# Advanced Electronic Connector Technologies

Military electrical connectors have traditionally used very conservative design rules that provide the ruggedization needed for harsh military use environments. Commercial electronic connectors have typically used less conservative design rules that provide sufficient reliability in the less harsh environments of the commercial world.

The EMPF is adapting these two novel commercial connector design features to standard military connector applications. The result is military leveraging of innovative commercial connector technology for the benefit of the warfighter. In addition to the first applications targeted at the electronic systems used aboard the Navy's new Zumwalt class destroyer, other potential applications are:

- Additional Navy high power, high density interconnect applications
- Army (or other service) battery connector applications

Standard connectors are rated to electrical current carrying capacity typically based on two or three (bifurcated or trifurcated) sliding beams contacting each connector pin within each socket.


*Figure 1-1: Bal Seal Corporation's toroidal spring concept. Each coil in the spring provides an additional contact point between the contact pin and the contact socket. Several such springs are inserted into grooves in the socket contact. When the pin is inserted, many contact points engage the pin.*

The two connector technologies being investigated enable higher electrical currents to be conducted through smaller connectors by multiplying the number of individual contact points making electrical contact between the pin contacts in the plug half and the socket contacts in the receptacle half of the connector pair.

The two new commercial technologies being investigated at the EMPF exploit multiple (tens or hundreds) electrical receptacle contacts to each connector pin. The first of these, from Bal Seal Corporation, is shown in Figure 1-1.

The second of these innovative designs from Methode Technology (formerly Tribotek) is shown in Figure 1-2.

Close-up photographs of the three socket contact methods are shown in Figure 1-3.
These multiple connection technologies reduce contact resistance by increasing the number of contacts between the pin and the socket, thus decreasing pin heating and allowing increased current carrying capacity for a given standard pin size.

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Manufacturing applied R&D tasks include:

- Manufacture connectors using the new Bal Seal and Methode (formerly Tribotek) multiple receptacle contact technologies to apply to military interconnects.
- Test these new connectors built at ITT Canon (using the Bal Seal technology) and DCX CHOL (using the Methode technology) to standard military specifications.
- Compare current capacities to existing standard connectors having the normal standard two or three receptacle contacts at each pin.
- Down select optimal connectors for field tests in DDG 1000 high current, high density applications.

The new technology contacts are expected to allow significantly higher current carrying capability (40-400% increase) over a comparable size traditional electrical contact.

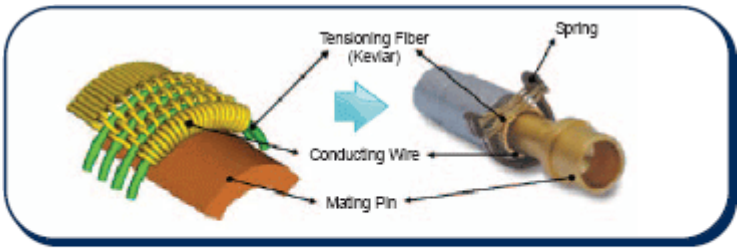


*Figure 1-2: The Methode Electronics design for high power contacts uses a Kevlar aramid fiber tensioned with a spring and woven with gold-plated copper wire. The result is a large number of electrical contacts (at each Kevlar/wire knuckle) that reduce contact resistance and increase current carrying capacity for the contact.*

For example, a commonly used #20 AWG M39029 contact can carry 7.5Amps. These new contact technologies claim to be capable of carrying more than 17Amps per comparable #20 AWG contact. If applicable in standard military connectors, this higher current density will facilitate significant performance benefits resulting in reduced cost as well as higher reliability by reducing the overall number of power cables as well as reducing cost of the remaining cables.

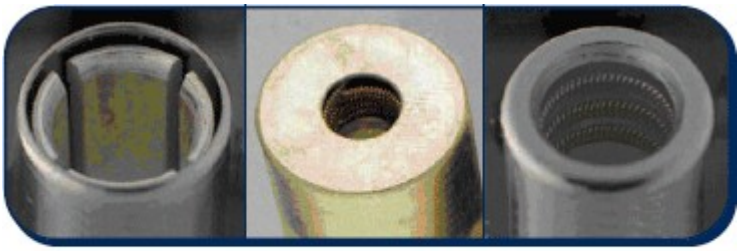

*Figure 1-3: Shown left to right are Standard #4 socket contacts (4 contact beam springs), DCX CHOL/Methode (woven Kevlar), and ITT Cannon/Methode (toroidal spring). The DCX and ITT contacts represent substantially higher current carrying capacity than the standard contact.*

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This EMPF program will help achieve lower interconnection costs by incorporating emerging contact technologies into commonly used military specification configurations and testing them to ensure they can meet the advertised increased power densities and military requirements. Reduction in the cost is strongly related to power density and interconnection hardware. Connectors, cables, and even small Z-Axis sockets can be significant contributors to the overall cost of a system. By introducing this new technology into circular and rectangular Mil-Spec connectors, the anticipated reduction in power cable assemblies and the reduction in cost associated with being able to utilize smaller, less costly connectors will be a significant cost reduction per new ship.

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