Electric Technologies Panel
Project: Fiber Optic Go/No-Go

Project Technical Update

NSRP Day – WNY 9/22/11

Presented by:

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Project Background

- The use of Optical Fiber for critical shipboard systems is rapidly accelerating.
- The main drivers are:
  - System consolidation and the increase in data.
  - Reduced channel loss.
- It is part of your network and is here to stay!

Project Background

- In order to ensure system performance and reliability, **MIL-STD-2042B** (*Fiber Optic Cable Topology Installation Standard Methods for Naval Ships)* is contractually specified and required.
- The MIL-STD requires many quality and verification tests. The most critical types to ensure system performance and lifecycle reliability are:
  - **Visual Quality Check** (Project Focus)
  - **Optical Performance Tests** (Measured and Considered as part of project)
- Optical Connectors/Links **Must** pass **all** tests:
  - It is possible to pass one and fail the other
  - System may operate but the lifecycle is greatly reduced

Project Background

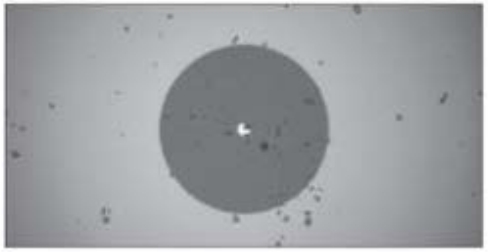
- Visual Quality Check
  - Critical to ensure lifecycle reliability
  - Performed by the Technician during connector fabrication
  - Requires the use of a 400x (magnification) direct view hand held microscope
  - No equipment calibration required
  - No eye exam required
  - No operational verification required
  - Very subjective from one Technician to another
  - Technicians tend to rely more on Optical Performance Tests than the Visual Quality Check

Project Background

- Various Visual Quality Check Conditions

CLEAN FIBER

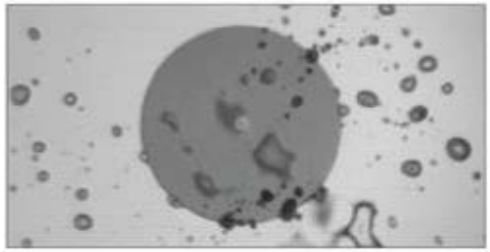
DIRT / CONTAMINATION



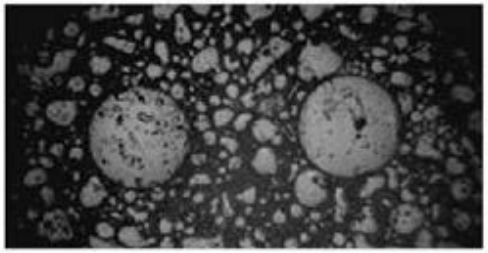
PITS / CHIPS

SCRATCH

OIL / CLEANING FLUID RESIDUE



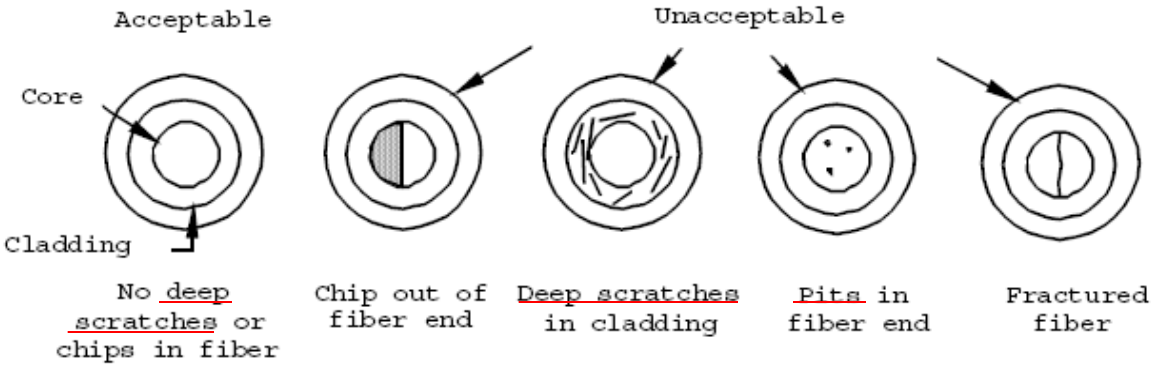
MULTI-FIBER CONTAMINATION



M2042-5B Visual Quality Check

3.2.5 Quality check.

Step 1 - Examine the connector with the optical microscope to ensure that the optical surface is smooth and free of scratches, pits, chips, and fractures (see figure 5B1-15). If any defects are present, repeat the polish with the 0.1 um paper (and the ultrafine paper for enhanced polish connectors) or reterminate the fiber. (NOTE: Do not polish the connector more than necessary to pass the quality check.) A high intensity back light may be used to illuminate the fiber during the quality check.



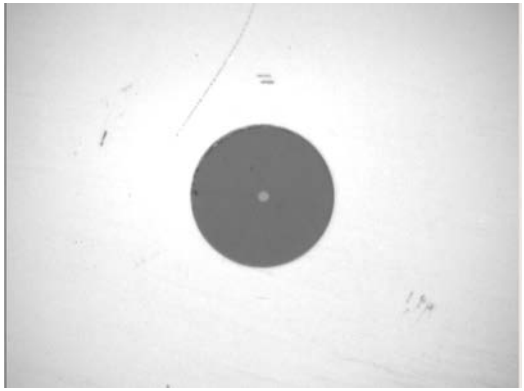


FIGURE 5B1-15. Quality check.

NOTE: Depending on the optical microscope used, viewing quality may be different.

NOTE: A small number of very light scratches (e.g. scratches that can barely be seen) is minimally acceptable.

Step 2 - If the connector is not to be immediately mated into an adapter, install a plastic protective cap over the connector ferrule.

Project Purpose

Reduce construction costs related to fiber optic installation

- Remove human subjectivity by adopting an automated Go/No-Go inspection tool to provide consistent objective connector quality
- Evaluate the commercial profile criteria to determine if it is stringent enough for Navy applications

Overall Project Description

DIRECT-VIEW SCOPE

AUTOMATED ANALYSIS

Deliverable: Various

- Automated profile criteria
- Preliminary test data
- Probe equipment for each participant
- All material for field testing
- Field test data
- Final Report with summary and recommendation

Description/Objective of project

- Develop automated fiber optic inspection profile to replace the existing subjective requirement identified by Mil-Std-2042 (Hand held microscope)
- Prove thru field testing that shipyards can meet proposed quality criteria
- Obtain written approval from NAVSEA to use automated inspection as an optional method

Payoff / Value Added

- Realize TOC benefits thru reduced construction rework and future maintenance issues
- Enhanced system performance and consistency
- Reduce re-work due to poor endface quality and contamination
- Remove human subjectivity through the use of an automated tool that provides a consistent determination of connector quality
- Increase optical performance through higher quality connectors
- Reduce training for field termination
- Reduce time for connector installation
- Materials and labor savings

Project Plan Accomplished

Field Testing

- Prepared 20 cable samples for field testing at 3 shipyards - 60 cable assemblies – 120 connectors
  - Shipyard technicians performed polishing fabrication function
  - Shipyard personnel inspected samples with 400x scope to ensure MIL-STD-2042B Visual Quality Check acceptance
  - Samples then tested using Automated method against proposed M2042B Go/No-Go profile
- Completed Optical Performance Testing
- Documented results and provided to participating shipyards and NSWCDD for consideration

Project Findings

- Variation exists between Technicians using current method (human subjectivity, no eye exam requirement, equipment quality, experience, training)
- Quality of current inspection equipment varies impacting consistency
- The automated inspection method will significantly improve quality, consistency and repeatability; resulting in costing savings with enhanced system performance and lifecycle improvement
- NSWCDD has no objection to the use of a video inspection system, in place of a hand held microscope, for a human operator to perform a visual quality check to determine acceptable quality based on M2042B criteria.

Next Steps

- Work with NSWCDD to generate documentation allowing the utilization of Video Inspection equipment (instead of hand held microscope) to perform the end-face visual quality check.
- Use the profile that was developed and proposed for this project as the “No-Go” automated acceptance criteria baseline until the “Go” criteria can be developed.
- Based on the results from this study, defining MIL-STD-2042B acceptance criteria to be measured in a quantitative manner.
- Use this quantitative criteria to determine if current automated inspection equipment has the necessary capabilities to perform automated inspections at the desired level of the Navy.
- Review NASA-STD-8735.5 (2/1998), NAVAIR 805 and other international standards to determine if there is criteria that more aligns with NSWCDD.