(3)

DEPARTMENT OF THE NAVY
NAVAL SURFACE WARFARE CENTER
CARDEROCK DIVISION

NAVAL SHIP SYSTEMS
ENGINEERING STATION
PHILADELPHIA, PA 19112-5083

IN REPLY REFER TO

9504
Ser 96315/055
28 APR 2000

From: Commanding Officer, Naval Ship Systems Engineering Station, Carderock Division, Naval Surface Warfare Center
To: Commander, Space and Naval Warfare Systems Command Headquarters San Diego (Code PMW-158-2)

Subj: MISMATCHING, MATING, POLISHING, AND PROPER APPLICATIONS OF MIL-SPEC ST AND COTS CONNECTORS

Ref: (a) Naval Training Center Mtg, Purpose: Update Fiber Optic Course, of 5-6 Apr 2000
(b) NSWCCD-SSES ltr 9504 Ser 9542/028, Subj: Navy Recommended Fiber Optic Components Parts List, of 1 Apr 98
(c) NSWCCD-SSES ltr 9504 Ser 9542/09, Subj: Criteria For Shipboard Usage Of Military Fiber Optic Components, Second Update; of 30 May 97

1. Purpose

This letter clarifies issues addressed during reference (a) with mismatching, mating, polishing and determining proper placement of MIL-SPEC ST and COTS connectors. This letter considers MIL-SPEC connectors as ST connectors that are qualified to MIL-C-83522/16. COTS (Commercial-Off-The-Shelf) connectors are only the subset listed in reference (b), the Navy Recommended Fiber Optic Components Parts List.

2. Over-polish on metal ferrules.

Over polishing typically occurs when the glass fiber is polished below the surface of the ferrule (an "undercut" condition). A fiber cannot be over polished in a metal ferrule since the metal is softer than the glass fiber. Material will be removed from the metal ferrule at a greater rate than the glass fiber. Metal ferrules that are subjected to excessive polishing may be shortened resulting in inadequate mating forces between connectors.

3. Metal versus ceramic ferrules.

Ceramic ferrules are made to tighter tolerances for critical parameters (such as ferrule hole and ferrule diameters, concentricity, etc.). Tighter tolerances result in better alignment with lower optical power loss.

4. Proper alignment sleeve materials for adapters.

Mating ceramic ferrules can be joined using adapters (feed-through's) with ceramic or plastic (composite) alignment sleeves. Mating metal ferrules can be joined using adapters (feed-through's) with metal or plastic alignment sleeves. Mixing of ceramic and metal ferrules and alignment sleeves have been found to increase contamination (dirt particle) problems.

5. Mismatch of ferrule and alignment sleeve materials.

Repeated mating of connectors with metal ferrules in ceramic alignment sleeves can result in greater misalignment and damaged fiber end faces. The harder ceramic alignment sleeve "polishes" the softer metal ferrule. Fine metal shavings (dust or contamination) are formed from this "wearing down" of the ferrule. The deformed (now looser toleranced) ferrules result in greater misalignment. Fine metal shavings are spread to the ferrule end face and result in end face damage.

6. Mismatch of mating ceramic and metal ferrules.

Larger degree of misalignment, not connector end face separation, occurs as a result of mating metal and ceramic connectors. Contamination, in the form of metal shavings, may be produced from a metal ferrule if a ceramic alignment sleeve is used in the adapter joining a connector with metal ferrule to one with a ceramic ferrule. Contamination, in the form of metal shavings, may be produced from a metal alignment sleeve if a metal alignment sleeve is used in the adapter joining a connector with metal ferrule to one with a ceramic ferrule.

7. Mismatch of MIL-SPEC and COTS connectors.

Larger degree of misalignment, not connector end face separation, occurs as a result of mating MIL-SPEC and COTS connectors. The two ferrule end faces do not meet in the center of the alignment sleeve. This off-center meeting results in poorer ferrule-to-ferrule alignment. Optical performance also becomes more variable (unstable) with off-center connections. The COTS connector spring (with an approximately 2 lb. spring constant) is collapsed down to the solid spring height. The long-term effect of this collapse is to spring deformation and permanent spring damage. De-mating and reconnection (to same connector or elsewhere) may result in poorer optical performance.

8. Criteria for shipboard usage.

a. General guidance. Reference (c) specifies the criteria for shipboard usage of military fiber optic components and conditions under which COTS components may be used. A general statement, with exceptions listed in reference (c), can be made pertaining to the use of COTS connectors. This statement is that if the connector is interfaced with COTS equipment (switches, routers, hubs, etc), then a COTS connector may be used at the adjoining cable end. The integrated, shipboard, fiber optic cable plant is classified as a mission critical system and MIL-SPEC connectors must be used within this system as one control measure to ensure high reliability. MIL-SPEC connectors are preferred within the present cable plant even within non-critical cable runs since more applications tied into the integrated cable plant are being reclassified as mission critical or future use for those cable runs may be mission critical.

b. Backbone cables. Backbone cables runs are routed from the servers to the switches. COTS connectors may be used on the ends of backbone cables if the connectors go directly into equipment or patch panels interior to shock mounted racks.

c. Drop cables. Drop cables are the 4 fiber cable runs from the switch to the drop boxes in specified compartments. COTS connectors may be used on one end of drop cables if the connectors on that end go directly into equipment (switches) or to patch panels interior to shock mounted racks that house the equipment. MIL-SPEC connectors are to be used at the drop box.

d. Zip cord. Zip cord cables are run from the drop box to the workstation. This zip cord should have MIL-SPEC connectors at one end (interfacing with the drop box) and COTS connectors on the opposite end (interfacing with the workstation). Most zip cords purchased now have COTS connectors on both end and a cable jacket with a riser or plenum rated material. Zip cord; with a low smoke, low toxicity, low acid gas, low halogen material; is the suitable choice for an inter-compartment, COTS jacketed cable. Zip cords can be purchased from some fabrication houses that have MIL-SPEC connectors on one end.

9. Points of contact

Please direct questions or comments to the Naval Surface Warfare Center Carderock Division, Ship Systems Engineering Station (NSWCCD-SSES) point of contact for fiber optic component testing, E. Bluebond. He can be contacted by FAX: (215) 897-8509 or E-mail: bluebond@spawar.navy.mil. The Naval Surface Warfare Center, Dahlgren Division (NSWC DD) point of contact for fiber optic specification requirements is G. Brown. He can be contacted by telephone: (540) 653-1579, FAX: (540) 653-8673 or E-mail: browngd@nswc.navy.mil.

J. A. DOLAN
By direction

Copy to:
SPAWAR PMW-158 (CDR Ziegler)
NSWC DD B35 (G. Brown)
SPAWAR. PMW-152 (R. Evans)
SPAWAR PD 15Q2 (J. Bachrach)
SPAWAR D632 (A. Maldonado)
SPAWAR 04N-43A (D. Zsutty)
SPAWAR 051 (C. Suggs)
NAVSEA 05J2 (J. Moschopolous)
NAVSEA 53Z (H. Lewis)
DSCC-VQP (A. Eschmeyer)