2004 Page: 14 of 23
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4.2 Classification of Inspections. The examination and testing of connectors covered by this specification shall be classified as follows:

- a. Qualification inspection (See par. 4.3)
- b. Acceptance inspection (See par. 4.4)

4.3 Qualification Inspection. Qualification inspection shall consist of the tests in Table X. Qualification may be based on a combination of testing and similarity to previously qualified parts. Qualification shall be granted upon successful completion of the inspections and tests of Table X, conducted upon the samples of Table X, in accordance with Specification C-6100.

4.3.1 Test Samples for Qualification Inspection. Test samples submitted for qualification inspection shall be produced using equipment and procedures normally used in production. Test samples for each test group shall be two mated pairs of each configuration for which qualification is desired. Individual test samples shall be selected in compliance with the qualification requirements of Specification C-6100.

4.3.2 Failures. One or more failures of the tests listed in Table X shall be cause for failure of qualification of the parts under test. An exception to this is visual examination, where occurrence of one major defect or two minor defects shall be cause for failure of qualification. Major and minor defects shall be as defined in MIL-STD-105E.

4.3.3 Qualification Report. Qualification shall be documented in a report that shall be available to the buyer.


TABLE X: Qualification Inspection

Test or Examination	Req. Par.	Test Group 1	Test Group 2	Test Group 3	Test Group 4	Test Group 5
Examination Of Product	3.1, 3.5, 3.7, 3.8	X	X	X	X	X
Coupling Torque	3.6.11	X	X	X	X	
Engaging force with contacts	3.6.27	X	X	X	X	
Maintenance aging	3.6.13		X	X	X	
Contact engagement and separation forces	3.6.6		X	X	X	
Low signal level contact resistance	3.6.3.2	X				
Contact resistance at room temperature	3.6.3.1	X				
Polarization lockout	3.6.20	X				
Magnetic permeability	3.6.24					X
Ozone exposure	3.6.22					X
Fluid immersion	3.6.23					X
Shell-to-shell conductivity	3.6.4	X	X	X	X	
Ground pin insertion force	3.6.28	X				
Ground pin probe test	3.6.29	X				
Contact retention	3.6.10			X	X	

TABLE X : Qualification Inspection, Continued

	Tyco Electronics Corporation 300 Constitution Drive Menlo Park, CA 94025 USA	Raychem	No: C-6114 Rev: B Date: August 2, 2004 Page: 15 of 23
--	--	----------------	--

Test or Examination, Continued	Req. Par.	Test Group 1	Test Group 2	Test Group 3	Test Group 4	Test Group 5
Insulation resistance at 25°C	3.6.1		X	X	X	
Insulation resistance at 125°C	3.6.1			X		
Dielectric withstanding voltage at sea level	3.6.2		X	X	X	X
Dielectric withstanding voltage at altitude	3.6.2			X		
Thermal cycling	3.6.16		X	X	X	
Durability	3.6.7		X	X	X	
Seal leakage	3.6.19		X			
Insulation resistance			X			
Dielectric withstanding voltage			X			
Vibration	3.6.14			X		
Mechanical shock	3.6.15			X		
Humidity	3.6.18			X		
Insulation resistance after 1 - 2 hours				X		
Insulation resistance after 24 hours				X		
Temperature life	3.6.17				X	
Contact resistance at 125°C.					X	
Insulation resistance, mated, at 125°C					X	
Salt spray	3.6.21		X			
Low signal level contact resistance	3.6.3.2			X	X	
Contact resistance at room temperature	3.6.3.1			X	X	
Shell-to-shell conductivity	3.6.4	X	X	X	X	
Insulation resistance at 25°C, unmated	3.6.1				X	
Dielectric withstanding voltage, unmated	3.6.2				X	
Electrical engagement	3.6.5			X		
Contact engagement and separation forces	3.6.6		X	X	X	
Coupling Torque	3.6.11	X	X	X	X	
Engaging force with contacts	3.6.27		X	X	X	
Contact retention	3.6.10			X	X	X
Insert retention	3.6.9			X	X	X
Contact inductive load switching	3.6.25			X		
Contact circuit breaker compatibility	3.6.26			X		
Contact walkout	3.6.30	X		X	X	
Coupling mechanism proof test	3.6.12	X				
Post test examination	3.6.31	X	X	X	X	X
Termination tensile strength	3.6.8			X		

	Tyco Electronics Corporation 300 Constitution Drive Menlo Park, CA 94025 USA	Raychem	No: C-6114 Rev: B Date: August 2, 2004 Page: 16 of 23
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4.4 Acceptance Inspection. Lot acceptance inspection for connectors shall consist of the tests listed in Table XI. Acceptance inspection shall be performed on every lot of connectors manufactured under this specification. The sample units shall be tested unterminated and shipped against orders. In-process examination may be used for acceptance inspection.

TABLE XI: Acceptance Inspection

Test or Examination	Requirement Paragraph	Procedure Paragraph	Inspection Level	AQL
Examination of product	3.1, 3.5, 3.7, 3.8	4.5.2	S-3	1.0
Dielectric Withstanding Voltage (Inserts Only) 10-second test	3.6.2	4.5.4	100%	---
Contact engagement and separation forces (Contacts only)	3.6.6	4.5.8	S-3	1.0

AQL shall apply to individual defects in accordance with MIL-STD-105E, Section 4.5



4.4.1 Sampling for Acceptance Inspection. MIL-STD-105E shall apply for definitions of inspection terms used herein. For purposes of this specification, the following shall apply:

4.4.1.1 Inspection Lot. The inspection lot shall consist of all connectors or components of one part number, manufactured under essentially the same conditions, and offered for inspection at one time.

4.4.1.2 Inspection Level and Acceptable Quality Levels (AQL). The inspection levels and acceptable quality levels shall be in accordance with MIL-STD-105E and shall be as specified in Table XI.

4.4.2 Rejected Lots. If an inspection lot is rejected, the lot shall be replaced, or the defective units shall be reworked to correct the defect or screened out. If the lot is reworked or the defective units are screened out, the lot shall be resubmitted for inspection. Resubmitted lots shall be inspected using tightened inspection in accordance with MIL-STD-105E.

4.4.3 Examination of Preparation for Delivery. Preparation for delivery of material ready for shipment shall be examined to determine compliance with the requirements of Section 5.

	Tyco Electronics Corporation 300 Constitution Drive Menlo Park, CA 94025 USA		No: C-6114 Rev: B Date: August 2, 2004 Page: 17 of 23
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4.5 Test Procedures.

4.5.1 Test Conditions. Unless otherwise specified, all tests shall be performed at ambient pressure, and relative humidity as specified in the general requirements of MIL-STD-1344 with an ambient temperature of 20 to 25°C. Where conditioning at the 125°C is specified, the temperature tolerances shall be minus 0 and plus 3°C.

4.5.1.1 Connector Assembly Preparation. When terminated connectors are specified for testing, the contacts shall be terminated in accordance with the applicable specification control drawing. Wire or cable lengths shall be 3 to 6 feet. Connectors shall be assembled in accordance with the applicable Raychem engineering standard (ES). Cable clamps shall be installed, if provided for.

4.5.2 Examination of Product (see 3.1, 3.5, 3.7, 3.8). Connector components and assemblies shall be visually examined at 4X magnification.

4.5.3 Insulation Resistance (see 3.6.1). Connector assemblies shall be tested in accordance with MIL-STD-1344, Method 3003. Insulation resistance shall be measured between all adjacent contacts in the insert and between all contacts and the shell (ground). When insulation resistance at 125°C is specified, the connector assemblies shall be conditioned in an oven at the maximum rated temperature for 30 minutes, and the measurements shall be made while the connector assemblies are at the maximum rated temperature.

4.5.4 Dielectric Withstanding Voltage (see 3.6.2). Connector assemblies shall be tested in accordance with MIL-STD-1344, Method 3001. Test voltage shall be 60 Hz ac applied between all adjacent contacts in the same insert and between all contacts and the shell (ground). The shell and all contacts not connected to the test voltage shall be grounded. The magnitude of the test voltage, and altitude pressure equivalents, shall be as specified in Table XII.



TABLE XII: Dielectric Withstanding Voltage

Altitude (Pressure equivalent)	Test Voltage, V rms.
Sea Level (760 torr)	1500
50,000 ft (87.5 torr)	500

4.5.5 Contact Resistance (see 3.6.3).


4.5.5.1 Contact Resistance at Specified Current (Room Temperature). Mated connector assemblies shall be tested in accordance with MIL-STD-1344, Method 3004. All size 12 and size 16 contacts and at least 20 percent of size 20-22 contacts in each connector assembly shall be tested.

4.5.5.2 Contact Resistance at Specified Current (Maximum Rated Temperature). Mated connector assemblies shall be conditioned in an oven at the 125°C for 30 minutes. Measurements shall be made as detailed in 4.5.5.1, while the connector assemblies are at the maximum rated temperature.

	Tyco Electronics Corporation 300 Constitution Drive Menlo Park, CA 94025 USA		No: C-6114 Rev: B Date: August 2, 2004 Page: 18 of 23
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- 4.5.5.3 Low Signal Level Contact Resistance. Mated connector assemblies shall be tested in accordance with MIL-STD-1344, Method 3002. All size 12 and size 16 contacts and at least 20 percent of size 20-22 contacts in each connector assembly shall be tested.
- 4.5.6 Shell-to-Shell Conductivity (see 3.6.4). Mated connector assemblies shall be mounted to a suitable aluminum panel with a MIL-C-5541 Class 3 finish.
- 4.5.6.1 Shell-to-panel grounding (see 3.6.4). All connectors shall be tested by applying a direct current of 1 +/- 0.1 ampere from the rear of the receptacle shell to the to the aluminum panel and measuring the voltage drop between the connector shell adjacent to the shield grounding accessory mounting holes and the panel adjacent to the connector.
- 4.5.6.2 Shell-to-shell conductivity (see 3.6.4). Connectors with shield grounding accessories shall be tested by applying a direct current of 1 +/- 0.1 ampere between the shields of shielded cables attached to the shield grounding accessories. The voltage drop between the mated plug and receptacle shells shall be measured between points adjacent to the shield grounding accessory mounting holes. The overall voltage drop between the shield grounds shall be measured from points on the shield ground leads 1-inch behind the shield grounding accessories. Voltage drop will not be measured on shield ground leads prior to Salt Fog Conditioning, Test Group 2.
- 4.5.7 Electrical Engagement (see 3.6.5). A suitable power source and indicator shall be provided such that the point at which the outermost contact pairs mate can be established. Connector halves shall be held flat against a smooth, flat surface and mated by alternately engaging each helix. As the second helix is engaged, the mating operation shall be stopped at the point where electrical contact is made between the outermost pin and socket contacts. The separation of the connector halves at the outermost contact position shall be measured. The mating operation shall then be continued until the connector halves are completely mated and the shell spacing shall again be measured. Electrical engagement shall be the difference between the two measurements.
- 4.5.8 Contact Engagement and Separation Forces (see 3.6.6). Contacts shall be tested in accordance with MIL-STD-1344, Method 2014, Procedure I. Test blades for size 20-22 signal contacts shall be generally of the shape of pin contacts and as detailed below. Round test pins for size 12, size 16, size 20-22 contacts shall be as defined on the applicable specification sheets. Contacts shall be conditioned by inserting and withdrawing the maximum thickness test pin. For qualification inspection, at least 20 percent of the contacts in each connector assembly shall be tested. Shield grounding accessories shall have a minimum of 4 contacts tested on each accessory.

Size 20-22 test blade details:


	Tyco Electronics Corporation 300 Constitution Drive Menlo Park, CA 94025 USA	Raychem	No: C-6114 Rev: B Date: August 2, 2004 Page: 19 of 23
--	--	----------------	--

<u>Material</u>	<u>Hardened tool steel</u>
Hardness	Rockwell C 50-55
Surface finish	6 to 10 microinch on sliding surfaces
Blade width	0.050
Tip thickness	0.008 max. at tip
Maximum blade	0.0208 to 0.0210 uniform body thickness
Minimum blade	0.0190 to 0.0192 uniform body thickness

- 4.5.9 Durability (see 3.6.7). Terminated connector assemblies shall be mated and unmated 250 times at a rate not to exceed 300 cycles per hour and in a manner simulating actual service. The test may be performed by hand or by mechanical means.
- 4.5.10 Termination Tensile Strength (see 3.6.8). Terminated contacts shall be tested in accordance with Method 2003 of MIL-STD-1344. A minimum of twenty percent of the contacts shall be tested on each connector. Shield grounding accessories shall have a minimum of 4 contacts tested on each accessory.
- 4.5.11 Insert Retention (see 3.6.9). Terminated connector assemblies shall be tested in accordance with MIL-STD-1344, Method 2010, except that the load shall be applied only against the insert mating surface. The load shall be 200 psi (1.4 MPa), applied evenly over the entire mating surface. If a tensile tester is used to apply the load, the speed of head travel shall be 0.02 inch (0.5 mm) per minute.
- 4.5.12 Contact Retention (see 3.6.10). Terminated inserts shall be tested in accordance with MIL-STD-1344, Method 2007. Axial load shall be 10 lb. for size 20-22 contacts and 25 lb. for size 16 contacts, and 30 lb. for size 12 contacts, applied to mating ends of contacts. In addition to the 10 lb. axial load, shield grounding accessories shall also have an 8 lb. load applied at ninety degrees in each of the 2 other major axes, pulling in a direction away from the centerline of the MTC housing.
- 4.5.13 Coupling Torque (see 3.6.11). The torque required to completely engage the helix on each side of the connector shall be measured.
- 4.5.14 Coupling Mechanism Proof Test (see 3.6.12). A torque of 40 inch-lb. shall be applied to the coupling mechanism at each side of a mated connector. The shells and hardware shall be visually examined for damage.
- 4.5.15 Maintenance Aging (see 3.6.13). Terminated connector assemblies shall be fully mated and unmated three times. 20 percent of size 20-22 contacts and all size 16 and size 12 contacts shall be removed and reinstalled in the inserts 10 times. Shield grounding accessories shall be removed and reinstalled 3 times in a manner simulating actual service. Shield grounding accessories shall have a minimum of 4 contacts tested on each accessory which shall be removed and reinstalled 3 times.

	Tyco Electronics Corporation 300 Constitution Drive Menlo Park, CA 94025 USA		No: C-6114 Rev: B Date: August 2, 2004 Page: 20 of 23
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- 4.5.16 Random Vibration (see 3.6.14). Terminated, mated connector assemblies shall be tested in accordance with MIL-STD-1344, Method 2005, Test Condition V, Letter E. Connectors shall be panel mounted by normal means, with at least 8 inches (200 mm) of wire unsupported behind each connector. Specimens shall be subjected to vibration for 8 hours in each major axis for a total of 24 hours. Shield grounding accessories shall have a minimum of 4 ground circuit wires independently monitored for discontinuities.
- 4.5.17 Mechanical Shock (see 3.6.15). Terminated, mated connectors shall be tested in accordance with MIL-STD-1344, Method 2004, Test Condition A. The connectors shall be panel mounted by normal means, with at least 8 inches (200 mm) of wire unsupported behind each connector. Shield grounding accessories shall have a minimum of 4 ground circuit wires independently monitored for discontinuities.
- 4.5.18 Thermal Cycling (see 3.6.16). Mated connector assemblies shall be tested in accordance MIL-STD-202, Method 107, Test Condition B.
- 4.5.19 Temperature Life (see 3.6.17). Terminated, mated connector assemblies shall be tested in accordance with MIL-STD-1344, Method 1005, for 1000 hours at 125°C, using an air-circulating oven. Contacts shall not be wired in series or connected to an electrical load. Leads shall be brought out through a suitable port so that electrical measurements can be taken. After 1000 hours and while connectors are still at the maximum rated temperature and mated, the insulation resistance shall be measured in accordance with 4.5.3.
- 4.5.20 Humidity (see 3.6.18). Terminated, mated connector assemblies shall be tested in accordance with MIL-STD-1344, Method 1002, Type II. Polarization voltage is not required. Step 7 (a) shall be performed during the last cycle. After the end of the last cycle the connector assemblies shall be removed from the humidity chamber and placed in ambient conditions. Insulation resistance measurements shall be made within 1 to 2 hours and again after 24 hours.
- 4.5.21 Seal Leakage (see 3.6.19). Terminated, mated connectors shall be tested in accordance with the seal leakage procedure specified in ARINC Specification 600 Attachment 19.
- 4.5.22 Polarization Lockout (see 3.6.20). Connector assemblies shall be prepared with one side of the shells having compatible keying pins and the other side having keying pins, which completely interfere with each other. The mating hardware on the side of the connector with compatible keying pins shall be engaged. The force required to override the keying pins shall be recorded. The applied force shall be limited to 100 lb. The test shall then be repeated with the interfering keying pins at right angles to each other forming a 50% interference.


	Tyco Electronics Corporation 300 Constitution Drive Menlo Park, CA 94025 USA		No: C-6114 Rev: B Date: August 2, 2004 Page: 21 of 23
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- 4.5.23 Salt Spray (see 3.6.21). Terminated unmated connector assemblies shall be tested in accordance with MIL-STD-1344, Method 1001, Test Condition B. Suitable measures shall be taken to preclude migration of condensation along the conductors.
- 4.5.24 Ozone Exposure (see 3.6.22). Terminated unmated connector assemblies shall be tested in accordance with MIL-STD -1344, Method 1007.
- 4.5.25 Fluid Immersion (see 3.6.23)
- 4.5.25.1 Seals. One mated pair of connectors shall be tested in accordance with MIL-STD-1344, Method 1016 in the fluids shown in Table XIII. Following the required number of cycles the parts shall be subjected to the dielectric withstanding voltage test.

TABLE XIII: Fluid Immersion Test

MIL-STD-1344, Method 1016 Fluid designation	Fluid specification	Fluid description
Fluid (e)	MIL-L-23699	Lubricating Oil
Fluid (a)	MIL-H-5606	Hydraulic Fluid
Fluid (i)	TT-I-735 and TT-I-291 or P-D-680	Isopropyl Alcohol and Mineral Spirits

- 4.5.25.2 Retention System. An unmated pair of connectors, without contacts installed, shall be immersed in each of the fluids in Table XIII for 20 hours at room ambient conditions. After removal excess fluid shall be allowed to drain from each connector half for 4 hours prior to the measurement of contact retention forces and insert retention forces. Shield grounding accessories shall meet the contact retention requirements of 3.6.10.
- 4.5.26 Magnetic Permeability (see 3.6.24). Connector components shall be tested in accordance with MIL-STD-1344, Method 3006.
- 4.5.27 Contact Inductive Load Switching (3.6.25). Each of five contacts shall be demated ten times while supplying current to an inductive load. The circuit parameters shall be 5.0 amperes for size 20-22 contacts, 115 volts, 400 Hz, and 0.70 +/- 0.05 lagging power factor.
- 4.5.28 Circuit Breaker Compatibility (see 3.6.26). Size 20-22 contacts in a mated connector assembly shall be subjected to an overload current of 50 amps for 1 second. Each overload condition shall be tested five times using a different contact each time.

	Tyco Electronics Corporation 300 Constitution Drive Menlo Park, CA 94025 USA	Raychem	No: C-6114 Rev: B Date: August 2, 2004 Page: 22 of 23
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- 4.5.29 Engaging Force with Contacts (see 3.6.27). The maximum forces required to engage the connector coupling mechanisms shall be determined under two conditions. The maximum longitudinal force required to bring the two mating halves of a connector together, while maintaining the front surfaces parallel to each other, shall be measured. The connector halves shall then be demated and separated. The coupling mechanism at one side of the connector shall then be full engaged. The maximum longitudinal force, applied to the driver, required to bring the coupling helix at the second side of the connector into an engaging position shall then be measured.
- 4.5.30 Ground Pin Insertion Force (see 3.6.28). Shield grounding accessories shall be tested in accordance with MIL-STD-1344, Method 2012 without the use of an insertion tool.
- 4.5.31 Probe Damage (see 3.6.29). Shield grounding accessories shall be tested accessories shall be tested in accordance with MIL-STD-1344, Method 2006, except that the probe depth shall be 0.550 +/- 0.010 inches.
- 4.5.32 Contact Walkout (see 3.6.30). Two pin contacts and two socket contacts in an insert shall be tested. The contacts shall be soldered or crimped as applicable, to stranded steel or steel-cored cable of an appropriate size and the inserts shall be installed in a shell without a cable clamp. The unmated connector shall be mounted in a test fixture as described in ARINC 600-8, Section 19.5.21. A 3.0 lb. weight shall be attached to the cable. One 360° rotation of the fixture with the connector mounted shall constitute one cycle. The connector shall be subjected to 100 cycles at a rate of 10 to 20 cycles per minute. Shield grounding accessories shall have a minimum of 2 contacts tested on each accessory.
- 4.5.33 Post Test Examination (see 3.6.31). The tested connectors shall be examined for evidence of cracking, loosening of parts, carbon tracking, excess wear, or missing parts.

tyco <i>Electronics</i>	Tyco Electronics Corporation 300 Constitution Drive Menlo Park, CA 94025 USA	Raychem	No: C-6114 Rev: B Date: August 2, 2004 Page: 23 of 23
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5.0 PREPARATION FOR DELIVERY

5.1 Packaging and Packing. Unless otherwise specified in the procurement document, packaging and packing shall be in accordance with commercial practice.

5.2 Marking. Unless otherwise specified in the procurement document, marking shall be in accordance with commercial practice.