DEPARTMENT OF THE NAVY
NAVAL SURFACE WARFARE CENTER
CARDEROCK DIVISION

NAVAL SHIP SYSTEMS
ENGINEERING STATION
5001 S. BROAD STREET
PHILADELPHIA, PA 19112-1403

IN REPLY REFER TO

9504
Ser 965/005
23 March 2007

From: Commanding Officer, Naval Surface Warfare Center,
Carderock Division, Naval Ship Systems Engineering Station
To: Defense Logistics Agency,
Defense Supply Center Columbus (Code VQP)

Subj: OPTICAL TEST MEASUREMENT INSTRUMENTATION, QUALIFIED PRODUCTS LIST, TEST SUITABILITY FOR FIBER OPTIC CABLE TOPOLOGY COMPONENTS

Ref: (a) NSWCCD-SSES LTR 9504 Ser 963210/06-005, Optical Test Measurement Guide, Qualified Products List, Test Suitability for Fiber Optic Cable Topology Components, dated 31 October 2005

Encl: (1) Optical Test Measurement Instrumentation Requirements, Verification Sheet for, dated 23 March 2007

1. Purpose.

This letter addresses the intent of reference (a), the Optical test Measurement Guide, in defining the requirements for the optical test measurement systems used in the optical test measurements during Qualified Products List (QPL) testing of Fiber Optic Cable Topology (FOCT) components.

2. Background.

Naval Surface Warfare Center, Carderock Division, Ship Systems Engineering Station (NSWCCD-SSES) is tasked by the Naval Sea Systems Command (NAVSEA) and the Naval Air Systems Command (NAVAIR) to provide technical support for qualification and test efforts regarding FOCT components. One subtask is to provide technical support/consultation to the Defense Supply Center Columbus (DSCC). As part of the subtask, NSWCCD-SSES has supported DSCC in past efforts to qualify component vendors. These efforts include auditing their in-house test facilities, auditing independent, commercial test laboratories, clarifying requirements in military specifications, and reviewing documentation (such as test procedures and reports). Development and update of the Optical Test Measurement Guide, along with preparation of the letter, is another type of support being provided. For these efforts, other Government Activities with technical expertise in this field have provided input and review for these efforts.

The Optical Test Measurement Guide was developed to further define the test requirements, test methods and test measurement systems to be used for performing optical measurements. As this document evolved, it became evident that requirements for optical test measurement instrumentation needed to be better defined to ensure that the risk to the Government of accepting bad optical measurement data was small. In the past, testing was done using a host of different type optical measurement systems. Some of the optical measurement instrumentation used provided very "optimum" results (such as using very restrictive launch conditions, smaller area detectors than the fiber core size used, etc.). Other optical measurement instrumentation did not provide consistent conditions or were of questionable stability. To minimize test variations and permit more accurate comparison of test results from multiple sources, a "prescription" approach evolved for optical measurement instrumentation.

3. Distribution statement

Distribution Statement A: Approved For Public Release, Distribution Is Unlimited.

4. Current status, the prescription approach.

Launch conditions for Navy shipboard and military aircraft applications have evolved from specifying a requirement to stating the method used (use of a launch jumper/cable) and implementation constraint (test configuration and type of optical fiber) to achieve a particular launch condition. Other documentation (such as NAVSEA Drawings) has specified the particular launch method to be used and the implementation constraints. The Optical Test Measurement Guide has been updated to add use of specific launch jumpers, but not exclude other means to achieve the desired launch condition. Verification of launch conditions produced by other means is an issue. Current technical society investigations (such as TIA FO-4.1.2) have found that Coupled Power Ratio (CPR) specifications do not effectively control higher order modes and are not an effective mechanism for measuring source power distributions at large radii. Mode power distribution specifications (verified using near field data) are difficult to verify, involve differentiating and dividing noisy data that amplifies uncertainties and are not sufficient for the specification and verification of launch conditions.

The use of a standardized launch condition approach requires that an optically well-behaved measurement system be used. For a change in optical transmission measurement, the Optical Test Measurement Guide specifies the use of an optical measurement system consisting of optical sources, power meters and switching system. This configuration is the one sold by vendors of laboratory grade optical test instrumentation during the time the Optical Test Measurement Guide was developed. For insertion loss measurements, an optical source and power meter with no intermediary devices is specified. Use of this prescription approach of specifically defined instrumentation used in conjunction with a standardized launch condition allows verification without necessitating analysis of the launch conditions to verify compliance.

5. Future plans.

The Government is in the process of characterizing the standardized launch conditions obtained by the use of specified launch jumpers. International and national standards bodies are developing techniques for analyzing the launch conditions. Once developed, these techniques will be used to prepare templates for the standardized launch conditions. At that time, a determination shall be made as to any optical measurement system restrictions (such as the limitations of other devices/technologies) and the means to submit launch conditions data (such as near field data in two column format on Excel spreadsheet).

6. Recent determinations.

For change in optical transmittance measurements, alternative technologies for optical measurement systems will be considered once the templates for analyzing the standardized launch conditions are developed.

For insertion loss measurements, a switching mechanism as part of the optical measurement systems will be considered once the templates for analyzing the standardized launch conditions are developed. Some alternate technologies (couplers in particular) are not appropriate for an absolute versus relative measurement and will not be permitted in any optical measurement system for insertion loss.

The Optical Test Measurement guide will be updated to address (1) the prescription approach, (2) the verifications required for optical measurement instrumentation and systems conforming to this approach, (3) allowance for and restrictions on optical measurement instrumentation and systems not conforming to the prescription approach, (4) and additional verifications required for a non conforming approach.

Subj: OPTICAL TEST MEASUREMENT INSTRUMENTATION, QUALIFIED PRODUCTS LIST, TEST SUITABILITY FOR FIBER OPTIC CABLE TOPOLOGY COMPONENTS

7. Optical measurement instrumentation suitability.

Current optical test measurement requirements do not require (specify) the analysis of launch conditions; however, the Optical Test Measurement Guide does specify other requirements for the optical measurement instrumentation. The vendor (entity performing QPL testing) must provide the Government with complete verification that each instrument and system meets specified requirements. Enclosure (1) is the list of requirements extracted from the Optical Test Measurement Guide for your convenience.

8. Non QPL test measurements. This letter is directed at measurements performed for QPL testing; however, measurement instrumentation used in the field (such as for an optical loss measurement) and for other purposes should conform to tailored version of these optical performance requirements.

9. Addressees.

This letter is intended for vendors and out-of-house (outside the component's vendor facilities or independent) test laboratories performing QPL testing. This letter is to be used by DSCC and other Government agencies/activities, parties in direct support of the Government agencies/activities to clarify intent of requirements specified.

10. Point of contact.

DSCC-VQP is to be the initial point of contact for the qualification issues/inquiries that pertain to this matter. Principle point of contact is A. Baillieul. He can be contacted by telephone: (614) 692-2867 or E-mail: vqp.ab@dla.mil. Alternative point of contact is Richard Marbais. He can be contacted by telephone: (614) 692-0620 or E-mail: richard.marbais@dla.mil. Technical inquires and clarifications on this Navy letter are to be placed in writing and sent by e-mail to the above addressee.

S. Walicki

S. WALICKI
By direction

Copy to:
NAVSEA 05Z5 (M. McLean)
NAVSEA PEO IWS (J. Moschopoulos)
NAVSEA PEO IWS (H. Lewis)
NSWC DD W23 (G. Brown)
NSWC DD W13 (R. Throm)
NAVAIR 4.5.1.1 (G. Walles)
NAVAIR 4.5.7 (B. McDermott)
NAVAIR 4.5 7 (M. Beranek)
NAVAIR 4.5.7 (M. Hackert)
DSCC-VQP (A. Baillieul)
DSCC-VAT (D. Leight)
DSCC-TEB (J. Hemmila)

23 March 2007

Verification Sheet for
Optical Test Measurement Instrumentation Requirements 1/
Change in Optical Transmittance

	Test Equipment			
1	LED Source	Wavelength	1300 ± 20 nm (variation for aircraft 6/)	
		Power output	-20 dBm minimum for multimode	
		Spectral width	170 nm maximum	
		Optical power stability	≤ 0.1 dB/hr.	
		Coupled Power Ratio (CPR), see CPR test 2/	range of 20.5 to 22.5 4/	
		Mechanical stability of connector interface/port	≤ 0.1 dB between any two of the matings	
2	LD Source (LD = Laser Diode, Fabry Perot type)	Wavelength	1310 + 20/-30 nm (variation for aircraft 7/)	
		Power output	-10 dBm minimum	
		Spectral width	5 nm maximum	
		Optical power stability	≤ 0.1 dB/hr.	
		Mechanical stability of connector interface/port	≤ 0.1 dB between any two of the matings	
3	Power meter	Optical noise floor	- 60 dB minimum	
		Resolution	0.01 dB minimum	
		Accuracy	0.25 dB minimum	
		Linearity: over the range of optical power from – 60 dBm to 3 dBm.	≤ 5 % or ≤ 0.22 dB (see Section X for conversion) Attenuate power level over the range of -60 dBm to 3 dBm	
		Detector size (see detector verification test per trigonometric analysis, Section X)	sufficient active area and placed sufficiently close to the end of the fiber to detect all the radiation emitted from it (captures light - both spatial and angular)	
		Detector stability	≤ 0.1 dB/hr.	
		Measurement repeatability	Less than 3 percent variation	
		Ambient light susceptibility (recommended)	Detector unit sealed to extent that not exposed to ambient light (ports covered completely)	
4	Switching system	Repeatability, each switch channel	≤ 0.03 dB either random or sequential switching after monitor fiber correction	
		Drift relative to monitor channel	0.06 dB for ten days relative to monitor fiber/designated monitor channel	
		Fiber size in launch end switch	= fiber size of DUT	
		Fiber size in detector end switch	≥ fiber size of DUT	
		Launch end switch, when use restricted launch	MM: restricted launch device @ ea. output port	
		Launch end switch, single mode	Higher order mode filter @ ea. output port	
		Launch end switch, jumper: source-to-switch	Fiber size same: jumper & switch	
		Detector end switch, jumper: switch-to-detector	Fiber size same: jumper & switch	
5	Monitor fiber	Fiber size	Same as DUT cable assembly	
		Configuration	Source sw.-to-det. sw, same amb, no bends, etc.	
6	System (overall)			
a	Verify system stability	Optical system: 4 hour & 96 hour stability tests Each channel: 1x per minute for 4 hours, every 30 minutes for 96 hours. Find min, max, avg, std dev.	See Section X (<0.1 of optical performance requirement)	
b	Maximum system insertion loss	System power level minus source-to detector power level	5 dB maximum	
c	Launch distribution 3/	Prescription: launch jumpers Non prescription: Verify - To Be Determined	Requirement: To Be Determined	

1/ This table is prepared from requirements listed in the Optical Test Measurement Guide. This table summarizes information in the various sections and is meant to be used as a check list. Some requirements in this table may need to be tailored, added or deleted for other optical tests.
2/ Alternative to verify overfilled launch is to measure near field and far field. Requirements: Nominal spot ≥ nominal core diameter, nominal NA ≥ nominal NA.
3/ Perform at the optical source end. Optical source end includes optical source, switch and/or other devices, launch jumpers (if used).
4/ For the 62.5/125 micron fiber size and below.
5/ Section X refers to Section X in the Optical Test Measurement Guide.
6/ Aircraft wavelength is 850 ± 20 nm with launch condition specified in Section X.
7/ Aircraft wavelength is 1550 +20/-30 nm.