

Connectors Introduction

Historically, connectors were only considered a hardware item with little attention paid to the concerns of today's sophisticated system requirements. Connectors must be carefully selected through an assessment process that considers all applicable electrical, mechanical, and environmental stresses as well as the design's requirement for size function, reliability, and at a price that is cost effective. Connector designs and technologies are too vast and changing for all to be addressed in this narrative. The following are general requirement guidelines that should be supplemented with current information from the connector manufacturer, specific to the application and product.

General Characteristics

Electrical connectors usually consist of a mating pair (plug and receptacle)* each with electrically conductive male (pins) or female (sockets) contacts, and one of the connector halves, or inserts/contacts must always be floating. The contacts are often beryllium copper or phosphor bronze-plated with gold or some other non-corrosive, highly conductive metal. The contacts are contained by an insulator (insert) of adequate dielectric material, and when necessary, housed in an enclosure (shell), often die-cast or sheet aluminum, plated or anodized for corrosion protection. The contacts may be captive or removable with a special tool. The electrical connection into the system at the contact terminal is either a crimp or solder connection. The seal between the shell and insert may be moisture resistant or hermetic. The inserts in each connector half must be oriented for correct mating, and the shell or insert usually contains a keying feature to prevent mis-mating, which could damage the connector and/or result in a electrical problem. Cable clamps and mounting hardware may be provided and used as required. The mated halves are usually secured by a locking mechanism to prevent untimely disengagements.

*NOTE: The terms referenced in parenthesis are names in general usage and are not necessarily appropriate nomenclature for some connector designs, e.g. flat male and flat female contacts are called "blade" contacts, not "pins and sockets".

Connectors are precision mechanical devices whose interfaces are critical and subject to mechanical wear, more so than most other electrical components. They may be required to make-and-break contact frequently, are often subjected to vibration or repeated physical affect, which contribute to fatigue, abrasion or galling of the contact materials. These life stresses cause degradation of electrical conductivity, and can result in opens, intermittents, or high contact resistance. In some installations, these stresses can also adversely affect the integrity of the securing apparatus. Another concern is chemical activity from the environment, for instance. oxidation and sulfide formation that adversely affect

conductivity. These concerns, when applicable to the intended usage, need be to addressed in the connector assessment and test program.

MIL-SPEC Connectors

MIL-SPEC connectors, originally designed for severe and/or critical tactical applications, are sometimes used in automotive (e.g. under-hood), aviation, industrial, marine, and special commercial applications. As a convenient reference, a partial listing of available military connectors are shown in Table 1. Complete listings are available from DSCC (Defense Supply Center Columbus) 3990 E. Broad St., Columbus, Ohio, 43216-5000.

Non-MIL-SPEC Connectors

Alternative procurement can be achieved through product identification by Performance Specifications or by using CIDs (Commercial Identification Drawings). See Tables 2 and 3 for a representative list. DSCC can also be contacted for a more complete listing of these documents.

Connector performance specifications are intended to describe product that is essentially the same quality previously defined by familiar military specifications, but with the QML, product/supplier controlled system rather than the QPL system.

Connector CIDs are specifications that describe products as defined by the connector manufacturer's specification. These products may not be suitable for environmentally severe and/or critical, communication or tactical military applications. In cases where the product is found suitable through an assessment process, periodic re-assessments are recommended and a contractual requirement for change notification should be considered. These items may be an acceptable cost effective choice in less demanding applications.

Table 1. Common Military Connectors

Military Standard	Description	Class	Application Considerations
MIL-C-28840	Circular threaded, high density, high shipboard	D	Intended for use with a jacket cable in shipboard applications.
MIL-C-22992	Cylindrical, heavy duty	C	Intended for heavy duty, rough service applications such as in shelters, vans, buildings, missile launch sites, etc.
		R	Intended for heavy duty, rough service applications such as in shelters, vans, buildings, missile launch sites, etc.
		L	Intended for power connections (60 to 200A) with heavy duty jacketed cables.
		N	Intended for applications where EMI must be held to low levels to prevent

			interference with nearby sensitive electronics.
		H	Intended for applications where atmospheric pressures must be contained by the connectors across the wall or panels they are mounted on.
MIL-C-28731	Rectangular, removable contact, formed blade, fork type	N/A	General use connector for rack and panel mounting. No active QPL source
MIL-C-28804	Rectangular, high density, polarized center jackscrew, rack and panel mounting	G	Intended for non-environmental resisting applications where operating temperature is -55 to 125°C.
		E	Intended for non-environmental applications. Have a provision for sealing around wire at rear of connector.
MIL-C-81659	Rectangular, environment resistance, crimp contacts	N/A	ARINC type connector for rack and panel mounting.
MIL-C-83733	Rectangular, miniature, back to panel,	N/A	Environmental resisting, high continuous operating temperatures (up to +200°C).
MIL-C-21097	Edge card connector	N/A	General-purpose connector intended to be mounted to printed wiring board.
MIL-C-55302	Printed circuit subassembly and assembly	N/A	General purpose for printed wiring board and other assemblies. No restrictions apply.
MIL-C-39024	Test point, panel, or printed wiring type	N/A	Intended to be used as test point connector. No restrictions apply.
WC-596	Plug, receptacles and cable outlet, power	N/A	Intended for high power applications. Grounding type and non-armored, front construction.
MIL-S-83502	Round sockets "TO" style	N/A	Intended for printed circuit boards.
MIL-S-83505	Individual sockets	N/A	Intended for insertion through printed circuit boards
MIL-S-83734	IC DIPs Plug-in	N/A	Intended for printed circuit boards.
MIL-S-12883	Sockets, Relay and Misc.	N/A	Intended for plug-in electrical components e.g. relays crystals, batteries, capacitors, coils, etc.

Table 2. Military Connector Performance Specifications

Performance Specification	Description	Comments
MIL-PRF-24308	Rectangular, miniature, polarized shell, rack and panel	Non –environmental with range of -55°c to +125°C
MIL-PRF-31031	Coaxial, plugs and receptacles, RF	High reliability, for flexible and semi-rigid cables
MIL-PRF-38999	Circular, miniature, quick disconnect, bayonet,	Environmental, high density, with either removable crimp or hermetic solder

	threaded or breech coupling	contacts
MIL-PRF-39012	Coaxial, RF	Intended to be used with flexible RF cables and coaxial transmission lines. Intended for high frequency applications.
MIL-PRF-49142	Triaxial, RF	For triaxial cable applications
MIL-PRF-55339	Coaxial adapter, RF	For use between and within series
MIL-PRF-83513	Rectangular, micro-miniature polarized shell	For limited space allocation applications
MIL-PRF-49291	Optical, fiber, metric	For fiber optics cable applications
MIL-PRF-85045	Fiber optics cable	For use with above connectors)

Table 3. CIDs (Commercial Item Description) – Connectors

CIDs	Description	Comments
A-A-55094	Rectangular, miniature, plugs, 24 pos. polarized shell	Meets IEEE 488 Interface Std, cable terminating, bail locking
A-A-55138	Rectangular, miniature, receptacle, 24 pos. polarized shell	Meets IEEE 488 Interface Std, cable terminating, screw/bail locking, thick flange
A-A-55139	Rectangular, miniature, receptacle, 24 pos. polarized shell	Meets IEEE 488 Interface Std cable terminating, screw/bail locking, thin flange
A-A-55140	Rectangular, miniature, receptacle, 24 pos. polarized shell, shielded, pre-assembled,	Meets IEEE 488 Interface Std, flat cable terminating, screw locking,
A-A-55141	Rectangular, miniature, receptacle, 24 pos. polarized shell, low profile	Meets IEEE 488 Interface Std, flat cable terminating, panel mount
A-A-55144	Rectangular, miniature, receptacle, 24 pos. polarized shell, shielded	Meets IEEE 488 Interface Std, printed circuit board terminating, screw locking
A-A-55145	Rectangular, miniature, receptacle, 24 pos. polarized shell, right angle, shielded	Meets IEEE 488 Interface Std, printed circuit board terminating, screw locking
A-A-55146	Rectangular, miniature, receptacle, 24 pos. polarized shell, right angle, shielded	Meets IEEE 488 Interface Std, printed circuit board terminating, bail locking
A-A-55147	Rectangular, miniature, plug, 24 pos. polarized shell, low profile	Meets IEEE 488 Interface Std, flat cable terminating, screw locking
A-A-55148	Rectangular, miniature, 24 pos. polarized shell	Meets IEEE 488 Interface Std, cable terminating, back to back interface, screw locking
A-A-55155	Rectangular, miniature, receptacle, 24 pos. polarized shell, shielded, loose piece const.	Meets IEEE 488 Interface Std, flat cable terminating, screw locking.
A-A-55463	Power, receptacle housing, polarized	Power applications
A-A-55464	Power, plug housing, polarized	Power applications
A-A-55513	Rectangular, miniature, plug, 24 pos. polarized shell, EMI shielded	Meets IEEE 488 Interface Std, cable terminating, screw locking
A-A-55528	Telecommunication, plug, male, polarized shell, solder contacts	Rack and panel applications, screw locking
A-A-55529	Telecommunication, receptacle female, polarized shell, solder	Rack and panel applications, screw locking

	contacts	
A-A-55530	Telecommunication, plug, male, polarized shell, solder contacts	Rack and panel applications, side entry shield, screw locking
A-A-55531	Telecommunication, receptacle, female, polarized shell, solder contacts	Rack and panel applications, side entry cover, screw locking
A-A-55532	Telecommunication, plug, male, polarized shell, solder contacts	Printed circuit board applications, screw locking
A-A-55533	Telecommunication, receptacle, female, polarized shell, solder contacts	Printed circuit board applications, screw locking
A-A-55558	Receptacle, electrical, power, utility receptacle with cover	15 amp, 125 volts, 50/60 Hz. power applications

Closing Comments

When choosing a connector, provide for additional future circuits and circuit changes by selecting a style that has a few extra contacts. Consider using standard styles that are more likely to remain viable in the market place. Consider carefully the cost of the style in comparison to its expected use. For a room ambient, permanent installation, where seldom disconnects are required, a less costly, lower quality design may be cost effective and substantially reliable. In addition to the recommendations already provided for specific connectors and applications, caution is urged in the consideration of new and untried designs, commercial quality product, and product from new, unfamiliar sources and/or installations involving new or unfamiliar applications, which may justify more frequent inspections and preventative maintenance. Also risky, is continued procurement without periodic re-assessment, availability of a special/unique design from a single source, and dealing with a supplier that is having financial difficulties.