MIL-HDBK-277 (NAVY)

10 JULY 1984

# MILITARY HANDBOOK

## FIBER OPTIC CHECKOUT PROCEDURE FOR MILITARY APPLICATIONS

FSC 60GP

DEPARTMENT OF DEFENSE
WASHINGTON, DC 20360

Fiber Optic Installation Checkout Procedure

MIL-HDBK-277(NAVY)

1. This Military (Navy) Handbook is approved for use by all Departments and Agencies of the Department of Defense.

2. This publication was approved for printing on 10 July 1984 and inclusion in the military standardization handbook series.

3. Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Sea Systems Command, SEA 55Z3, Department of the Navy, Washington, DC 20362 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

# FOREWORD

1. This document provides general information on the checkout and testing of optic cable installation in military applications. It provides information and guidance to personnel concerned with the testing involved in installing fiber optic data links. The handbook is not intended to be referenced in purchase specifications except for informational purposes, nor shall it supersede any specification requirements.

2. Every effort has been made to reflect the latest information on fiber optic checkout procedures. It is the intent to review this handbook periodically to ensure its completeness and currency.

CONTENTS

CONTENTS - Continued.

APPENDIX



FIGURES

1. SCOPE

1.1 General. This procedure provides general information on the checkout and testing of fiber optic cable installations.

1.2 Application. This procedure covers the test and checkout of fiber optic cables, connectors, splices, couplers, hull penetrators and bulkhead penetrators.

2. REFERENCED DOCUMENTS - NOT APPLICABLE

3. DEFINITIONS

3.1 Attenuation. The reduction of average optical power during transmission from the input to the output of the device under test usually measured in decibels (dB).

3.2 Decibel. The decibel is a logarithmic unit used to express optical power ratios.

3.3 Insertion loss. The optical power loss in a transmission cable assembly or system caused by the installation of an optical component such as a connector, splice, or coupler.

3.4 Operating wavelength. The optical wavelength, expressed in nanometers, at which the system is intended to operate.

3.5 Optical link. A fiber optic cable system consisting of assembled cables, connectors, penetrators, couplers, and splices used to interconnect electro-optic devices (such as sources or detectors) in a system.

3.6 Pulse rise or fall time. The time in nanoseconds required for the pulse to rise or fall from 10 percent to 90 percent of its steady state peak power level.

3.7 Terminus. A device which terminates an optical fiber and provides a means to locate and contain the optical fiber within a connector.

4. GENERAL REQUIREMENTS

4.1. Safety.

4.1.1 Procedures. The following safety procedures apply:

a. Never look into a light beam generated by a LED or laser source.

| CAUTION: Light generated by these sources may not be visible but is still hazardous to the unprotected eye. Never look into the end of an optical fiber connected to these sources. Safety glasses are required in these instances. |
|---|

b. Observe all warning signs on equipment and all written safety precautions in the instruction manual.

c. Always handle cable carefully to avoid personal injury. Care should be taken with individual fibers to prevent injury to the eyes or penetration of the fibers into the skin.

d. Wash hands after handling bare fibers or performing fiber termination/splice operations.

4.2 Test equipment.

4.2.1 Test instrumentation. The following type of test instrumentation is required to conduct the tests outlined in this procedure:

4.2.1.1 Optical power meter. The optical power meter is an instrument that measures optical power on a dB scale. See Appendix for a sample list of manufacturers, but they are not necessarily recommended or endorsed.

4.2.1.2 Optical source. The optical source shall consist of a portable light source or a source of optical power employing a light emitting diode (LED) or a laser. The optical source shall operate at the specified test wavelength.

4.3 Test accessories.

4.3.1 Test equipment interface connectors. Test connectors shall be required to interface between the cables and the test equipment. The type of connector will depend upon the test equipment used. See handbook for "Fiber Optic Cable Installation Procedure" for methods and equipment required to terminate the test connectors.

5. DETAILED REQUIREMENTS

5.1 Pretermination testing.

5.1.1 Fiber breakage test. The fiber breakage test is performed after cable installation in the wireways, but prior to final termination of connectors, splices, couplers, or penetrators.

5.1.1.1 Test equipment.

5.1.1.1.1 Optical power meter (OPM) (see 4.2.1.1).

5.1.1.1.2 Optical source (see 4.2.1.2).

5.1.1.1.3 Unconnectorized calibration fiber (see figure 1).

5.1.1.1.4 Calibration and fiber breakage measurement form. The form shall include attenuation values for the unconnectorized calibration fiber and the acceptable attenuation values for the fiber breakage test. This form shall be provided by the engineering department.

5.1.1.2 Procedure.

5.1.1.2.1 Calibration. Utilizing the calibration configuration shown on figure 2, adjust output of source to provide levels as read on the optical power meter which match the values shown on the calibration and fiber breakage measurement form (see 5.1.1.1.4).

5.1.1.2.2 Fiber breakage measurement.

a. Connect both ends of the fiber to be tested to the source terminal and optical sensor terminal of the source and OPM as shown on figure 3.

b. Measure and record the optical output level and compare with the values shown on the calibration and fiber breakage measurement form (see 5.1.1.1.4).

c. Repeat steps a and b for each fiber in the optical test link.

d. If any of the measurements vary from the values shown on the calibration and fiber breakage measurement form (see 5.1.1.1.4), the optical link shall be considered defective and reported to the engineering department.

5.2 Post termination testing.

5.2.1 Connector-to-connector attenuation. The connector-to-connector attenuation test is to determine that the individual connectorized cable attenuation is within power budget requirements.

5.2.1.1 Test equipment.

5.2.1.1.1 Optical power meter (OPM) (see 4.2.1.1).

5.2.1.1.2 Optical source (see 4.2.1.2).

5.2.1.1.3 Adapter cables (see figures 4 and 5).

5.2.1.1.4 Calibration test link (see figure 6).

5.2.1.1.5 Calibration and optical link measurement value form. The form shall include all values to be compared, and shall be provided by the engineering department.

5.2.1.2 Procedure.

5.2.1.2.1 Calibration. Utilizing the calibration configuration shown on figure 7, adjust output of source to provide levels as read on the optical power meter which match the values provided from the engineering department.

5.2.1.2.2 Optical link measurement.

a. Connect both ends of the fiber to be tested to the source terminal and optical sensor terminal of the source and OPM as shown on figure 8.

b. Measure and record the optical output level and compare with the values shown on the calibration and optical link measurement value form (see 5.2.1.1.5).

c. Repeat steps a and b for each fiber in the optical test link.

d. If any of the measurements vary from the values shown on the calibration and optical link measurement form (see 5.2.1.1.5), the optical link shall be considered defective and reported to the engineering department.

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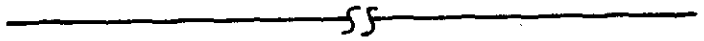

FIGURE 1. Unconnectorized calibration fiber.

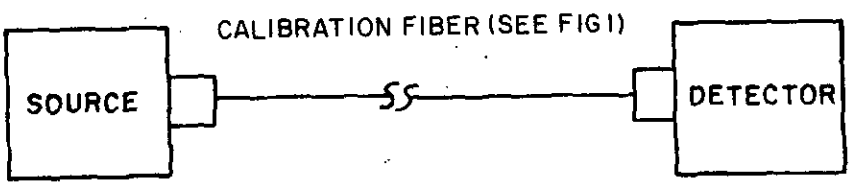


FIGURE 2. Source/optical power meter calibration configuration.

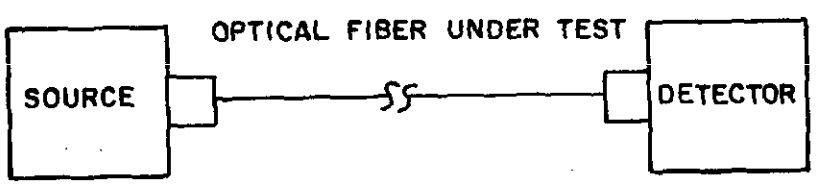


FIGURE 3. Fiber breakage test configuration.

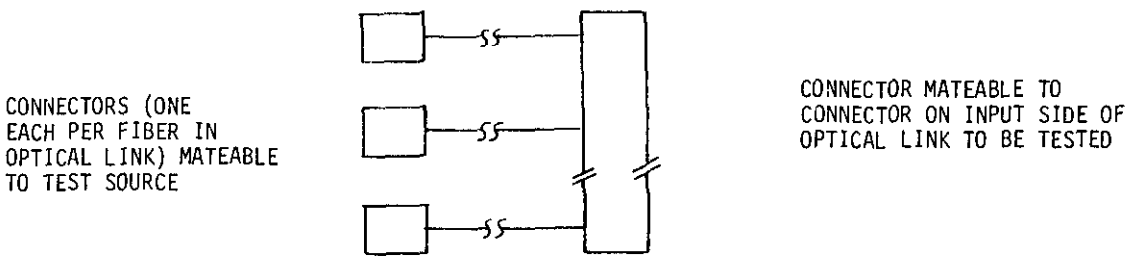


FIGURE 4. Source adapter cable.

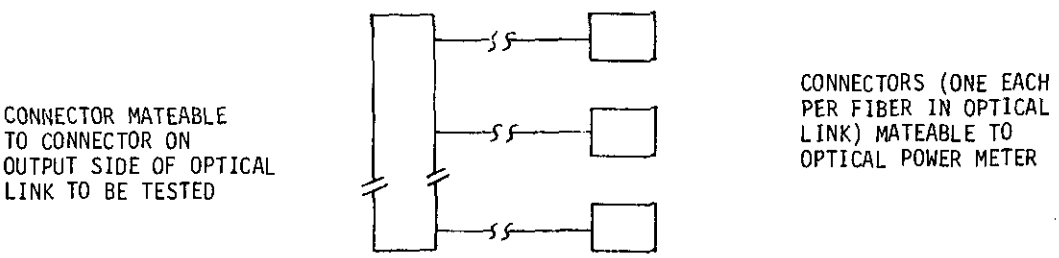


FIGURE 5. Optical power meter adapter cable.

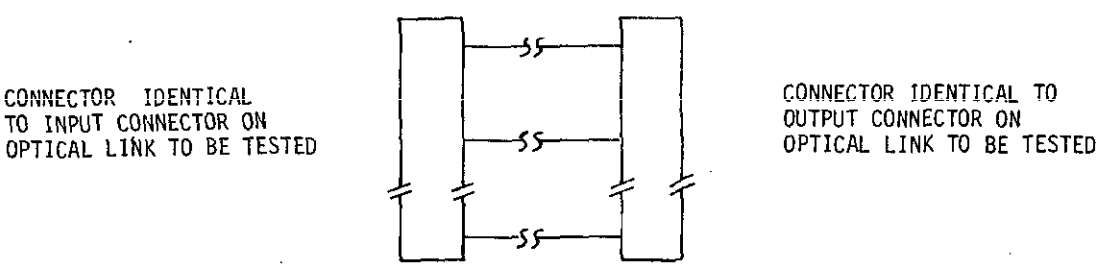


FIGURE 6. Calibration test link.

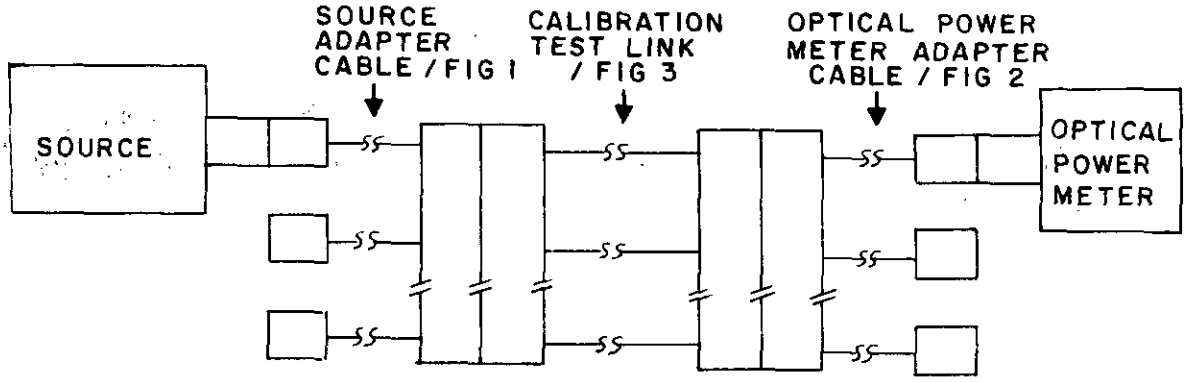


FIGURE 7. Source/optical power meter calibration configuration.

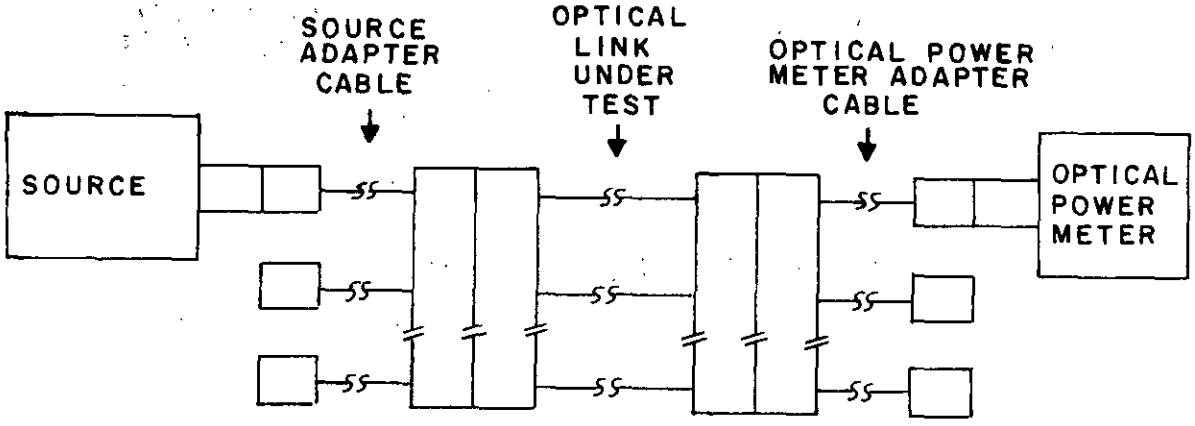


FIGURE 8. Optical link test configuration.

# APPENDIX

## SAMPLE LIST OF MANUFACTURERS

10. GENERAL

10.1 Scope. This appendix supplies a sample list of manufacturers known to supply test equipment. This list is not intended to be exhaustive and may be supplemented by manufacturers of equivalent equipment. This appendix is a mandatory part of this handbook. The information contained herein is intended for compliance only.

10.2 Optical power meters.

10.2.1 Bowmar model 650B optical fiber level measuring set. Bowmar/ALI Inc., 531 Main Street, Acton, Massachusetts 01720 (617) 263-8365.

10.2.1.1 Characteristics. Characteristics shall be as follows:

Power ranges: -80 dBm to +2 dBm

Measurement ranges: 830 nanometers (others available upon request)

10.2.2 Photodyne 22XL optical multimeter. Photodyne Inc., 948 Tourmaline Drive, Newbury Park, California 91320 (213) 889-8770.

10.2.2.1 Characteristics. Characteristics shall be as follows:

Power ranges: -90 dBm to +30 dBm

Measurement ranges: 220 to 2000 nanometers

10.2.3 UDT S550 fiber optic power meter. United Detector Technology, 3939 Landmark Street, Culver City, California 90230.

10.2.3.1 Characteristics. Characteristics shall be as follows:

Power ranges: -90 dBm to +30 dBm

-60 dB to +33 dB

Measurement ranges: 250 to 2000 nanometers

10.2.4 Plantronics/Wilcom model T312(B) optical attenuation test set. Plantronics/Wilcom, Box 508, Laconia, New Hampshire 03246.

10.2.4.1 Characteristics. Characteristics shall be as follows:

Power ranges: -65 dBm to +3 dBm

Measurement ranges: 400 to 1100 nanometers

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