



IEEE Standard for Receiver Fixture Interface

IEEE Standards Coordinating Committee 20

Sponsored by the
IEEE Instrumentation and Measurement Society

and the

IEEE Standards Coordinating Committee 20 on
Test and Diagnosis for Electric Systems

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IEEE Standard for Receiver Fixture Interface

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**IEEE Standards Coordinating Committee 20 on
Test and Diagnosis for Electric Systems**

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Abstract: This standard provides a mechanical and electrical specification for implementing a common interoperable mechanical quick disconnect interconnect system for use by industry for interfacing large numbers of electrical signals (digital, analog, RF, power, etc.). These large interface panels (receiver and fixture panels) are employed primarily in test systems between stimulus/measurement assets and a related unit under test (UUT), although any application involving high density contacts requiring a quick disconnect interface could benefit. The Receiver is a receptacle that is mounted to test system mates with multiple Fixtures, which serve as the "buffer" between the UUT and ATE. Fixtures translate standard I/O signal routing offered at the Receiver to a wiring interface that directly connects to the UUT. These UUT interfaces can represent cable connectors, direct plug-in (printed circuit board edge connectors), sensor monitoring, or manual feedback from the test technician.

The primary objectives of this standard are: a) to establish interface standards that permit interchangeability of mechanical/electrical receiver/fixture/connector product assemblies from various manufacturers under an "open architecture"; and b) to develop within this framework a defined set(s) of interconnecting connector and mechanical specifications that supports available, accepted, low- cost commercial technology to reduced dependence on proprietary designs, and extend life- cycle availability.

Keywords: connector, fixture, framework, interface, interoperability, mass-interconnect, quick disconnect, receiver, specification

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Introduction

This introduction is not part of IEEE Std 1505-2006, IEEE Standard for Receiver Fixture Interface. The information provided is informative only. It provides background and general overview of the standard to assist interested parties implementing the specification.

Historical Background

On September 19, 1996, a group of receiver fixture product vendors/integrators announced the formation of an industry standards group called the RFI Alliance.

The organization later sought to gain identity through a standards organization, which ultimately became the Institute of Electrical and Electronic Engineers, Inc. Under the joint sponsorship of the Instrumentation and Measurement Society and SCC-20 Subcommittee of the Computer Society, a PAR 1505 Standard Working Group was developed and authorized by the IEEE Standards Association. Participation in the IEEE Std 1505 RFI Working Group is open to vendors, integrators and users.

IEEE Std 1505 Receiver Fixture Interface Working Group focus

The IEEE Std 1505 RFI Working Group sponsored by the IEEE Instrumentation and Measurement Society and the IEEE SCC-20 Technical Committee was formed to define a common electrical/mechanical interface specifications for applications involving test, production processing, quick-disconnect electrical interfacing, and subassembly mating requirements. The group is made up of technical individuals from industry, government, and academia, which reflect perspective views of a supplier, user, and general interest in the standard. To derive these specifications, the IEEE Std 1505 Working Group utilized the results of a study conducted by the Department of Defense Automatic Test System Research & Development Integrated Product Team (ARI) Critical Interface Working Group (CIWG), which reviewed as part of their tasks the Automatic Test System (ATS) Test Interface and the joint industry/government Common Test Interface (CTI) Working Group. The methodology step process includes: (a) defining the problem, (b) establishing a set of requirements, (c) evaluating available interface designs against a set of parameters that relate to the problem and requirements, and (d) defining a specification that will meet the consensus of the Working Group and industry short- and long-term goals. It was designed upon open standards or functional specifications that are supported by multiple-vendor products.

Cooperative relationship with the Common Test Interface (CTI)

This IEEE Std 1505 serves as the basis for supplemental pin map configuration standards, such as IEEE Std 1505.1 and others that are expected to meet unique pin map requirements. Future revisions to this document are expected to add new connector styles or types that support RFI needs.

The IEEE Std 1505 Working Group recognizes industry/government end-user integration and maintenance support of a defined Common Test Interface (CTI), a specific connector/pin map implementation of the standard. IEEE Std 1505 provides for these CTI end-users, and for its ATE system and hardware integrators, a defined, standardized framework and connector, and configuration specification to assure agency/aerospace interoperability and upward compatibility. The CTI Working Group is also developing a Common Test Interface Pin Map Configuration IEEE Std 1505.1 that uses this standard as its basis.

Vendor responsibility

Users and buyers of the IEEE 1505-compliant hardware are forewarned that neither the IEEE nor any other referenced agency has responsibility for the warranty or certification of any RFI product compliance. Therefore, purchasers of RFI products are encouraged to request such information from the manufacturer.

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IEEE Standard for Receiver Fixture Interface

1. Overview

1.1 Scope

The scope of this document is the development of a common receiver/fixture interface (RFI) specification that is based upon available commercial standards integrated under a common “open” architecture. This mechanical/electrical interface is intended to serve government/commercial interest for applications in test, system integration, manufacturing, monitoring, and other functional requirements that demand large contact densities and quick-disconnect mechanical operation. A joint technical forum has been operational since 1997 under the auspices of the IEEE Std 1505 RFI Working Group and a recently formed industry/government Common Test Interface (CTI) Working Group.

Readers of this document are encouraged to comment on details unclear, contradictory, or undefined to the IEEE 1505 RFI Working Group or the IEEE Standards Association for review and change. These organizations can be contacted at the locations described in the preface of this document.

As IEEE Std 1505 evolves, additional revisions may be required and reballoted by the IEEE Standards Association. The RFI Working Group serves to encourage vendors to produce same product class types that are intermatable and interchangeable by adhering to performance specifications of this standard.

The document has been developed in accordance with Institute of Electrical and Electronic Engineers (IEEE) Standards Association Policies and Procedures per the *IEEE-SA Standards Board Bylaws* [B23],¹ the *IEEE-SA Standards Board Operations Manual* [B24], the *IEEE-SA Standards Companion* [B25], and the *IEEE Standards Style Manual* [B26]. Additional guidance and reference was utilized from *The Authoritative Dictionary of IEEE Standard Terms* [B15] and *SI 10™ American National Standard for Use of the International System of Units (SI): The Modern Metric System* [B35].

1.1.1 Annexes overview

Included within this document are two informative annexes: (a) Annex A “Receiver Fixture Interface (RFI) Tutorial, dated 11/1/05,” an overview of the RFI description, background, and application use to inform new users; and (b) Annex B “Automatic Test System Critical Interfaces Report, dated 9/30/96” [B27], the results of a study conducted by the Department of Defense Automatic Test System Research and Development

¹The number in brackets correspond to those of the bibliography in Annex C.

Integrated Product Team (ARI) Critical Interface Working Group (CIWG), which reviewed as part of their tasks the ATS test interface.

1.2 Purpose

The purpose of this standard is to permit interchangeability of mechanical/electrical receiver/fixture/connector product assemblies from various manufacturers under an “open architecture.” To develop within this framework, a defined set(s) of interconnecting connector and mechanical specifications that supports available, accepted, low-cost commercial technology to reduce dependence on proprietary designs and extends life-cycle availability. Technical requirements identified by government and industry include maximum flexibility, scalability, and range of application.

2. Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments or corrigenda) applies.

ANSI B46 Surface Texture (Surface Roughness Waviness and Lay).²

ANSI/NCSL Z540-1 Laboratories, Calibration, and Measuring and Test Equipment.

ASTM A240, ASTM A666, ASTM A693 Steel Plates, Sheets and Strip-Corrosion Resisting.³

ASTM A342 Indicator, Permeability, Low-Mu (Go–No Go).

ASTM A484 Steel Products Wrought Stainless and Heat Resisting General Requirements.

ASTM A581 Steel Wire Free Machining Stainless and Heat Resistant.

ASTM A582 Free Machining Stainless and Heat Resisting Steel Bars, Hot Rolled or Cold Finished.

ASTM A967, SAE AMS QQ-P-35 Passivation Treatment for Austenitic, Ferritic, and Martensitic Corrosion-Resistant Steel (Fastening Devices).

ASTM B103 Phosphor Bronze Plate, Sheet Strip and Rolled Bar Specification.

ASTM B121/B12M, QQ-B-613 Brass, Leaded/Non-Leaded; Flat Products.

ASTM B134 Brass Wire.

ASTM B139, QQ-B-750 Bronze, Phosphor, Bar, Plate, Rod, Sheet, Strip, Flat Wire, and Structural and Special Shaped Sections.

ASTM B159 Wire Phosphor Bronze.

ASTM B16 Rod, Brass, Free-Cutting, Bar and Shapes for Use in Screw Machines.

²ANSI publications are available from the Sales Department, American National Standards Institute, 25 West 43rd Street, 4th Floor, New York, NY 10036, USA (<http://www.ansi.org/>).

³ASTM publications are available from the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, USA (<http://www.astm.org/>).

ASTM B194, QQ-C-530 Copper-Beryllium Alloy Bar/Rod/Wire (Copper Alloy Numbers 172/173).

ASTM B194, QQ-C-533 Copper-Beryllium Alloy Strip (Copper Alloy Numbers 170 and 172).

ASTM B196 Rod and Bar, Copper-Beryllium Alloy.

ASTM B197 Wire, Alloy Copper-Beryllium.

ASTM B206/B206M, QQ-W-321 Wire, Copper Alloy.

ASTM B209, QQ-A-250/11 Aluminum Alloy 6061, Plate and Sheet.

ASTM B209, QQ-A-250/12 Aluminum Alloy 7075, Plate and Sheet.

ASTM B209, QQ-A-250/2 Aluminum Alloy 3003 Plate and Sheet.

ASTM B209, QQ-A-250/4 Aluminum Alloy 2024 Plate and Sheet.

ASTM B209, QQ-A-250/8 Aluminum Alloy 5052 Plate and Sheet.

ASTM B209, SAE-AMS-QQ-A-250/1 -Aluminum Alloy 1100 Plate and Sheet.

ASTM B301 Free Cutting Copper Rod and Bar.

ASTM B36 Plate, Brass, Sheet, Strip, and Rolled Bar.

ASTM B441 Copper Cobalt Beryllium Rod and Bar.

ASTM B488 Gold for Engineering Uses, Electrodeposited Coatings of.

ASTM B740 CDA 72,900 Copper Nickel Tin Alloy.

ASTM D4067 Gold Plating, Electrodeposited.

ASTM D5927 Thermoplastic Polyester (TPES) Injection and Extrusion Materials Based on ISO Test, Methods, Standard Specification for.

ASTM D5948, Type SDG-F Molding Plastics and Molded Plastic Parts, Thermosetting.

ASTM-B121/B12M, QQ-B-626 Brass, Leaded/Non-Leaded; Rod/Shapes/Forgings/Flat Products with Finished Edges (Bar and Strip).

EIA 364, MIL-STD-1344A Test Methods for Electrical Connectors.

EIA 557 Statistical Process Control Systems.⁴

Electrical Safety-Related Work Practices Inspection Procedures and Interpretation Guidelines.
STD 01-16-007 [STD 1-16.7] (1991, July 1).

⁴EIA publications are available from Global Engineering Documents, 15 Inverness Way East, Englewood, CO 80112, USA (<http://global.ihs.com/>).

Enforcement of the Electrical Power Generation, Transmission, and Distribution Standard. CPL 02-01-038 [CPL 2-1.38] (2002, October 31).⁵

FED-STD-H28 Screw Thread Standards for Federal Services.

IEC 309-1 Plugs, socket-outlets and couplers for industrial purposes—Part 1.⁶

IEEE Standards Style Manual, July 2005.⁷

IEEE/ASTM SI 10, American National Standard for Use of the International System of Units (SI).

Inspection Guidelines for 29 CFR 1910. STD 01-06-006 [STD 1-6.6] (1995, June 16).

IPC-D-275 Design Standard for Rigid Printed Boards and Rigid Printed Board Assemblies.

ISO 10012-1 Equipment, Quality Assurance Requirements for Measuring, Part 1: Meteorological Confirmation System for Measuring Equipment.

ISO 9001 Quality Systems Model for quality assurance in design/development, production, installation and servicing.⁸

MIL -F-14072 Finishes for Ground Electronic Equipment.

MIL-C-24308 Filter Connectors.

MIL-C-83517 Connector, Coaxial, RF for Coaxial, Strip or Microstrip Transmission Line.

MIL-C-83517 SMA Series Coaxial Connectors.

MIL-DTL-16878/1 Wire, Electrical, Insulated, High Temperature—General Requirements for.⁹

MIL-DTL-55302 Connectors, Printed Circuit Subassembly and Accessories.

MIL-DTL-55330 Connectors, Electrical and Fiber Optic, Packaging of.

MIL-HDBK-217 Reliability Prediction of Electronic Equipment.

MIL-HDBK-454A/4 General Guidelines for Electronic Equipment.

MIL-M-24519 Molding Plastics, Polyester Thermoplastic, Polyarylether Thermoplastic, Plastic Molding Material, Polyphenylene Sulfide, Glass Fiber Reinforced.

⁵U.S. Regulatory Guides are available from the Superintendent of Documents, U.S. Government Printing Office, P.O. Box 37082, Washington, DC 20013-7082, USA (<http://www.access.gpo.gov/>).

⁶IEC publications are available from the Sales Department of the International Electrotechnical Commission, Case Postale 131, 3, rue de Varembe, CH-1211, Genève 20, Switzerland/Suisse (<http://www.iec.ch/>). IEC publications are also available in the United States from the Sales Department, American National Standards Institute, 25 West 43rd Street, 4th Floor, New York, NY 10036, USA (<http://www.ansi.org/>).

⁷These publications are available from the Institute of Electrical and Electronics Engineers, Inc., 445 Hoes Lane, Piscataway, NJ 08854, USA (<http://standards.ieee.org/>).

⁸ISO publications are available from the ISO Central Secretariat, Case Postale 56, 1 rue de Varembe, CH-1211, Genève 20, Switzerland/ Suisse (<http://www.iso.ch/>). ISO publications are also available in the United States from the Sales Department, American National Standards Institute, 25 West 43rd Street, 4th Floor, New York, NY 10036, USA (<http://www.ansi.org/>).

⁹Copies of specifications, standards, drawings, and publications required by manufacturers in connection with specific procurement functions may be obtained from the U.S. Government Printing Office, P.O. Box 37082, Washington, DC 20013-7082, USA (<http://www.access.gpo.gov/>) or from other sources that may require additional fees.

MIL-M-24519, GDI-30F, GPT-30F, GST-40F Molding Plastics, Electrical, Thermoplastic.

MIL-P-55110 Military Specification, General Specification For Printed-Wiring Boards.

MIL-PRF-31032 Performance Specification Printed Circuit Board/Printed Wiring Board, General Specification for (w/Amendment 1) Revision: A, Dated: 24 February 2006.

MIL-PRF-55110 Performance Specification, Printed Wiring Board, Rigid, General Specification for (w/Amendment 1) FSC 5998.

MIL-STD-1130 Connections, Electrical, Solderless Wrapped.

MIL-STD-1285 Marking of Electrical and Electronic Parts.

MIL-STD-1344A Test Methods for Electrical Connectors (equivalent standard EIA 364).

MIL-STD-202G Test Methods for Electronic and Electrical Component Parts.

MIL-STD-2166 Connections, Electrical, Compliant Pin FSC 5935.

MIL-STD-275 Printed Wiring for Electronic Equipment (equivalent standard IPC 2221).

MIL-STD-810 Environmental Test Methods.

MIL-STD-889 Dissimilar Metals.

MIL-W-16878, General Cable Manufacturers, Specifications.

MS3197 Gage Pin for Socket Contact Engagement Test.

OSHA Technical Manual (OTM). TED 01-00-015 [TED 1-0.15A] (1999, January 20).

SAE AMS QQ-N-290 Nickel Plating (Electrodeposited).

SAE AMS QQ-S-763 Steel Bars, Wire, Shapes, and Forgings, Corrosion-Resistant.

SAE AMS-3197, MS-3197 Gauge Pin for Socket Contact Engagement Test.

SAE AMS-81728 Plating, Tin-Lead (Electrodeposited).

SAE-AMS 2422, Gold Plating for Electronic and Electrical Applications.

SAE-AMS-2418 Copper Plating (Electrodeposited).

SAE-AMS-QQ-A-250/1 Aluminum 1100, Plate and Sheet.¹⁰

SAE-AMS-QQ-A-250/11 Aluminum Alloy 6061, Plate and Sheet.

SAE-AMS-QQ-A-250/12 Aluminum Alloy 7075, Plate and Sheet.

SAE-AMS-QQ-A-250/2 Aluminum Alloy 3003, Plate and Sheet.

¹⁰SAE publications are available from the Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096, USA (<http://www.sae.org/>).

SAE-AMS-QQ-A-250/4 Aluminum Alloy 2024, Plate and Sheet.

SAE-AMS-QQ-A-250/8 Aluminum Alloy 5052, Plate and Sheet.

SAE-AMS-QQ-B-613 Brass, Leaded/Non-Leaded; Rod/Shapes/Forgings/Flat Products with Finished Edges (Bar and Strip).

SAE-AMS-QQ-B-626 Brass Wire.

SAE-AMS-QQ-B-750 Bronze, Phosphor, Bar, Plate, Rod, Sheet, Strip, Flat Wire, and Structural and Special Shaped Sections.

SAE-AMS-QQ-C-530 Copper-Beryllium Alloy Bar/Rod/Wire (Copper Alloy Numbers 172/173).

SAE-AMS-QQ-C-533 Copper-Beryllium Alloy Strip (Copper Alloy Numbers 170 and 172).

SAE-AMS-QQ-P-35 Passivation Treatments for Corrosion-Resistant Steel.

SAE-AMS-QQ-S-766 Steel, Corrosion Resisting.

SAE-AMS-QQ-W-321 Wire, Copper Alloy.

SAE-AS39029 Contacts, Electrical Connector, General Specification for.

2.1 Conventions

2.1.1 Order of precedence

Rule 2.1.1: In the event of a conflict between the text of this specification and the references cited herein (except for associated detail specifications, specification sheets, or mil-spec standards), the text of this specification shall take precedence. Nothing in this specification, however, shall supersede applicable laws and regulations unless a specific exemption has been obtained. Any change, however, to those references or the specification once approved must follow the IEEE Standards Association Operational Manual to reinitiate a change to the document and subsequent ballot/approval policies (consult IEEE Web site www.ieee.org for current policy requirements).

2.1.2 RFI qualification requirements versus standard specification relationships

Rule 2.1.2: Product qualification requirements shall be as specified herein and related to applicable specifications. In the event of any conflict between the qualification requirements and the specification documents, the latter shall govern.

2.1.3 Reference applicability to this standard

Observation 2.1.3: The IEEE Std 1505 requires a measurement means for evaluating vendor products but does not intend to impose undue rigorous demands on a commercial-off-the-shelf (COTS) product being applied to the RFI specification. The IEEE Std 1505 will accept any equivalent standard to that referenced, both active or inactive, as long as the vendor applies common criteria referenced within the respective reference. The goal offered by these references is to give vendors a measurement stick for comparing its product to that of another. It is not the intent of the standard to be so rigorous that vendors qualifying its product under older standards must continue to requalify that product as the reference is superseded, modified, or discontinued. For this reason both are referenced without revision dates.

2.1.4 Responsibility of the vendor and implementer

Rule 2.1.4: The IEEE 1505 Working Group and IEEE Standards Organization or its respective representatives shall not accept any liability, either implied or otherwise, for vendors' products stipulating compliance to the IEEE 1505 RFI Specification. It shall be understood that integrators have full responsibility to accept product with or without understood limitations and shall have responsibility for soliciting from the supplier any and all certifications that the product meets the specifications.

3. Definitions

For the purposes of this document, the following terms and definitions apply. Annex C, *The Authoritative Dictionary of IEEE Standards Terms*, and IEEE Std C37.100™ [B22] should be referenced for terms not defined in this clause.

3.1 Definition of specification terms

This section describes the specification terms used throughout this document.

Rule: Rules *shall* be followed to ensure compatibility to the standard. A rule is characterized by the use of the words *shall* and *shall not*. These words are not used for any other purpose other than stating rules.

Recommendation: Recommendations consist of advice to applicants that will affect the usability of the final device. Discussions of particular hardware to enhance throughput would fall under a recommendation. These should be followed to avoid problems and to obtain optimum performance.

Suggestion: A suggestion contains advice which is helpful but not vital. The reader is encouraged to consider the advice before discarding it. Suggestions are included to help the novice designer with problematic areas of the design.

Permission: Permissions are included to clarify the areas of the specification that are not specifically prohibited. Permissions reassure the reader that a certain approach is acceptable and will cause no problems. The word *may* is reserved for indicating permissions.

Observation: Observations spell out implications of rules and bring attention to things that might otherwise be overlooked. They also give the rationale behind certain rules so that the reader understands why the rule must be followed.

3.2 ball-lock mechanism: A pin and socket type of mechanical assembly used in the RFI frameworks, that when latched together can withstand considerable push-pull force (maximum 159 kg [350 lb] per ball-lock assembly) applied to engage or disengage their respective attached frames.

3.3 connector module body: A dielectric material that holds the contacts in their proper arrangement and electrically insulates them from each other and is secured to the framework as a single slot, two slot, and four slot wide application.

3.4 continuous frame interval: An RFI framework segmentation in which a frame can be extended to 9, 14, 24, and 29 slots without segmentation or fixture shroud spacing.

3.5 combination frame interval: An RFI framework segmentation, in which a combination of a segmented frame and representative continuous frame are applied.

3.6 eurocard DIN standard: The Eurocard Deutsches Industrie Normal (DIN) Standard (German industry connector standard organization), which establishes a signal pin contact definition and connector footprint standard for RFI mounting, stroke, and interchangeability for RFI connector modules and contact implementation.

3.7 fixture: An assembly that integrates a fixture frame, fixture enclosure and any other passive and active components or wiring necessary to interconnect the test system to the UUT.

3.8 fixture enclosure: Typically a metal encasement that is attached to the fixture frame to contain and protect components and cabling.

3.9 fixture frame: RFI framework element that supports fixture connectors, keying, and ball-lock/release subassemblies.

3.10 fixture plug/pin header connector module: A connector module mounted to the fixture framework and typically identified as pins protruding from its housing that is encased by a shroud and recessed within the fixture to protect the pins from damage.

3.11 frame interval: The mechanical frame width dimension of 76.20 mm (3.00 in.) that identifies with a segmented frame supporting four connector slots and is iterated to create continuous and combination framework.

3.12 framework structure: A contoured tongue-and-groove metal or composite structure with different spacing on the top and bottom frame outline for keying and alignment function that supports ball-lock assembly and connector mounting.

3.13 mechanical float: The ability of framework, connector housing, or the contact/termination to adjust position within fixed mechanical limits.

3.14 mechanical advantage: Mechanical leverage that the receiver drive system is capable of producing, which is represented as the ratio of engagement force versus the force applied by the operator on the manual handle, or motor torque applied to the drive system.

3.15 MIL-DTL-55302 military connector standard: A U. S. Defense Department connector standard to meet higher environmental and electrical performance requirements for avionic board connectors based upon the commercial DIN standard.

3.16 pin contact: Male mating contact that is applied typically in the fixture module and may be terminated by direct wire, solder post for PCB mounting, or wire-wrap post.

3.17 receiver frame: The framework assembly that is fixed to the test system and configured to serve as a common interface for multiple fixtures. It houses the receiver connectors and mechanical actuator subsystem that connects or disconnects the fixture frame to the receiver.

3.18 receiver ball-lock receptacle/fixture ball-lock assembly: A mechanical assembly that, when engaged in a pin-and-socket fashion, aligns and automatically latches the receiver and fixture framework together or, when operated upon, can release the frames.

3.19 receiver receptacle connector module: Connector assembly that houses the receptacle contacts, which is normally mounted in the receiver in a recessed manner to protect the contact from damage and operator from potential live circuit condition.

3.20 Receiver fixture interface (RFI): Represents a mass electrical interconnect system that includes a test interface panel (receiver) mounted to the test system and multiple mating test interface panels (fixtures) that are uniquely designed to adapt the unit-under-test to the receiver.

3.21 RFI framework: Consists of two basic mating picture frame halves that support unique multiple functions of the interface, one for the receiver and the other for the fixture. See also Clause 5.

3.22 segmented framework: An RFI framework with a width dimension of 76.20 mm (3.00 in.) that supports two ball-lock engagement points, four connector slots 60.96 mm (2.40 in.) representing 4 x 15.24 mm (0.60 in.) slot width, and 7.62 mm (0.30 in.) space on each side of the four slots for the mating fixture protective shrouds.

3.23 slot: RFI term representing a connector footprint designated for one connector type with a footprint measuring 15.24 mm (0.60 in.) wide by 0.15 m (5.75 in.) long, based upon a MIL-DTL-55302 military connector standard, DIN type, signal module with 200 positions (4 x 50 pin).

3.24 socket contact: Female contact that is applied protectively within the housing of a receiver module and may be terminated by direct wire, solder post for PCB mounting, or wire-wrap post.

3.25 stroke: Length of movement or travel necessary to engage or disengage the RFI connectors along an axial dimension of a pin-and-socket contact.

3.26 termination: Part of a contact that is attached to the printed wiring board or hookup wire.

3.27 two-part connector: Defines a mating pair of a receiver connector module and fixture connector module that contains the respective socket or pin contacts, with integral alignment keying to assure proper mating of the contacts.

3.28 unit-under-test (UUT): The particular equipment being tested (e.g., printed circuit board, electronic device, electrical subassembly, etc.).

4. Qualification requirements

4.1 Responsibility for inspection

Rule 4.1: Unless otherwise specified, the manufacturer shall be responsible for the performance of all inspection requirements as specified herein. The referenced specifications and standards apply to extent that they are referenced herein. Where references overlap, are revised, or are superseded by other equivalent industry references, either may apply to this standard.

Permission 4.1: Manufacturers may use their own or any other facilities suitable for the performance of the inspection requirements specified herein.

4.1.1 RFI qualification requirements versus standard specification relationships

Rule 4.1.1: Product qualification requirements shall be as specified herein and related to applicable specifications. In the event of any conflict between the qualifications requirements and the specification documents, the latter shall govern.

4.1.2 Reference applicability to this standard

Observation 4.1.2: The IEEE Std 1505 requires a measurement means for evaluating vendor products, but does not intend to impose undue rigorous demands on a commercial-off-the-shelf (COTS) product being applied to the RFI specification. The IEEE Std 1505 will accept any equivalent standard to that referenced, both active or inactive, as long as the vendor applies common criteria referenced within the respective reference. The goal offered by these references is to give vendors a measurement stick for comparing their products to those of another. It is not the intent of the standard to be so rigorous that vendors qualifying product under older standards must continue to requalify that product as the reference is superseded, modified, or discontinued. For this reason both old and new standards are referenced without revision dates.

4.1.3 Inspection conditions

Rule 4.1.3: Unless otherwise specified herein, all inspections shall be performed in accordance with the test conditions specified in the general requirements of MIL-STD-202G and MIL-STD-1344A or the equivalent methods of EIA 364.

4.1.4 Test equipment and inspection facilities

Rule 4.1.4: Test and measuring equipment, ISO calibration and inspection facilities, maintained by inspection facility, shall be of sufficient accuracy, quality, and quantity to permit performance of the required inspection. The establishment and maintenance of a calibration system to control the accuracy of the measuring and test equipment (i.e., ANSI/NCSS Z540-1, ISO 10012-1 part 1, or comparable standards) shall be required.

4.1.5 Responsibility of the vendor and implementer

Rule 4.1.5: The IEEE and the IEEE Std 1505 Working Group or its respective representatives shall not accept any liability, either implied or otherwise for vendors' products stipulating compliance to IEEE 1505. It shall be understood that integrators have full responsibility to accept product with or without understood limitations and shall have responsibility for soliciting from the supplier any and all certifications that the product meets the specifications.

4.2 General requirements

4.2.1 Statistical process control (SPC)

Recommendation 4.2.1: It is recommended that the manufacturer implement and use SPC techniques in the manufacturing process for parts covered by this specification. The SPC program should be developed and maintained in accordance with guidelines of EIA-557. Where SPC cannot be utilized because of noncontinuous production requirements, a lot sampling plan for inspection in accordance with group A lot and sample size with $c = 0$ is recommended. The SPC and $c = 0$ programs may be documented and maintained as part of the overall reliability assurance program as specified in EIA-557.

4.2.2 Materials

Rule 4.2.2: Manufacturer shall identify materials used. When a definite material is not specified, a material shall be used that will enable the connectors and accessories to meet the form, fit, function, and performance requirement. Acceptance or approval of any constituent material by the buyer shall not be construed as a guaranty of the acceptance of the finished product from the manufacturer.

4.2.2.1 Reference materials, platings and processes

Rule 4.2.2.1a: The identified reference materials, platings, and processes have been established to provide assurances that connectors manufactured to this specification will properly interface to similar industry standard or government-specified connector systems without problems related to electrochemical contamination, or critical electrical or mechanical interfaces.

Permission 4.2.2.1: The manufacturers of connectors supplied to this specification may use alternate recognized industry standard materials, platings, and processes from those identified in 4.2.2 of this specification. However, use of alternate materials, platings, and processes shall be coordinated with the respective qualifying activity as part of the qualification process.

Rule 4.2.2.1b: Use of alternates to those referenced guidance items by the supplier shall not result in inferior short- or long-term performance or reliability of supplied connectors as compared with connectors manufactured using the referenced materials, platings, or processes. Short- or long-term failures or reliability problems due to use of these alternates shall be the responsibility of the supplier.

4.2.2.2 Recycled, recovered, or environmentally preferable materials

Recommendation 4.2.2.2: Recycled, recovered, or environmentally preferable materials should be used to the maximum extent possible provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life-cycle costs.

4.2.2.3 Nonmagnetic materials

Rule 4.2.2.3: All direct electrical interconnect/contact assembly parts shall be made from materials which are classed as nonmagnetic (permeability 2μ using indicator in accordance with ASTM A342).

4.2.2.4 Plastic molded materials

Rule 4.2.2.4: Unless otherwise specified (see respective Clauses 7–12), the connector molded body material shall conform to:

- a) SDG-F or GDI-30F in accordance with ASTM D5948 (see 4.2.2) *or*
- b) Type TPES013G30 in accordance with ASTM D5927 *or*
- c) PPS000G40A30330E1F01Y11 in accordance with ASTM D4067 *or*
- d) Type GPT-30F or GST-40F in accordance with MIL-M-24519
- e) Reground materials shall not be used.

4.2.3 Metals

4.2.3.1 Aluminum

Rule 4.2.3.1: Where applicable, aluminum shall be as specified in SAE-AMS-QQ-A-250/1 (Aluminum 1100), SAE-AMS-QQ-A-250/2 (Alloy 3003), SAE-AMS-QQ-A-250/4 (Alloy 2024), SAE-AMS-QQ-A-250/8 (Alloy 5052), SAE-AMS-QQ-A-250/11 (Alloy 6061), or SAE-AMS-QQ-A-250/12 (Alloy 7075), and anodized to meet the requirements of MIL-F-14072.

4.2.3.2 Corrosion-resistant steel

Rule 4.2.3.2: Where applicable, corrosion-resistant steel shall be 300 series, low magnetic permeability in accordance with SAE-AMS-QQ-S-763, ASTM A581, ASTM A582, or ASTM A484 and passivated in accordance with SAE-AMS-QQ-P-35, or to finish E300 as specified in MIL-F-14072.

4.2.3.3 Socket contacts, hermaphroditic contacts, and contact terminations

Rule 4.2.3.3: Socket contacts, hermaphroditic contacts, and contact terminations shall be copper-nickel-tin alloy C72900 per ASTM B740, or beryllium copper as specified in ASTM B194, ASTM B196 or ASTM B197 or C17500 in accordance with ASTM B441, or phosphor bronze in accordance with ASTM B103 or ASTM B139, or contact terminations of brass alloy in accordance with ASTM B16 or ASTM B134, or thermocouple materials in accordance with SAE-AS39029, or gold plated per 4.2.3.6.

4.2.3.4 Pin contacts and contact terminations

Rule 4.2.3.4: Pin contacts and contact terminations shall be:

- a) Copper-nickel-tin alloy C72900 as specified in ASTM B740 *or*
- b) Brass as specified in ASTM B16, ASTM B36, ASTM B134, or ASTM B121 *or*
- c) Phosphor bronze, in accordance with ASTM B139 or beryllium copper as specified in ASTM B159, ASTM B194, ASTM B196, ASTM B197, or C18700 in accordance with ASTM B301 *or*
- d) Thermocouple materials in accordance with SAE-AS39029 or gold plated per 4.2.3.6.

4.2.3.5 Connector guide pins and guide bushings

Rule 4.2.3.5: Guide pins and guide bushings shall be:

- a) Free-cutting, half-hard brass as specified in ASTM B36 or ASTM B121 *or*
- b) copper alloy as specified in ASTM B134, or ASTM B159, or ASTM B206 *or*
- c) Stainless steel as specified in SAE-AMS-QQ-S-763 or ASTM A582 *or*
- d) Alternate acceptable materials, which shall be of appropriate physical performance to provide a non-corrosive, nongalling condition and provide adequate wear characteristics in accordance with ASTM-A240, or similar nickel-based materials.

4.2.3.6 Plating

Rule 4.2.3.6: Unless otherwise specified (see Clause 6, Annex A, and Annex B), contacts shall be gold plated 76 μm (30 $\mu\text{in.}$) minimum, in accordance with ASTM B488 Type II, Class 1.27, Grade C, or the equivalent SAE AMS 2422 sections, over suitable underplate (see 4.2.3.3).

4.2.3.7 Nickel underplate

Rule 4.2.3.7: Nickel underplate shall be Class 2, 76 μm (30 $\mu\text{in.}$) to 381 μm (150 $\mu\text{in.}$), as specified in SAE-AMS-QQ-N-290.

4.2.3.8 Localized finish

Rule 4.2.3.8: Localized systems such as selective plating, welded dot, etc., are permitted in lieu of overall plating providing the following conditions are met:

- a) Contact engagement end shall be gold plated to 0.076 mm (30 $\mu\text{in.}$) minimum in accordance with ASTM B488, Type II, Class 1.27, Grade C, over nickel underplate per 4.2.3.8.
- b) Contact termination end plating (solderless wrap) shall be tin-lead (95-5%) composition in accordance with SAE-AMS-81728, 254 μm (100 $\mu\text{in.}$) to 762 μm (300 $\mu\text{in.}$) thick over nickel underplate in accordance with 4.2.3.8.
- c) Contact termination end plating (crimp), tin-gold (96%-4%) composition, 0.076 mm (30 $\mu\text{in.}$) minimum over nickel underplate in accordance with 4.2.3.8, or tin-lead (95-5%) composition 254 μm (100 $\mu\text{in.}$) minimum thickness in accordance with SAE-AMS-81728 over nickel underplate

in accordance with 4.2.3.8. Solder dipping is permitted, providing it meets procedures and requirements of MIL-STD-202G, Method 208.

- d) Nonfunctional areas need not be overplated, provided they have a minimum thickness of 127 μm (50 $\mu\text{in.}$) of nickel in accordance with SAE-AMS-QQ-N-290, Class 2.

Permission 4.2.3.8: When contacts have been provided in strip form, the absence of plating in the area where the contact was removed from the strip is acceptable provided it is in a nonfunctional area and any corrosion formed as a result of salt spray testing does not creep into contact mating area.

4.2.4 Restricted materials

4.2.4.1 Flammable, explosive, or toxic

Rule 4.2.4.1: Material shall be nonflammable, nonexplosive, and nontoxic over the operating temperature range.

4.2.4.2 Corrosion resistance

Rule 4.2.4.2: Framework, connectors, and accessories shall be of corrosion-resistant materials or treated to prevent corrosion.

4.2.4.3 Ferrous

Rule 4.2.4.3: Material containing more than 5% iron shall not be used for current carrying parts.

4.2.5 Dissimilar metals

Rule 4.2.5: Where dissimilar metals are used in intimate contact with each other, protection against electrolysis and corrosion shall be provided. Dissimilar metals shall be as defined in MIL-STD-889. Dissimilar metals such as brass, copper, or steel (except corrosion-resisting steel, passivated in accordance with 4.2.3.2), shall not be used in intimate contact with aluminum or aluminum alloy.

4.2.6 Fungus resistance

Rule 4.2.6: Finishes and materials used in the construction of all interface components shall be fungus inert in accordance with MIL-STD-810.

4.3 Qualification inspections

Rule 4.3: Qualification inspections shall be supported by verifying data from the manufacturer that the materials listed in Table 1, used in fabricating the framework, connectors, and accessories, are in accordance with the applicable IEEE Std 1505 conformance definitions, product drawings, and/or referenced specifications and maintained under equivalent ISO-9001 quality assurance provisions or otherwise agreed by the customer's quality authority where noncompliance occurs.

4.4 Inspection conditions

Rule 4.4: Unless otherwise specified herein, all inspections shall be performed in accordance with the test conditions specified or normal manufacturing expected conditions, whichever is more absolute. All products per advertised specifications shall be maintained under ISO-9000 quality assurance provisions or otherwise noted and agreed by the customer's quality authority.

Table 1—Qualification inspection

Component Material	Related RFI Spec Subclause	Applicable Referenced Specifications
Plastic, Molded Materials	5.4	SDG-F, GDI-30F, GPT-30F, GST-40F, MIL-M-24519, (equivalent to ASTM-D5927/ D5948), ASTM-D4067
Framework/Connector Metal Hardware	5.4	
Copper Nickel Alloy	5.4, 5.5; 6.7, 6.8	ASTM B740, SAE-AMS-2418, and SAE-AMS-QQ-N-290
Phosphor Bronze/Beryllium Copper	5.4, 5.5; 6.7, 6.8	SAE-AMS-QQ-B-750, SAE-AMS-QQ-C-530, or ASTM B139/B194, SAE-AMS-QQ-C-533
Copper Alloy Wire	5.4, 5.5; 6.7, 6.8	SAE-AMS-QQ-W-321, ASTM B206/B740
Brass (Leaded and Nonleaded)	5.4, 5.5; 6.7, 6.8	SAE-AMS-QQ-B-626 and SAE-AMS-QQ-B-613, ASTM B121, ASTM B134
Aluminum	5.4, 5.5; 6.7, 6.8	SAE-AMS-QQ-A-250/1./2./4./8./11 and /12; MIL-F-14072, ASTM-B209
Steel	5.4, 5.5; 6.7, 6.8	SAE-AMS-QQ-P-35, SAE-AMS-QQ-S-763, SAE-AMS-QQ-S-766, (or equivalent to ASTM A240, ASTM A666, ASTM A693, and ASTM-A967), and ASTM-A581/582/484
Dissimilar Metals	5.4, 5.7; 6.10	MIL-STD-889
Fungus Resistance	5.4, 6.11	MIL-HDBK-454A/4
Framework/Connector Body	5.4, 5.9, 5.10; 6.12	FED-STD-H28

4.5 Qualification inspection

Rule 4.5: Qualification inspection shall be performed on sample units produced with equipment and procedures normally applied in production.

4.5.1 Sample

Rule 4.5.1: Mating pairs of IEEE 1505 product samples and sample size shall be inspected per respective testing requirements per 4.6 and related specifications.

4.5.1.1 Sample inspection for RFI product

Rule 4.5.1.1: To qualify product elements described by applicable connector and contact clause specification (see Clauses 7–12) and supplied normally disassembled, each supplier shall perform compliance testing to the product level it supports (i.e., contacts only to contact specification that it advertises) or certify in accordance with the inspection criteria in Tables 2–4.

4.5.1.2 Sample size and measurements

Rule 4.5.1.2: Sample size of connectors shall be in accordance with respective product element specifications described in Clause 6. All framework sample units shall undergo full inspection requirements. For connector sample units, a total of 15% of the contact positions shall be measured per connector sample for each subgroup. For connectors with 13 or fewer contacts, all positions shall be measured. This shall apply to the requirements as specified in 4.6. The same contact positions shall be monitored throughout the test sequences.

4.5.2 Inspection routine

Rule 4.5.2: Sample units shall be subjected to the inspections specified in Tables 2–4. All RFI framework and connector assembly sample units shall be subjected to the visual, dimensional, mechanical, and environmental inspections in accordance with the inspection acceptance criteria in Tables 2–4. RFI connector samples shall further undergo testing in accordance with the connector inspection acceptance criteria in Table 3.

4.5.3 Failures

Rule 4.5.3: All failures shall be documented and reliability data supplied when requested by a purchaser to verify product conformance to IEEE Std 1505 or stipulate deviation.

Recommendation 4.5.3: MIL-HDBK-217 is the recommended resource for determining reliability for the respective product being supplied under this standard.

Suggestion 4.5.3: Failure history collection is suggested by all product manufacturers, to support goals of continuous improvement/product reliability enhancement.

Table 2—Framework and connector mechanical inspection acceptance criteria

Inspection Requirement	Related RFI Spec. Subclause	Method Subclause
Visual and mechanical	5.4–5.21; 6.8	4.6.1
Interchangeability and engagement forces*	5.10–5.13, 5.16, 6.12–6.14	4.6.2.1
Mating and unmating conformance*	5.10–5.18; 6.12–6.17	4.6.2.2, 4.6.2.3
Durability Cycling	5.21; 6.12–6.17	4.6.2.6, 4.6.2.7
Connector/Contact Conformance*	6.15	4.6.2.4, 4.6.2.5

*When applicable (see Subclause 4.3 and Table 4.1)

NOTE—All electrical tests may be performed on same sample(s) in one test. All mechanical tests may be performed on an additional sample(s) in one test group.

4.6 Method of examination and test

4.6.1 Visual and mechanical examination

Rule 4.6.1a: Examination shall be made to determine compliance with each of the requirements of 4.3.

Table 3—Connector electrical inspection acceptance criteria

Inspection Requirement	Related RFI Spec. Subclause	Method Subclause
Contact resistance	6.19	4.6.3.1
Electrical characteristics	6.8	4.6.3.9
Dielectric withstanding voltage* (sea level) 5 s exposure	5.20.1, 6.21	4.6.3.3
Low level contact resistance	6.22	4.6.3.4
Insulation resistance*	5.20.2, 6.23	4.6.3.5
Crimp/Wire-wrap termination	4.6.3.6	
Crimp tensile strength	6.29	4.6.3.7
Contact retention	6.20	4.6.3.2
Solderability (contacts only)	6.27–6.28	4.6.3.8

* Applicable to connectors furnished with assembled contacts.

Table 4—Framework and connector environmental inspection acceptance criteria

Inspection Requirement	Related RFI Spec. Subclause	Method Subclause
Operating temperature	5.22.1	4.6.4.1
Temperature cycling	5.22.2	4.6.4.2
Humidity	5.22.3	4.6.4.3
Vibration	5.22.5	4.6.4.4
Shock (specified pulse)	5.22.6	4.6.4.5
Salt spray	5.22.7	4.6.4.6
Solvent resistance/ Fluid immersion	5.22.8	4.6.4.7
Flammability	5.22.9	4.6.4.8

Rule 4.6.1b: Connectors and accessories shall be visually inspected in such a manner as to be uniform in quality and shall be free from burrs, crazing, cracks, voids, pimples, chips, blisters, pinholes, sharp cutting edges, and other defects that will adversely affect life, serviceability, or appearance.

4.6.2 Framework and connector mechanical specification conformance testing

4.6.2.1 Inspection for Interchangeability

Rule 4.6.2.1a: All RFI products shall satisfy interchangeability requirements between common or multiple-manufacturer entities by meeting:

- Physical configuration and dimensional measurements of 4.3
- Related Clause 5 (framework) and Clause 6 (connector) specifications

- c) Qualification inspections, as referenced in Table 3
- d) Subsequent applicable requirements in accordance with Methods 2013.1 *and* 2014 of MIL-STD-1344A or equivalent methods of EIA 364.

Rule 4.6.2.1b: The following dimensions shall be gauged or measured to determine conformance to the physical interchangeability requirements of applicable specifications (see 4.3). When a listed dimension is not within specified dimensions and tolerances as defined by this specification, it shall be considered a major defect, including:

- a) External and internal dimensions of cases, covers, and inserted assemblies, when such dimensions affect mating parts
- b) Dimensions of cavities, when such dimensions affect insertion of items
- c) Location of connectors, locking pins, fasteners, adequacy of connector float/mounting screw implementation, and other mountings, as applicable, which receive mating parts of plug-in assemblies and major units, and location of the mating parts on the plug-in assembly or major unit

Recommendation 4.6.2.1: It is recommended that manufacturers utilize opportunities to mate/unmate products with other manufacturers' products to assure compatibilities exist. Integrators and/or users may implement their own respective tests with multiple vendors' products to qualify source acceptance.

4.6.2.2 Mating framework conformance specification testing

Rule 4.6.2.2a: To meet IEEE Std 1505 requirements, each manufacturer shall conduct and comply with the mating framework conformance specification as established by Clause 5 and test in accordance with Method 2013.1 of MIL-STD-1344A, EIA 364, or equivalent methods, to verify the specification is being met. An applicable defined/measured compliant mating receiver/fixture test specimen, per 4.6.2.2, is required to perform this test.

Rule 4.6.2.2b: Each manufacturer, or third-party test facilitator, shall conduct mating receiver/fixture conformance tests in accordance with Method 2013.1 of MIL-STD-1344A, EIA 364, or equivalent methods, to verify the specification is being met, as described in 5.10 and 5.18. The test requires that a test specimen receiver or fixture be applied to a compliant mating frame, with a minimum engagement load of 75% of advertised engagement capability for a period of 5 s, through a 500-cycle exercise, without causing:

- a) Mechanical interference, binding, push-back by ball-lock spring actions, and/or visible wear to the receiver or fixture
- b) Misalignment of greater than 0.51 mm (0.02 in.) to preset alignment connector contact points (minimum of five contact points, four corners and center), per 76.2 mm (3.0 in.) increment of the framework
- c) Failure to engage, maintain engagement under 75% load of maximum pin load in quantity or force, and disengage the fixture and all related ball-lock mechanisms from their respective receiver receptacles
- d) Visible connector gap due to coplanar distortion, ball-lock nonengagement, or other mechanical instability that results in contact electrical "opens" or contact electrical/mechanical resistance beyond the specification;
- e) Failure to maintain parallel relationships between the receiver and fixture framework that would cause a greater than 2.032 mm (0.080 in.) gap between facing surfaces (see 5.10), contact electrical excessive resistance, or contact electrical opens
- f) Other detrimental impact to mating elements

A minimum sample of two units shall be measured on conformance test.

Rule 4.6.2.2c: Each manufacturer, or third-party test facilitator, shall conduct *framework fixture support weight tests* to verify the specification is being met, as described in 5.19. The test shall require that a compliant test specimen receiver and specified weighted fixture (fixture weight is calculated by applying the specified maximum weight at center point of fixture width at 381 mm (15 in.) from the face of the fixture framework), with a minimum engagement load of 75% load of maximum pin load in quantity or force, be engaged for a period of 10 s through a 100-cycle exercise, without causing any conditions specified in Rule 4.6.2.2b.

Rule 4.6.2.2d: Maximum fixture support weight rating of framework shall be as specified based upon combined drive and ball-lock engagement capability (holding force) not to be less than 45 kg (100 lb) per ball-lock, reflecting amount fixture weight that can be both supported in a cantilevered fashion while also meeting a specified engagement resistance specifications as tested in accordance with RFI qualification requirements (see 4.6.2).

4.6.2.3 Mating contact/receptacle conformance specification testing

Rule 4.6.2.3a: To meet IEEE Std 1505 requirements, each manufacturer shall conduct and comply with an mating contact/receptacle conformance specification established within each respective connector/contact specification described in Clauses 7–12. An applicable defined/measured compliant mating pin or receptacle contact test specimen per Clauses 7–12, is required to perform this test.

Rule 4.6.2.3b: Each manufacturer, or third-party test facilitator, shall conduct *mating contact/receptacle conformance tests* as subscribed herein, in which compliant test contact pins are applied to sample contact sockets of the connector, or the reverse for a period of 10 seconds/cycle, through a 500-cycle exercise, without causing:

- a) Visible wear to the socket or pin
- b) Loss of memory to spring-loaded receptacle features to maintain surface contact
- c) Nonconformance to mechanical engagement resistance (per 6.17) across mating surfaces
- d) Nonconformance to electrical resistance, or reduced parametric performance (per 6.19) across mating surfaces
- e) Mechanical pushback (greater than 15%) within connector housing cavity
- f) Other detrimental impact to mating elements

A minimum sample of seven mating connector sets shall be measured to satisfy conformance tests.

Rule 4.6.2.3c: Each manufacturer or third-party test facilitator shall conduct mating connector conformance tests as subscribed in **Rule 4.6.2.3b**. During 500 cycles of insertion and withdrawal, the force required to fully insert and withdraw a fully populated connector plug from the mating receptacle shall be measured after 25, 100, 250, and 500 cycles. Each fully populated connector plug and receptacle so mated shall be considered as one test specimen, with a minimum of three mated pairs being required to satisfy conformance tests. The measuring equipment shall conform to the following specifications:

- a) Axis of insertion of the pin contacts and mating receptacle contacts or hermaphroditic contacts as applicable shall coincide during insertion and withdrawal.
- b) Speed of insertion of the plug into the receptacle contacts shall not exceed 6 cycles per minute for constant speed machines, or the rate of loading shall not exceed 80 pounds per minute for constant-rate-of-force machines.
- c) Scale mechanisms shall have no dashpots or other damping devices.
- d) Scales shall be calibrated in 56.7 g (0.13 lb) steps or less and shall be accurate to within 56.7 g (0.13 lb).

NOTE—When mating and unmating tests are required by another test such as contact life, the preconditioning cycles are not required.

4.6.2.4 Oversized pin exclusion (pins only) test

Rule 4.6.2.4: The *oversized pin exclusion (contact pins only)* requirement, which determines RFI product pin dimension conformance, shall be met by inserting test sample pin into the mating end of the socket test fixture that excludes the entry of a test sample pin larger than the allowable maximum pin dimensions, as specified in Clause 6 and related detailed specifications in Clauses 7–12.

4.6.2.5 Oversized pin/probe damage socket test

Rule 4.6.2.5: The *oversized pin/probe damage socket test* requirement determines RFI connector socket/receptacle test sample ability to maintain dimension conformance when an oversized pin or probe is inserted in accordance with Method 2006-1 of MIL-STD-1344A, EIA 364, or equivalent methods. The connector and mating socket contact entry opening must prevent an oversized pin or probe that exceeds the tolerances, as specified in Clause 6 and related Annex descriptions, from entering the socket. The receptacle/socket test sample and oversized pin shall be fixtured to assure concentric relationships are maintained during the insertion test.

4.6.2.6 Framework durability cycling

Rule 4.6.2.6a: To meet IEEE Std 1505 requirements, each manufacturer shall subject the test specimen receiver and fixture to a *durability cycle test* in accordance with Method 2016 of the MIL-STD-1344A, EIA 364, or equivalent methods. A minimum durability cycle objective of 25,000 repetitions shall be used. Each manufacturer or third-party test facilitator shall establish a defined mechanical/electrical setup to assure a comprehensive test and data collection verifies the manufacturers product specifications and meets minimum requirements of IEEE Std 1505. The framework cycle test shall validate reliability of the framework to achieve its advertised capabilities under subsequent MIL-STD-1344A requirements.

Rule 4.6.2.6b: For the framework durability cycle test of fixture engagement, insertion, and withdrawal, the force shall be sufficient to fully insert and withdraw from the receiver. If the force is manually applied, it shall be measured at the operating handle and shall not exceed 16 kg (35 lb). Each plug and receptacle so mated shall be considered as one test specimen when further testing of the plug or receptacle is indicated. The measuring equipment shall conform to the following specifications:

- a) Axis of insertion of the pin contacts and mating receptacle contacts or hermaphroditic contacts as applicable shall coincide during insertion and withdrawal.
- b) Speed of insertion of the plug into the receptacle contacts shall not exceed six cycles per minute for constant speed machines, or the rate of loading shall not exceed 80 pounds per minute for constant-rate-of-force machines.
- c) Scale mechanisms shall have no dashpots or other damping devices.
- d) Scales shall be calibrated in 56.7 g (0.13 lb) steps or less and shall be accurate to within 56.7 g (0.13 lb).

4.6.2.7 Connector durability cycling

Rule 4.6.2.7a: To meet IEEE Std 1505 requirements, each manufacturer shall conduct and comply with an mating contact/receptacle conformance specification established within each respective connector/contact specification described in Clauses 6–12; MIL-STD-1344A, Method 2002.1; EIA 364; or equivalent methods.

Rule 4.6.2.7b: Each unit shall be subjected to 10,000 insertion and withdrawal cycles. The following items shall apply:

- a) Axis of the pin contacts and mating receptacle contacts shall coincide during insertion and withdrawal.

- b) Durability cycle rate shall not exceed six cycles per minute.
- c) Contact electrical resistance continuity measurements shall be measured at each 2,500-cycle interval to 5% of the pins in equal pattern across the beam of the mating connectors, maintaining requirements established in 6.19.
- d) Connector mating and unmating forces shall be measured and maintained in accordance with respective connector requirements (see 6.17 and connector detailed specifications in Clauses 7–12).

4.6.3 Connector electrical specification conformance testing

Rule 4.6.3: Advertised connector electrical specifications by manufacturers shall be supported by documented test results conducted by the manufacturer, or third-party test labs in accordance with Clause 6, and the respective connector detailed specifications in Clauses 7–12).

4.6.3.1 Contact electrical resistance

Rule 4.6.3.1: The *contact electrical resistance* shall be measured individually between each mated pair of contacts. A minimum of six mated pairs of contacts shall be measured on each test specimen; in accordance with Method 3004 of MIL-STD-1344A, EIA 364, or equivalent methods.

- a) **Method of connection:** Attach current-voltage leads at extreme ends of contacts. For crimp-type contacts, attach current-voltage leads to wires at closest point to contact without touching contact.
- b) **Test current:** See respective contact rated current (see Clauses 7–12).

4.6.3.2 Contact retention/float within connector housing

Rule 4.6.3.2: Connectors shall be tested to meet minimum contact retention requirements per Method 2007 of MIL-STD-1344A, EIA 364, or equivalent methods. The following details and exceptions shall apply:

- a) **Number of samples:** A minimum of seven contacts per test specimen shall be tested.
- b) **Applied axial load:** 1 lb/s until the load specified in individual specification supplements has been reached. Maintain load for 5 s. (When hookup wire is used, the wire shall be large enough to withstand the applied load).
- c) **Maximum allowable contact displacement:** During application of specified force and after removal of specified force, per respective contact displacement-float tolerance (see the connector specifications in Clauses 6–12).
- d) **Axial direction:** Straight.
- e) **Removable type contacts:** Shall withstand an axial load (see 4.3) applied in the normal removal direction after 10 insertions and withdrawals from the same contact hole.

4.6.3.3 Dielectric withstanding voltage

Rule 4.6.3.3: Mated connectors shall be tested to meet dielectric-withstanding-voltage requirements in accordance with Method 3001 of MIL-STD-1344A, EIA 364, or equivalent methods. The following details and exceptions shall apply:

- a) **Preparation:** Mated, and may be mounted to printed wiring board.
- b) **Magnitude of test voltage:** As specified (see Clauses 6–12).
- c) **Nature of potential:** AC (rms).
- d) **Duration of application of test voltage:** 60 s.
- e) **Points of application of test voltage:** Between the closest contacts and between the contacts and all other metallic parts connected together.
- f) **Method of connection of test voltage to specimen:** Affix test probes to terminations described in 4.6.3.1 by clips or solder.

4.6.3.4 Low-Level circuit

Rule 4.6.3.4: A minimum of seven mated pairs of contacts on each test specimen shall be individually measured in accordance with Method 3002.1 of MIL-STD-1344A, EIA 364, or equivalent methods. The following details shall apply:

- a) **Method of connection:** Attach current-voltage leads at extreme ends of contacts. For crimp-type contacts, attach current-voltage leads to wires, at closest point to contact without touching contact.
- b) Not to exceed 100 mA at 20 mV DC open circuit.
- c) Respective specification measured as maximum contact resistance level that is described in associated maximum contact resistance tables.

4.6.3.5 Insulation resistance

Rule 4.6.3.5: Mated connectors shall be tested in accordance with Method 3003 of MIL-STD-1344A, EIA 364, or equivalent methods. The following details and exceptions shall apply:

- a) **Special preparation:**
 - 1) The connector shall be mated and may be mounted on a printed wiring board.
 - 2) The printed wiring board may be conformal coated or otherwise protected.
- b) **Point of measurement:** Check between pins and hardware, between pin and pin, and between pins and shell (on shell-constructed connectors).

4.6.3.6 Crimp/wire-wrap termination

Rule 4.6.3.6: Each terminal, except wire-wrap post and crimp, shall be subjected to Method 208 of MIL-STD-202G.

4.6.3.7 Crimp tensile strength (applicable to crimp contacts only)

Rule 4.6.3.7: The test shall be performed in accordance with Method 2003 of MIL-STD-1344A, EIA 364, or equivalent methods. Samples for test shall be placed in a standard tensile testing machine and the load applied at an approximate rate as specified to pull the wire out of the sample or break the wire sample. Values shall be in accordance with the respective connector clauses (Clauses 6–12. Note that these values are for MIL-W-16878, Type E wire used in conjunction with the proper crimp contact. Ten samples of each wire size (both pin and receptacle types) shall be tested.

4.6.3.8 Solderability

Rule 4.6.3.8: All connectors with solder terminations shall be tested in accordance with Method 210 of MIL-STD-202G, Condition C, except connectors with solder cup terminations shall be tested in accordance with the following details:

- a) The applicable wire size properly prepared for the solder cup size shall be inserted into the contact termination. A minimum of seven contacts shall be tested.
- b) An appropriately prepared resistance soldering iron with an appropriate tip shall be applied to the lower portion of the solder cup configuration where the wire enters the termination.
- c) The solder shall be applied in the normal manner.
- d) The resistance soldering iron shall be applied to the system. The wattage shall be adjusted as to allow a proper solder fillet to be formed or for a 4 s minimum time limit, whichever is more.
- e) After application, the soldering iron shall be removed and a visual/mechanical inspection performed.

- f) Visual inspection shall be at magnification power times 10. The connector shall show no evidence of distortion or damage to any area of the connector housing. The contact shall meet the contact retention requirement. The contact shall not interfere with normal floating conditions as applicable and shall meet applicable location dimensions.

4.6.3.9 Contact electrical characteristics

Rule 4.6.3.9a: Coaxial standing wave ratio (SWR) measurements in accordance with Method 3005 of MIL-STD-1344A, EIA 364, or equivalent methods, *if applicable*, shall be applied on all coaxial connector assemblies and included in any connector specification and contact rating.

Rule 4.6.3.9b: Coaxial radio frequency (RF) transmission loss, leakage, and RF high potential withstanding voltage measurements, in accordance with subclauses 4.6.12, 4.6.13, and 4.6.16 of MIL-C-83517, respectively, shall be included in any coaxial connector specification and contact rating.

Rule 4.6.3.9c: Power current rating measurements, in accordance with IEC-309-1, shall be included in any power connector specification and contact rating.

Rule 4.6.3.9d: Power creepage/dielectric resistance measurements, in accordance with Method 3003.1 of MIL-STD-1344A, EIA 364, or equivalent methods, shall be included in any connector specification and contact rating.

4.6.4 Environmental test compliance

4.6.4.1 Operating Temperature

Rule 4.6.4.1: Conformance to the temperature cycling requirements per applicable specification supplements (see 4.3) shall constitute verification of the product operating temperature.

4.6.4.2 Temperature cycling

Rule 4.6.4.2: Mated connectors shall be tested in accordance with Method 1003 of MIL-STD-1344A, EIA 364, or equivalent methods. The following details shall apply:

- a) **Special mounting:** The connector halves shall be mounted on mounting framework
- b) **Test condition:** A, except that the minimum temperature shall be $10^{\circ} +0/-5^{\circ}$ C and the maximum temperature shall be $50^{\circ} +3/-0^{\circ}$ C.
- c) **Test measurement:** The connector shall be capable of mating and unmating the temperature extremes (force shall not be monitored) during the fifth cycle.
- d) **After test examination:** Connectors shall be examined for evidence of cracking, crazing, or other physical damage, and the contact resistance shall be measured in accordance with 4.6.3.1.

4.6.4.3 Humidity

Rule 4.6.4.3: Connectors shall be tested in accordance with Method 1002, Type II of MIL-STD-1344A, except Steps 7a and 7b shall not be required. Alternatively, equivalent methods of EIA 364 shall be used. The mated pairs shall be connected as specified in 4.6.2.3. The printed wiring board may be conformal coated or otherwise protected. The loading voltage shall be 100 VDC. Insulation resistance shall be measured in accordance with 4.6.3.5, upon completion of step 6 of the final cycle, after removal of surface moisture from connector.

4.6.4.4 Vibration

Rule 4.6.4.4a: Framework shall be tested in accordance with Method 2005 of MIL-STD-1344A, EIA 364, or equivalent methods. The following details shall apply:

- a) **Mounting:** Specimen mating receiver/fixture connectors shall be mounted in a fully populated four-slot receiver and fixture configuration with the receiver framework mounted with standard mounting screws to receiver mounting plate, which is firmly mounted on the vibration table.
- b) **Stabilization:** Arrangement of a fully mated receiver and fixture shall be provided, which will prevent the mated connectors from mechanically separating, or electrically opening during vibration tests. The resisting medium shall contact the receiver framework mounting surfaces on the test jig only, and no initial load shall be imparted to the connector.
- c) **For connector saver connectors:** The mated pairs shall be mounted per integration specifications.
- d) **Monitoring circuit:** Shall be provided to detect any interruption greater than 1 μ s.
- e) **Electrical load condition:** 100 mA.
- f) **Test condition:** Frequency requirement for 5 Hz to 55 Hz at a maximum of 29.4 m/s for vibration. (6.86 m/s at 5 Hz to 15 Hz, 12.74 m/s at 16 Hz to 25 Hz, 29.4 m/s at 26 Hz to 55 Hz).
- g) **After test examination:** Connectors' mounting hardware shall be visually examined for loosening, fracture, or other deterioration.

Rule 4.6.4.4b: Mated connectors shall be independently tested in accordance with Method 2005 of MIL-STD-1344A, EIA 364, or equivalent methods. The following details shall apply:

- a) **Stabilization:** Arrangement shall be provided as indicated on Figure 2 of Method 2005 of MIL-STD-1344A, EIA 364, or equivalent methods, such that a resisting force shall exist through a compliant material (rubber with a Shore A durometer of about 25), which will prevent the mated connectors from separating during vibration and shock. The resisting medium shall contact the top and side surfaces on the test jig only, and no initial load shall be imparted to the connector other than the weight of the test jig.
- b) **For straight-through connectors:** A mated pair shall be mounted on individual parallel wiring boards and secured by bolts and standoffs as indicated on Figure 3 of Method 2005 of MIL-STD-1344A, EIA 364, so that the distance between the wiring boards is equal to the height of the assembled connectors.
- c) **Monitoring circuit:** Shall be provided to detect any interruption greater than 1 μ s.
- d) **Electrical load conditions:** 100 mA
- e) **Test condition:** III
- f) **After test examination:** Connectors and mounting framework shall be visually examined for loosening, fracture, or other deterioration.

4.6.4.5 Shock (specified pulse)

Rule 4.6.4.5: Mated four-slot receiver and fixture framework with full population of specimen mating connectors shall be tested in accordance with Method 2004 of MIL-STD-1344A, EIA 364, or equivalent methods. The following details shall apply:

- a) **Mounting method and accessories:** In accordance with 4.6.4.4a and suitable monitoring circuit to detect any interruption greater than 1 μ s.
- b) **Test condition:** Pulse requirement for 5 ms of 49 m/s for shock.
- c) **Number of blows:** One blow in both directions along each of three mutually perpendicular axes for a total of six shocks.

- d) **Test current:** 100 mA
- e) **After test examination:** Connectors and mounting framework shall be visually examined for loosening, fracture, or other deterioration.

4.6.4.6 Salt spray (corrosion)

Rule 4.6.4.6: Mated connectors shall be tested in accordance with Method 1001 of MIL-STD-1344A, EIA 364, or equivalent methods. The following details shall apply:

- a) Applicable salt solution in accordance with MIL-STD-1344
- b) **Test condition:** B

4.6.4.7 Solvent resistance and fluid immersion

Rule 4.6.4.7: Mated connectors shall be tested in accordance with Method 1016 of MIL-STD-1344A, EIA 364, or equivalent methods.

4.6.4.8 Flammability

Rule 4.6.4.8: Mated connectors shall be tested in accordance with Method 1012 of MIL-STD-1344A, EIA 364, or equivalent methods.

4.6.4.9 Human Safety

Rule 4.6.4.9: Mechanical and electrical components shall be reviewed and marked accordingly per the following Occupational Safety and Health Administration (OSHA) regulations governing human safety and use of IEEE 1505 apparatus during operation. These include:

- a) Enforcement of the Electrical Power Generation, Transmission, and Distribution Standard. CPL 02-01-038 [CPL 2-1.38], (2002, October 31). Also available as a 948 KB PDF, 51 pages. Provides information to assist compliance personnel in performing inspections in electric power generation, transmission, and installations, including that of distribution lines and other equipment.
- b) OSHA Technical Manual (OTM). TED 01-00-015 [TED 1-0.15A], (1999, January 20). Assists OSHA Compliance Safety and Health Officers (CSHOs) in hazard recognition and provides guidance in accident prevention. Serves as a source of advice for CSHOs on safety and health issues.
- c) Inspection Guidelines for 29 CFR 1910. STD 01-06-006 [STD 1-6.6], (1995, June 16). Provides inspection assistance related to personal protective equipment (PPE) (29 CFR 1910, Subpart I) to assist OSHA Compliance Safety and Health Officers (CSHOs) performing inspections in general industry.
- d) Electrical Safety-Related Work Practices—Inspection Procedures and Interpretation Guidelines. STD 01-16-007 [STD 1-16.7], (1991, July 1). Establishes policies and provides interpretive guidelines to ensure uniform enforcement of the standard for electrical safety-related work practices, 29 CFR 1910.331 through 29 CFR 1910.335.

5. Framework specification

5.1 Framework specification introduction

5.1.1 General

This clause serves the function of defining framework application, styles, performance, dimensional, and environmental specifications for satisfying IEEE Std 1505. It is presented in two subsections: (a) first as a