METRIC
DOD-S-24622
3 December 1984

MILITARY SPECIFICATION

SOURCES, LED, FIBER OPTIC, GENERAL SPECIFICATION FOR (METRIC)

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification establishes the general requirements for light emitting diode (LED) fiber optic sources. These optical sources contain integrally attached pigtail fibers (see 6.5) for coupling the source optical power into the fiber optic link. Pigtail fibers specified herein are mechanically and optically compatible with the fibers specified in DOD-C-85045.

1.2 Classification. Optical sources are classified into two product assurance sealing levels designated A and B. Sealing level A (QLA) parts are hermetically sealed sources which have undergone and passed 100 percent screening tests. Sealing level B (QLB) parts are nonhermetically sealed sources which have undergone and passed 100 percent screening tests.

1.2.1 Military part number. The military part number shall consist of the letter "D", the basic number of the associated detail specification, and an assigned dash number as shown in tables I, II, and III, and in the associated detail specification.

D	24622/1-	A	08	A
Military metric designator	Detail specification number	Sealing level designator (table I)	Wavelength designator (table II)	Pigtail fiber designator (table III)

TABLE I. Sealing level designator.

Symbol	Sealing level
A	Fully hermetic
B	Nonhermetic

TABLE II. Wavelength designator.

Symbol	Wavelength of operation in nanometers
08	820-910
13	1250-1350
15	1400-1600

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Naval Sea Systems Command (SEA 55Z3), DoD Standardization Program and Documents Division, 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.

TABLE III. Pigtail fiber designator.

Symbol	Core/cladding diameter (µm)	Core index profile
A	50/125	Step
B	50/125	Graded
C	100/140	Step
D	100/140	Graded

For example part number D24622/1-A08B identifies a glass pigtailed type, LED fiber optic source that is fully hermetic, operating at a wavelength within the 820-910 nanometers range and using a graded index core fiber with core/cladding diameters of 50/125 micrometers respectively.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Government specifications and standards. Unless otherwise specified, the following specifications and standards of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DoDISS) specified in the solicitation, form a part of this specification to the extent specified herein.

SPECIFICATIONS

MILITARY

MIL-S-19491 - Semiconductor Devices, Packaging of.
DOD-S-24622/1 - Sources, LED, Fiber Optic, 820-910 Nanometers Wavelength Range, Glass Pigtailed Type.

STANDARDS

MILITARY

MIL-STD-104 - Limits for Electrical Insulator Color.
MIL-STD-129 - Marking for Shipment and Storage.
MIL-STD-202 - Test Methods for Electronic and Electrical Component Parts.
MIL-STD-454 - Standard General Requirements for Electronic Equipment.
MIL-STD-750 - Test Methods for Semiconductor Devices.
MIL-STD-889 - Dissimilar Metals.
DOD-STD-1678 - Fiber Optic Test Methods and Instrumentation.
MIL-STD-45662 - Calibration Systems Requirements.

(Copies of specifications, standards, drawings, and publications required by manufacturers in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

2.1.2 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence.

3. REQUIREMENTS

3.1 Associated detail specifications. Individual optical source requirements shall be as specified herein and in accordance with the applicable associated detail specification. In the event of conflict between requirements of this specification and the associated detail specification, the latter shall govern.

3.2 Qualification. Fiber optic sources furnished under this specification shall be products which are qualified for listing on the applicable qualified products list at the time set for opening of bids (see 4.4).

3.3 Materials.

3.3.1 General requirements. The optical source shall be constructed of material as specified herein or in the specification sheet. External metallic material shall be plated or treated to resist corrosion in accordance with MIL-STD-889 for Dissimilar Metals and shall be non-nutrient to fungus in accordance with requirement 4 of MIL-STD-454. Organic materials used in source construction shall not give off toxic, corrosive, or explosive fumes when tested to conditions specified herein. Material used shall have no adverse effect on the health of personnel when used for its intended purpose. Contractor shall submit a certificate of compliance with the specified material requirements.

3.3.2 Pigtail fibers. Pigtails shall be optical glass fibers as specified (see 3.1).

3.3.3 Recovered materials. Unless otherwise specified herein, all material incorporated in the products covered by this specification shall be new and shall be fabricated using materials produced from recovered materials to the maximum extent practicable without jeopardizing the intended use. The term "recovered materials" means materials which have been collected or recovered from solid waste and re-processed to become a source of raw materials, as opposed to virgin raw materials. None of the above shall be interpreted to mean that the use of used or rebuilt products is allowed under this specification unless otherwise specifically specified.

3.4 Design and construction. Overall dimensions, dimensional tolerances and physical characteristics for these sources shall be as specified (see 3.1). These sources shall be of the etched-well structure type with a single pigtail fiber integrally attached to the LED. The pigtail shall be terminated or unterminated as specified and sheathed in materials and constructions as specified (see 3.1). The source shall accept input electrical signals which provide bias and supply power and modulation for proper source operation, and shall provide optical power through the pigtail fiber to the external optical circuit. Source mounting characteristics and thermal control features, when required, shall be as specified (see 3.1). Source lead-in conductors shall be composed of materials and of dimensions adequate for their specified maximum current carrying capacity.

3.5 Performance. Optical, electrical, and electro-optical requirements specified herein, and as specified (see 3.1) shall be used to determine acceptance or rejection for sources subjected to the test method exposures of section 4.7.3. End point parameters (see 6.5) are listed with requirement and test paragraphs specified in table IV.

3.5.1 Optical.

3.5.1.1 Peak optical wavelength. When tested in accordance with 4.7.2.1, the source optical peak emission wavelength (see 6.5) shall be as specified (see 3.1).

3.5.1.1.1 Peak wavelength drift. When tested in accordance with 4.7.2.2, the source peak emission wavelength drift due to temperature change shall not vary from the peak emission wavelength by more than the wavelength tolerance specified (see 3.1).

3.5.1.1.2 Spectral bandwidth. When tested in accordance with 4.7.2.3, the spectral bandwidth (see 6.5) and bandwidth tolerance about the peak emission wavelength shall be as specified (see 3.1).

3.5.1.2 Power output.

3.5.1.2.1 Optical power amplitude. When tested in accordance with 4.7.2.4, the source optical output power amplitude (see 6.5), as coupled out of the fiber pigtail, shall be as specified (see 3.1).

3.5.1.2.2 Optical power amplitude stability. When tested in accordance with 4.7.2.5, the source optical output power stability shall be as specified (see 3.1).

3.5.1.2.3 Optical power angular distribution (radiation pattern). When tested in accordance with 4.7.2.6, the radiation pattern shall be as specified (see 3.1).

3.5.2 Electrical.

3.5.2.1 Forward voltage. When specified, source forward voltage levels shall be tested in accordance with 4.7.2.7. The acceptable level and variation in forward voltage shall be as specified (see 3.1).

3.5.2.2 Reverse current leakage. When specified, source reverse current leakage level shall be tested in accordance with 4.7.2.8. The acceptable level and variation of reverse leakage current shall be as specified (see 3.1).

3.5.2.3 Breakdown voltage. When specified, source breakdown voltage level shall be tested in accordance with 4.7.2.9. The acceptable breakdown voltage shall be as specified (see 3.1).

3.5.2.4 Thermal resistance. When specified, source thermal resistance level shall be tested in accordance with 4.7.2.10. Acceptable level and level variation for source thermal resistance shall be as specified (see 3.1).

3.5.3 Electro-optical.

3.5.3.1 Pulse rise and fall times. When tested in accordance with 4.7.2.11, the maximum acceptable rise and fall times for the optical pulses radiated from the pigtail fiber shall be as specifed (see 3.1).

3.5.3.2 Frequency response. When tested in accordance with 4.7.2.12, the frequency reponse of the pigtail radiated optical signals shall be as specified (see 3.1).

3.5.3.3 Signal linearity. When tested in accordance with 4.7.2.13, the linearity (L) of the source optical signals, as radiated by the pigtail fiber, shall contain less than -30 dB of total harmonic signal components as compared to the fundamental signal carrier.

3.6 Environmental and mechanical requirements.

3.6.1 Visual and mechanical inspection. When tested in accordance with 4.7.1.1, the source shall meet the lot tolerance percent defective (LTPD) (see 6.5) requirement specified in tables V and VII.

3.6.2 Physical dimensions. When tested in accordance with 4.7.1.2, the source shall meet the LTPD requirement specified in table VII.

3.6.3 High temperature (nonoperating) life (LTPD). When tested in accordance with 4.7.3.2, the visual inspection of 4.7.1.1, the LTPD requirement of table VI, and the end-point parameters and parameter limits as specified (see 3.1) shall be met.

3.6.4 Thermal shock (temperature cycling). When tested in accordance with 4.7.3.3, there shall be no visible evidence of source marking impairment or other damage. The LTPD requirement of table VI and the end-point parameters and parameter limits as specified (see 3.1) shall be met.

3.6.5 Constant acceleration. When tested in accordance with 4.7.3.4, the source shall meet the LTPD requirement of table VII and the end-point parameters and parameter limits as specified (see 3.1).

3.6.6 Steady-state reverse bias burn-in. When tested in accordance with 4.7.3.5, the source shall meet the reverse current requirement and optical parameters and limits as specified (see 3.1).

3.6.7 Steady-state power burn-in. When tested in accordance with 4.7.3.6, the source shall meet the end-point parameters and parameter limits noted in table IV and as specified (see 3.1).

3.6.8 Hermetic seal. When tested in accordance with 4.7.3.7, the source shall meet the LTPD requirements of tables VI and VII and shall not exceed the leakage rates as specified (see 3.1).

3.6.9 Solderability. When tested in accordance with 4.7.3.8, the source's electrical leads shall meet the solderability criteria stated in method 208 of MIL-STD-202, and meet the LTPD requirement specified in table VI.

3.6.10 Resistance to solvents. When tested in accordance with 4.7.3.9, the source's identification marking shall remain legible and intact. The LTPD requirement specified in table VI shall be met.

3.6.11 Steady-state operation life (LTPD). When tested in accordance with 4.7.3.10, the LTPD specified in table VI and the end-point parameters and parameter limits as specified (see 3.1) shall be met.

3.6.12 Intermittent operation life (LTPD). When tested in accordance with 4.7.3.11, the LTPD specified in table VI and the end-point parameters and parameter limits as specified (see 3.1) shall be met.

3.6.13 Decap internal visual design verification. When tested in accordance with 4.7.3.12, the source shall meet the LTPD requirement specified in table VI.

3.6.14 Bond strength. When tested in accordance with 4.7.3.13, the source shall meet the LTPD requirement specified in table VI.

3.6.15 Thermal shock (glass strain). When tested in accordance with 4.7.3.14, the source shall meet the LTPD requirement specified in table VII.

3.6.16 Terminal strength. Terminal strength tests for tension and torque shall be applied to both the external electrical leads and the optical pigtail of the source. The tensile and torque test loads to be applied shall be as specified (see 3.1). Evidence of breakage, loosening or relative motion between the terminal lead or pigtail and the source body shall constitute failure and part rejection. The LTPD requirement of table VII shall be met.

3.6.16.1 Tension. Terminal tensile strength shall be tested in accordance with 4.7.3.15.1. The minimum acceptable tensile load and the duration of application of this load shall be as specified (see 3.1).

3.6.16.2 Torque. Terminal torque strength shall be tested in accordance with 4.7.3.15.2. The minimum acceptable torque load and the duration of application of this load shall be as specified (see 3.1).

3.6.17 Moisture resistance. When tested in accordance with 4.7.3.16, the source shall meet the LTPD requirement of table VII and the end-point parameter and parameter limits as specified (see 3.1).

3.6.18 Shock. When tested in accordance with 4.7.3.17, the source shall meet the LTPD requirement of table VII and the end-point parameters and parameter limits as specified (see 3.1).

3.6.19 Vibration, variable frequency. When tested in accordance with 4.7.3.18, the source shall meet the LTPD requirements specified in table VII and the end-point parameters and parameter limits as specified (see 3.1).

3.6.20 Salt atmosphere (corrosion). When tested in accordance with 4.7.3.19, the source shall not exhibit illegible markings, flaking or pitting of the finish or corrosion that would interfere with the use of the device. The LTPD requirement specified in table VII shall be met.

3.6.21 Steady-state operation life. When tested in accordance with 4.7.3.20, the source shall meet the lambda requirement specified in table VII and the end-point values as specified (see 3.1).

3.6.22 Intermittent operation life. When tested in accordance with 4.7.3.21, the source shall meet the lambda requirement specified in table VII and the end-point values as specified (see 3.1).

3.7 Mass. Optical source mass shall be as specified (see 3.1).

3.8 Color. Optical source package color shall be as specified (see 3.1). Colors selected shall be in accordance with MIL-STD-104.

3.9 Marking. Marking size, color and preservation shall be in accordance with MIL-STD-129 and as specified (see 3.1). Source electrical polarity shall be marked as specified (see 3.1).

3.9.1 Marking on each source. The following marking shall be legible on each optical source at the time of shipment:

a. Polarity identification.
b. Military part number.
c. Manufacturer's designating symbol.

3.9.2 Marking legibility. Marking shall remain legible after all tests. Damage to marking on deliverable source test samples caused by mechanical fixturing in groups B and C nondestructive tests shall not be cause for lot rejection, but devices with damaged marking shall be remarked to insure legibility prior to shipment.

3.10 Workmanship. Optical sources shall be manufactured and processed in accordance with good design and sound engineering practice and to the requirements of this specification. The external surface of the source package, header or flange shall be finished and not have any depression or cavity, unless it is part of the original design. Burrs and sharp edges on the external package and leads shall be removed. External parts, elements or coatings shall not be blistered, cracked, softened or exhibit defects that adversely affect the storage, operation or environmental capabilities of these optical sources.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.1 Test equipment and inspection facilities. Test and measuring equipment and inspection facilities of sufficient accuracy, quality, and quantity to permit performance of the required inspection shall be established and maintained by the contractor. The establishment and maintenance of a calibration system to control the accuracy of the measuring and test equipment shall be in accordance with MIL-STD-45662. Fiber optic test methods and instrumentation, when specified, shall be in accordance with DOD-STD-1678.

4.2 Classification. The inspection requirements of optical sources shall be classified as follows:

a. Qualification inspection (see 4.4).
b. Quality conformance inspection (see 4.5).

4.3 Inspection conditions. Unless otherwise specified, all inspections shall be in accordance with MIL-STD-750.

4.3.1 Formation of inspection lots. Sources to be qualified shall be assembled into an identifiable inspection lot or collection of inspection sublots.

4.3.1.1 Inspection lot. The total number of sources that the manufacturer submits at any one time for qualification or quality conformance inspection shall constitute an inspection lot. The inspection lot is submitted to determine compliance with the requirements of the detail specification. Each inspection lot shall consist of sources of a single type or may consist of a collection of sublots of structurally identical sources (see 4.3.1.1.2) contained on a single detail specification manufactured on the same production line within a single plant through final seal by the same production technique and to the same source design with the same material requirements within the same 6-week period. Lot identification shall be maintained from the time the lot is assembled to the time it is accepted or rejected.

4.3.1.1.1 Inspection sublot. An inspection sublot shall consist of a single source type contained on a single detail specification manufactured on the same production line through final seal by the same fabrication technique and to the same source design with the same material requirements and within the same 6-week period. Quality level A and B optical sources are not structurally identical and therefore are independent sublots.

4.3.1.1.2 Structurally identical source types. Structurally identical sources are sources manufactured on the same production line through final seal by the same fabrication technique and to the same source design with the same material requirements, and differ only electrically. An example of such structurally identical sources are optical diodes grouped into different current ratings.

4.3.2 Preservation of lot identity. During all screening, inspection and marking operations, each lot and sublot shall be kept segregated, secure and traceable.

4.3.3 Sampling. Statistical sampling for qualification and quality conformance inspection shall be in accordance with the appendix of this specification.

4.3.4 Performance verification tests. Optical and electrical performance verification tests (see 4.7.2) shall be accomplished in a nondestructive manner.

4.3.5 Resubmitted lots. Resubmitted lots shall be kept separate from new lots and shall be clearly identified as resubmitted lots. When any lot submitted for qualification or quality conformance inspection fails any subgroup requirement of groups A, B, or C tests, it may be resubmitted once for that particular subgroup using tightened inspection criteria (as defined in the appendix of this specification). A second resubmission using tightened inspection criteria is permitted only if failure analysis is performed to determine the mechanism of failure for each failed source from the prior submissions and it is determined that failure is due to:

a. A defect that can be effectively removed by rescreening the entire lot, and that rescreen has been performed, or

b. Random type defects which do not reflect poor basic source design or poor basic processing procedures. In all instances where analysis of the failed sources indicates that the failure mechanism is due to poor basic processing procedures, a basic design fault, or nonscreenable defects, the lot shall not be resubmitted.

4.3.6 Methods of test. Conditions and methods of test shall be in accordance with MIL-STD-750. The general requirements of MIL-STD-750 apply as specified.

4.3.6.1 Alternative test methods. Other test methods or circuits may be substituted for those specified in MIL-STD-750 provided it is demonstrated to the Government that such a substitution in no way relaxes the requirements of this specification. The schematic wiring diagram of the test equipment shall be made available for checking by the Government. Control and calibration of the test equipment shall be established and documented in accordance with MIL-STD-45662.

4.3.6.2 Procedure in case of test equipment failure or operator error. If a source is believed to have failed as a result of faulty test equipment or operator error, the failure shall be entered in the test record which shall be submitted to the cognizant Government quality assurance representatives along with a complete explanation verifying why the failure is believed to be invalid. The Government quality assurance representative will then decide whether or not the failure is due to a valid part defect. If the Government quality assurance representative rules that the failure is invalid, a replacement source from the same inspection lot may be added to the sample. The replacement source shall be subjected to all those tests to which the discarded source was subjected prior to its failure and to any remaining specified tests to which the discarded source was not subjected to prior to its failure.

4.4 Qualification inspection. Qualification inspection shall be performed at a laboratory satisfactory to the Naval Sea Systems Command (NAVSEA) (see 6.3) on sample units produced with equipment and procedures normally used in production. For qualification inspection, sources shall be subjected to screening tests and inspections specified in groups A, B, and C for product assurance levels A or B. All samples subjected to groups B and C must be chosen from a lot which has passed the requirements of group A. The following conditions apply:

a. The required LTPD sample from a sublot of each source submitted, shall be tested for each group A subgroup.

b. A sample from one sublot shall be tested for each group B subgroup. A sample source from each sublot (each device type) shall be submitted to the physical property inspections.

c. A sample from one sublot shall be tested for each group C subgroup.

4.4.1 Inspection routine. For qualification, sources shall be subjected to screening tests (see 4.4.8) and inspections specified in groups A, B, and C for product assurance levels QLA or QLB. All samples subjected to groups B and C must be chosen from a lot which has passed the requirements of group A. The following conditions apply:

a. The required LTPD sample from a sublot of each source type submitted shall be tested for each group A subgroup.

b. A sample from one sublot shall be tested for each group B subgroup. A sample source from each sublot (each device type) shall be submitted to the design verification inspection (see 4.7.1).

c. A sample from one sublot shall be tested for each group C subgroup. At the option of the manufacturer, devices from table VI, group B, subgroup 3, may be continued on in group C, subgroup 6, to achieve 1,000 hours total, or separate samples may be used.

4.4.2 End points. End-point electrical and optical measurements (see 4.7.2) shall be taken and recorded before starting and after completion of all specified tests in the subgroups of groups B and C. Pre-test end-point failures shall be replaced by acceptable devices.

4.4.3 Variables data. Group A variables data and the pre-test and post-test groups B and C end-point variables data shall be included in the test report.

4.4.4 Data submitted. Data for all tests shall be recorded in sufficient detail to verify the test procedures and conditions applied.

4.4.5 Lot size. The qualification inspection lot shall be chosen by the manufacturer and the lot and each sublot shall contain at least twice the number of devices required for qualification.

4.4.5.1 Selection of samples. All samples shall be randomly selected from the qualification inspection lot. After a test has started, the manufacturer may add an additional quantity to the initial sample, but this addition may be done only once for any subgroup and the added samples shall be subjected to all the tests within that subgroup. The total samples (initial and added samples) shall determine the new acceptance number. The total defectives of the initial and second sample shall be additive and shall comply with the specified LTPD or lambda. The manufacturer shall retain sufficient devices from the qualification lot to provide for additional samples.

4.4.5.2 Identification of samples. The authorized Government Quality Assurance Representative may, at his option, mark or authorize the marking of each sample to be subjected to qualification testing in order to distinguish these devices from those not intended for qualification inspection.

4.4.6 Lot release. The lot from which the qualification samples are selected may be offered for delivery under contract after qualification approval has been granted provided screening and quality conformance requirements are satisfied.

4.4.7 Retention of qualification. To retain qualification, the manufacturer shall forward a report at 12-month intervals to the qualifying activity. The qualifying activity shall establish the initial reporting date. The report shall consist of a summary of the results of tests performed for quality conformance inspection (groups A, B, and C), including the number and mode of any subgroup failures. The summary shall include results of all quality conformance inspection tests performed on completed lots during the 12-month period. If the summary of the test results indicates nonconformance with specification requirements, (see 4.5.1 and 4.5.2) and corrective action acceptable to the qualifying activity has not been taken, action may be taken to remove the failing product from the qualified products list. The results of tests of all reworked lots shall be identified and accounted for. Failure to submit the report within 50 days after the end of each 12-month period may result in loss of qualification for the product.

4.4.7.1 Nonproduction. In the event that no production occurred during the reporting period, a report shall be submitted certifying that the company still has the capabilities and facilities necessary to produce the item. If during three consecutive reporting periods there has been no production of a device type or structurally identical types, the manufacturer may be required, at the discretion of the qualifying activity, to submit a representative product to appropriate testing in accordance with the qualification inspection requirements.

4.4.8 Source screening. The source screening procedure for sources shall be in accordance with table IV and as specified (see 3.1). All military optical sources (100 percent) shall be subjected to all applicable screening tests (as specified in table IV) in the sequence shown and shall meet the applicable percent defective allowed (PDA) for the type of optical source and product assurance level (A or B) specified. Sources which fail any test criteria in the screening sequence, shall be removed from the lot at the time of the observation or immediately at the conclusion of the test in which the failure was observed, and these devices shall not be shipped.

TABLE IV. Screening inspection.

Inspections	Requirement paragraph	Test method paragraph
Visual and mechanical inspection	3.6.1	4.7.1.1
High temperature (nonoperating) life (LTPD)	3.6.3	4.7.3.2
Thermal shock (temperature cycling)	3.6.4	4.7.3.3
Constant acceleration	3.6.5	4.7.3.4
Steady-state high temperature reverse bias burn-in	3.5.6	4.7.3.5
*Steady-state power burn-in	3.6.7	4.7.3.6
Hermetic seal	3.6.8	4.7.3.7
Fine leakage rate		4.7.3.7.1
Gross leakage rate		4.7.3.7.2

* Electrical and optical measurements shall be taken before and after this test to determine the delta parameters as specified (see 3.1).

4.4.8.1 Acceptance criteria. Selected electrical and optical parameters shall be designated as specified (see 3.1) as interim and end-point measurements for the 100 percent steady-state power burn-in noted in table IV. These parameters may also be compared to determine whether the change during burn-in (delta) is indicative of a lot stability problem. The percent defective allowable (PDA) for each inspection lot submitted to burn-in and interim (post burn-in) shall be 10 percent on all failures. The manufacturer shall not conduct burn-in in addition to that specified. Delta limits shall be defined as specified (see 3.1). When the PDA applies to delta limits, the delta parameter values measured after burn-in (100 percent screening test) shall be compared with the delta parameter values measured prior to that burn-in.

4.4.8.2 Lots resubmitted for burn-in. Unless otherwise specified, lots may be resubmitted for burn-in one time only and may be resubmitted only when the observed percentage of defectives does not exceed twice the specified PDA. Resubmitted lots shall contain only parts which were in the original lot. Resubmitted lots shall be kept separate from new lots and shall be inspected for all specified characteristics using a tightened inspection PDA of 3 percent. If the percent defective for the resubmitted lot exceeds the tightened inspection PDA, the entire resubmitted lot shall be unacceptable for any quality level. The delta criteria applying to such resubmitted lots shall be in accordance with the following procedure:

a. The screening (burn-in) shall be conducted and the delta drift values calculated. From this data the mean and standard deviation (SIGMA) shall be calculated.

b. Sources having delta drift values in excess of the mean ±3 sigma (calculated in step (a)) shall be removed from the lot and rejected.

c. The remaining sources shall then be submitted to the balance of the inspections as specified herein.

4.5 Quality conformance inspection. Quality conformance inspection shall be conducted in accordance with the requirements of groups A, B, and C for the specified product assurance level. Lot sampling shall be in accordance with appendix C of MIL-S-19500. If a lot is withdrawn in a state of failing to meet quality conformance requirements and is not resubmitted, it shall be considered a failed lot and reported as such. Each lot shall be subjected to groups A and B inspection. Successful completion of group C quality conformance for a given product assurance level shall satisfy the group C requirements for the tested level and for sources represented by a structurally identical group. The grouping of structurally identical devices shall be as agreed between the manufacturer and the qualifying activity.

4.5.1 Corrective action. If six of ten consecutive lots or if three successive lots of a source type or structurally identical types are rejected for the same reason, corrective action acceptable to the qualifying activity shall be initiated. Failure to initiate corrective action shall result in removal of products from the qualified products list.

4.5.2 Nonconformance. Lots which fail subgroup requirements of groups A, B, or C may be resubmitted in accordance with the provisions of 4.3.5. However, if the lot is not resubmitted or fails resubmission, the lot shall not be shipped. Samples from subsequent lots of the source types in the structurally identical device grouping represented by a failed group C inspection in the case of group C failures, shall then be subjected to all the tests of the subgroup in which the failure occurred, on a lot-by-lot basis until three successive lots pass the failed subgroup. The testing may then return to periodic testing. A source type which fails a group C inspection shall not be accepted until the type which failed successfully completes the failed group C subgroups. Other types from the same qualified group represented by the failed type may be accepted provided group C inspection requirements have been satisfied for those source types.

4.5.3 Group A inspection. Group A inspection shall be performed on each inspection lot and shall consist of visual and mechanical inspection, and electrical and optical tests as specified in table V, and the associated detail specification. Group A inspections may be performed in any order. If an inspection lot is made up of a collection of sublots, each sublot shall pass group A inspection as specified.

4.5.4 Group B inspection. Group B inspection shall be performed on each lot. Group B shall be in accordance with table VI and the detail specification for the specified product assurance level. Testing of one source type sublot in any subgroup shall be considered as complying with the requirements for that subgroup for all types in the lot. Different source types may be used for each subgroup. This inspection shall be applied only to completed and fully marked sources from lots which have been subjected to and passed the group A requirements. All tests within a subgroup shall be performed in the order specified.

4.5.5 Group C inspection. Group C inspection shall be in accordance with table VII and shall include those tests specified which are performed periodically at 6 month intervals on at least one source type from each structurally identical device grouping (from the same or different associated detail specification) in which the manufacturer has qualified source types. This inspection shall be applied only to completed and fully marked samples from lots that have satisfied the specified group A LTPD requirements.

TABLE V. Group A inspection.

Inspection subgroups	Requirement paragraph	Test method paragraph	LTPD
Subgroup 1			
Visual and mechanical inspections	3.6.1	4.7.1.1	5
Subgroup 2			
DC (static) electrical and optical at 25°C	3.1	3.1	5
Subgroup 3			
DC (static) electrical and optical at min/max rated operating temperatures	3.1	3.1	5
Subgroup 4			
Dynamic electrical and optical test at 25°C	3.1	3.1	5

* The specific parameters to be included for tests in each subgroup shall be as specified in the applicable associated detail specification. Where no parameters have been specified in a particular subgroup or test within a subgroup, no group A testing is required for that subgroup or test to satisfy group A requirements. A single sample may be used for all subgroup testing. These tests are considered nondestructive and devices may be shipped.

TABLE VI. Group B inspection.

Inspection subgroups	Requirement paragraph	Test method paragraph	LTPD
Subgroup 1 1/			
Solderability 3/	3.6.9	4.7.3.8	15
Resistance to solvents	3.6.10	4.7.3.9	
Subgroup 2 2/			
Thermal shock (temperature cycling)	3.6.4	4.7.3.3	
Hermetic seal a. Fine leak b. Gross leak	3.6.8	4.7.3.7 4.7.3.7.1 4.7.3.7.2	10
Subgroup 3 2/ 4/			
Steady state operation life (LTPD) or Intermittent operation life (LTPD)	3.6.21 3.6.12	4.7.3.10 4.7.3.11	5
Subgroup 4 1/			
Decap internal visual design verification	3.6.13	4.7.3.12	15
Bond strength	3.6.14	4.7.3.13	10
Subgroup 5			
Thermal resistance	3.6.2.4	4.7.2.10	10
Subgroup 6			
High temperature (nonoperating) life (LTPD)	3.6.3	4.7.3.2	10

1/ Failed devices from the same inspection lot may be used for all subgroups when electrical or optical end-point measurements are not required.

2/ Electrical or optical end-point measurements shall be taken after these tests as specified in the specification sheet.

3/ The LTPD for solderability test applies to the number of leads inspected except in no case shall less than three devices be used to provide the number of leads required.

4/ If a given inspection lot undergoing group B inspection has been selected to satisfy group C inspection requirements, the 340 hour life tests may be continued on test to 1,000 hours in order to satisfy the group C life test requirements. In such cases, either the 340 hour end-point measurements must be made as a basis for group B lot acceptance or the 1,000 hours end-point measurements shall be used for both groups B and C acceptance.

TABLE VII. Group C inspection.

Inspection subgroups	Requirement paragraph	Test method paragraph	LTPD
Subgroup 1 1/			
Physical dimensions	3.6.2	4.7.1.2	15
Subgroup 2 2/			
Thermal shock (glass strain)	3.6.15	4.7.3.14	10
Thermal strength	3.6.16	4.7.3.15	
Tension	3.6.16.1	4.7.3.15.1	
Torque	3.6.16.2	4.7.3.15.2	
Hermetic seal	3.6.8	4.7.3.7	
a. Fine leak		4.7.3.7.1	
b. Gross leak		4.7.3.7.2	
Moisture resistance	3.6.17	4.7.3.16	
External visual inspection	3.6.1	4.7.1.1	
Subgroup 3 2/			
Shock	3.6.18	4.7.3.17	10
Vibration (variable frequency)	3.6.19	4.7.3.18	
Constant acceleration	3.6.5	4.7.3.4	
Subgroup 4 1/			
Salt atmosphere (corrosion)	3.6.20	4.7.3.19	15
Subgroup 5 2/ 3/			
Steady state operation life	3.6.21	4.7.3.20	10
or			
Intermittent operation life	3.6.22	4.7.3.21	

1/ Failed devices from the same inspection lot may be used for all subgroups when electrical or optical end-point measurements are not required.

2/ Electrical or optical end-point measurements shall be taken after these tests as specified in the associated detail specification.

3/ If a given inspection lot undergoing group B inspection has been selected to satisfy group C inspection requirements, the 340 hour life tests may be continued on test to 1,000 hours in order to satisfy the group C life test requirements. In such cases, either the 340 hour end-point measurements must be made as a basis for group B lot acceptance or the 1,000 hours end-point measurements shall be used for both groups B and C acceptance.

4.5.5.1 Group C sample selection. Samples for subgroups in group C shall be chosen at random from the first lot submitted for quality conformance inspections during the specified group C inspection interval. Testing of one source type for each subgroup shall be considered as complying with the requirements for that subgroup for all types represented from the same line. A different source type shall be tested at each successive inspection interval until all structurally identical device types qualified on the same or different associated detail specification from the same qualified line have been tested. When none of the inspection lots passing group A of the first lot submitted contain the source type which is due to be tested, the samples for inspection shall be chosen from these types in the inspection lots being tested which have not been used for the longest time for group C inspection. The next lot which contains the skipped type shall be subjected to group C inspection as part of its quality conformance inspection.

4.5.6 Groups B and C end points. Post-test end points specified in the detailed specification shall be measured for each source of the sample after completion of all specified tests in the subgroup. Except as specified or otherwise required, all life test (operation and storage) end-point test measurements shall be performed within 96 hours after sample units have been subjected to and removed from required tests. All other end-point test measurements shall be made within 168 hours. Additional measurements may be made at the discretion of the manufacturer. At the end of each group B and C subgroup, end-point measurements shall include visual inspection without magnification to assure marking on each semiconductor tested is legible and complete. Damage to marking caused by mechanical fixturing or handling during test shall not be cause for lot rejection but devices so damaged shall be individually remarked prior to shipment. End points to be used for performance assessment shall be selected from table VIII.

TABLE VIII. End points.

End-point electrical measurements	Requirement paragraph	Test method paragraph
Peak optical wavelength	3.5.1.1	4.7.2.1
Peak optical wavelength drift	3.5.1.1.1	4.7.2.2
Spectral bandwidth	3.5.1.1.2	4.7.2.3
Optical power amplitude	3.5.1.2.1	4.7.2.4
Optical power amplitude stability	3.5.1.2.2	4.7.2.5
Optical power angular distribution	3.5.1.2.3	4.7.2.6
Forward voltage	3.5.2.1	4.7.2.7
Reverse current leakage	3.5.2.2	4.7.2.8
Breakdown voltage	3.5.2.3	4.7.2.9
Thermal resistance	3.5.2.4	4.7.2.10
Pulse rise and fall times	3.5.3.1	4.7.2.11
Frequency reponse	3.5.3.2	4.7.2.12
Signal linearity	3.5.3.3	4.7.2.13

4.5.7 Procedure for lots held more than 24 months. Sources which have passed quality conformance inspection and have been held by manufacturers or contractors for a total time period (time held by manufacturer plus time held by contractors) exceeding 24 months shall be reinspected by the manufacturer for all specified group A inspection requirements prior to shipment (shipped devices shall have a stamped quality conformance inspection date or a reinspection date less than 24 months old). In case of lot failure during reinspection, the lot shall be subjected to 100 percent inspection for all failed parameters and characteristics. All sources that fail any of these tests shall be rejected.

4 5.8 Inspection of packaging. The sampling and inspection of the preservation, packing and container marking shall be in accordance with the requirements of MIL-S-19491.

4.6 Verification of qualification. Optical sources to be qualified to this specification shall meet the requirements specified herein or as specified (see 3.1) when subjected to the screening tests (see 4.4.8) and quality conformance tests (see 4.5.) as specified herein. Verification of qualification shall be assessed by the design verification inspections and by the optical and electrical performance parameter measurements of 4.7.2.

4.6.1 Data recording. The results of all qualification screening and quality conformance tests and inspections and the results of all required failure analyses shall be recorded and maintained in the manufacturer's facility for at least three years. The Product Assurance Program Plan, qualification test reports, and periodic summary report (see 4.4.7) shall be submitted to the qualifying activity. The disposition of all lots or samples submitted for screening (when PDA is specified), quality conformance inspection or qualification shall be fully documented and lots which fail any specified requirement shall be recorded as failed lots whether resubmitted or withdrawn. Disposition of resubmitted lots shall likewise be recorded so that a complete history is available for every lot tested from initial submission to final disposition including all failures, resubmissions, and withdrawals.

4.7 Methods of inspection.

4.7.1 Physical property inspections.

4.7.1.1 Visual and mechanical inspection. Sources shall be inspected in accordance with method 2071 of MIL-STD-750.

4.7.1.2 Physical dimensions. Sources shall be inspected in accordance with method 2066 of MIL-STD-750 for physical conformance with the requirements of this specification. Critical dimensions to be used in this inspection shall be as specified (see 3.1).

4.7.2 Optical/electrical performance inspections. Cladding mode strippers shall be used on the fiber pigtail in all optical tests.

4.7.2.1 Peak optical wavelength (see 3.5.1.1.). Optical source peak wavelength, as radiated by the optical pigtail, shall be measured using a spectral radiometer whose calibration is traceable to the wavelength standard of the National Bureau of Standards. Measurement precision shall be better than ±1 nanometer with wavelength traceability (accuracy) better than ±0.1 percent of the peak wavelength.

4.7.2.2 Peak optical wavelength drift (see 3.5.1.1.1). Drift in optical source peak wavelength shall be measured out of the pigtail using the spectral radiometer of 4.7.2.1. Care shall be taken to place the pigtail end within the radiometers detection area such that all the emitted radiation shall be detected. Values for peak wavelength shall be obtained at ambient test temperatures of -55°C and +105°C, respectively, for both QLA and QLB type sources. Both peak wavelength values measured shall meet the drift limits as specified (see 3.1).

4.7.2.3 Spectral bandwidth (see 3.5.1.1.2). The spectral bandwidth of the optical source pigtail output radiation shall be measured using the spectral radiometer of 4.7.2.1. The wavelength difference between the plotted locations of the 50 percent of peak optical power amplitude shall be used as the basis for this measurement.

4.7.2.4 Optical power amplitude (see 3.5.1.2.1). The optical power amplitude shall be measured using procedure I, method 6010 of DoD-STD-1678. A large area radiation detector, sensitive and calibrated throughout the spectral bandwidth range of the pigtail output radiation shall be used so that the radiated energy is detected.

4.7.2.5 Optical power amplitude stability (see 3.5.1.2.2). Optical power amplitude stability shall be measured using the instrument and method of 4.7.2.4. The test instrument shall be inherently stable to better than ±1 percent of the full-scale meter reading over the measurement period. Values for P_o shall be taken at ambient test temperatures of -55°C and 105°C, respectively. These measured P_o values shall fall within the P_o limits as specified (see 3.1).

4.7.2.6 Optical power angular distribution (see 3.5.1.2.3). The optical power angular distribution (radiation pattern) shall be measured in accordance with procedure I, method 6030 of DOD-STD-1678. The detector of 4.7.2.4 shall be used the distance between the radiating pigtail fiber end and the detector is at least 50 times the diameter of the detector active element. Cladding mode stripping shall be used on the fiber pigtail. The numerical aperture (NA) of the radiation plot shall be calculated as the sine of the maximum and minimum off-axis angles obtained from two orthoconical radiation plots. These NA values shall not exceed the limits as specified (see 3.1).

4.7.2.7 Forward voltage (see 3.5.2.1). Sources shall be tested in accordance with method 4011 of MIL-STD-750. The levels of forward test current and voltage and the continuous or intermittent (duty cycle and rate) nature of the test current shall be as specified (see 3.1).

4.7.2.8 Reverse current leakage (see 3.5.2.2). Sources shall be tested in accordance with method 4016 of MIL-STD-750. The acceptable range of I_R level shall be as specified (see 3.1) for the specified value of reverse voltage (V_R).

4.7.2.9 Breakdown voltage (see 3.5.2.3). Sources shall be tested for breakdown voltage in accordance with method 4021 of MIL-STD-750. The level of reverse current through the device during the test shall be as specified (see 3.1).

4.7.2.10 Thermal resistance (see 3.5.2.4). Sources shall be tested for thermal resistance in accordance with method 4081 of MIL-STD-750. Temperature T_2 shall be +100°C for QLA devices and +70°C for QLB devices, and T_1 shall be 25°C in method 4081. The forward current through the device during the test shall be as specified (see 3.1).

4.7.2.11 Pulse rise and fall times (see 3.5.3.1). Optical pulse rise and fall times shall be measured at the pulse modulation rate as specified (see 3.1). An oscilloscope of suitable response shall be connected to the photodetector output to display the output pulse waveform. The pulse width time between the 10 percent and 90 percent maximum power level of the pulse waveform shall be used to determine the rise and fall time characteristics.

4.7.2.12 Frequency response (see 3.5.3.2). The optical source small signal frequency response test shall utilize a constant signal output, variable frequency sine wave signal generator covering the frequency range as specified (see 3.1) to modulate the optical source. A photodetector of suitable sensitivity, stability and frequency response shall detect the optical output of the pigtail fiber. The signal generator shall be scanned in frequency from 10 hertz up to a frequency where the detected output signal has dropped in amplitude by 3 dB. The frequency at this reduced signal level shall be the optical source cut-off frequency.

4.7.2.13 Signal linearity (see 3.5.3.3). The optical source signal linearity shall be measured using the instrumentation of 4.7.2.12 with the addition of a spectrum analyzer connected to the photodetector output. The frequency, input signal level and source bias level to be utilized shall be as specified (see 3.1). The signal generator shall modulate the source in accordance with these specification sheet instructions and the spectrum analyzer shall measure the fundamental and harmonic contents of the photodetector output signal. The ratio of total signal harmonic power content to signal fundamental power content shall be less than the acceptable level specified. Signal linearity in dB shall be equal to 10 log ratio of the harmonic to fundamental power levels measured.

4.7.3 Environmental and mechanical.

4.7.3.1 Elevated temperature life testing. A package may be elevated in temperature to perform accelerated life or reliability testing. For purpose of this specification, the time acceleration rule shall be to decrease the real time by a factor of 2 for every 10°C increase in temperature. The maximum temperature shall not exceed 105°C. (Example: a lifetime of 100,000 hours at 25°C can be tested for 12,500 hours at 55°C).

4.7.3.2 High temperature (nonoperating) life (LTPD) (see 3.6.3). Optical sources shall be tested in accordance with method 1032 of MIL-STD-750 to determine compliance with the specified LTPD (see 6.5) for the nonoperating storage condition. Exposure time and temperature shall be 24 hours at 125°C (QLA devices), and 24 hours at 85°C (QLB devices) for the screening test of table IV; and 340 hours at 125°C (QLA devices), and 340 hours at 85°C (QLB devices) for the group B quality conformance test of table VI.

4.7.3.3 Thermal shock (temperature cycling) (see 3.6.4). Sources shall be tested in accordance with test condition A-1, method 107 of MIL-STD-202, except that the lower test temperature shall be -40°C and the higher temperatures shall be +125 degrees celsius for QLA devices and +85°C for QLB devices. Source mounting for the test exposure shall be as specified (see 3.1).

4.7.3.4 Constant acceleration (see 3.6.5). Sources shall be tested in accordance with method 2006 of MIL-STD-750. A centrifugal force of 20,000 G units shall be applied in any sequence in each of the six axial directions.

4.7.3.5 Steady state reverse bias burn-in. (see 3.6.6). Sources shall be tested in accordance with test condition A, method 1038 of MIL-STD-750. The source shall be operated at 80 percent of maximum rated reverse voltage for 48 hours at a temperature of +100°C for QLA devices and +70°C for QLB devices.

4.7.3.6 Steady state power burn-in (see 3.6.7). Sources shall be tested in accordance with test condition B, method 1038 of MIL-STD-750. The source shall be operated at the maximum rated forward bias current for 96 hours at temperatures of 100°C and 70°C for QLA and QLB devices, respectively.

4.7.3.7 Hermetic seal (see 3.6.8).

4.7.3.7.1 Fine leakage rate. QLA sources shall be tested in accordance with test condition H, method 1071 of MIL-STD-750. QLB source shall omit this test.

4.7.3.7.2 Gross leakage rate. QLA sources shall be tested in accordance with test condition C, method 1071 of MIL-STD-750. QLB sources shall be tested only to gross leak step 1, test condition C, method 1071 of MIL-STD-750. Fluid test temperature shall be +85°C.

4.7.3.8 Solderability (see 3.6.9). All sources shall be tested in accordance with method 208 of MIL-STD-202 with the exception that the 60 minute aging period be extended to 12 hours.

4.7.3.9 Resistance to solvents (see 3.6.10). Sources shall be tested in accordance with method 1022 of MIL-STD-750.

4.7.3.10 Steady state operation life (LTPD) (see 3.6.11). When specified, sources shall be tested in accordance with method 1027 of MIL-STD-750. The source shall be operated continuously at 100 percent of rated power output. The source mounting arrangement for testing shall be as specified (see 3.1).

4.7.3.11 Intermittent operation life (LTPD) (see 3.6.12). When specified, sources shall be tested in accordance with method 1037 of MIL-STD-750. The source shall be operated at a 50 percent duty cycle from 100 percent rated power output to zero power output. The frequency of operation, the test duration, the test temperature (case or ambient) and the test mounting arrangement for the source shall be as specified (see 3.1).

4.7.3.12 Decap internal visual design verification (see 3.6.13). Sources shall be tested in accordance with method 2075 of MIL-STD-750. Particular attention shall be paid to the pigtail/die attachment region supported by photographic documentation as described in method 2075.

4.7.3.13 Bond strength (see 3.6.14). Sources shall be tested in accordance with test condition A, method 2037 of MIL-STD-750. Bond failure criteria shall be as stated in method 2037.

4.7.3.14 Thermal shock (glass strain) (see 3.6.15). QLA sources shall be tested in accordance with test condition A, method 1056 of MIL-STD-750. QLB sources shall be similarly tested but to a high temperature limit of +85 degrees celsius. Distilled water shall be used as the immersion fluid.

4.7.3.15 Terminal strength (see 3.6.16).

4.7.3.15.1 Tension (see 3.6.16.1). Sources shall be tested in accordance with test condition A, method 2036 of MIL-STD-750.

4.7.3.15.2 Torque (see 3.6.16.2). Sources shall be tested in accordance with test condition D1, method 2036 of MIL-STD-750.

4.7.3.16 Moisture resistance (see 3.6.17). Sources shall be tested in accordance with method 1021 of MIL-STD-750. The stated initial conditioning (lead-fatigue) test of method 1021 shall be applied to the fiber pigtail and all electrical leads of the source.

4.7.3.17 Shock (see 3.6.18). Sources shall be tested in accordance with method 2016 of MIL-STD-750. The source shall be subjected to shocks of 1500 G's for durations of 0.5 millisecond each. Five shocks in each of the X1, Y1 and Z1 directions shall be given.

4.7.3.18 Vibration, variable frequency (see 3.6.19). Sources shall be tested in accordance with method 2056 of MIL-STD-750.

4.7.3.19 Salt atmosphere (corrosion) (see 3.6.20). Sources shall be tested in accordance with method 1041 of MIL-STD-750.

4.7.3.20 Steady state operation life (see 3.6.21). When specified, sources shall be tested in accordance with method 1026 of MIL-STD-750. Test exposure time shall be 1000 hours at the maximum rated temperature or as specified (see 3.1). Test mounting arrangements shall be as specified (see 3.1).

4.7.3.21 Intermittent operation life (see 3.6.22). When specified, sources shall be tested in accordance with method 1036 of MIL-STD-750. The ambient test temperature, the number and duration of source operating test cycles, the percent of source rated optical power output and the test mounting arrangement shall be as specified (see 3.1).

5. PACKAGING

5.1 Packaging requirements. The requirements for packaging shall be in accordance with MIL-S-19491.

6. NOTES

6.1 Intended use. Optical sources specified herein and in the specification sheets are of the LED (light emitting diode) type and intended for use in general military fiber optic applications.

6.2 Ordering data.

6.2.1 Acquisition requirements. Acquisition documents should specify the following:

a. Part number (see 1.2.1).

b. The applicable detail specification number and its revision letter, if applicable.

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time set for opening of bids, qualified for inclusion in Qualified Products List (QPL-24622) whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or purchase orders for the products covered by this specification. The activity responsible for the Qualified Products List is Naval Sea Systems Command, SEA 55Z3, DOD Standardization Program and Documents Division, Washington, DC 20362; however, information pertaining to qualification of products may be obtained from Defense Electronics Supply Center, DESC-EQ, Dayton, Ohio 45444.

6.3.1 Application for qualification. Application for qualification tests shall be made in accordance with SD-6, "Provisions Governing Qualification".

6.4 Detail specification. The items listed below should be covered in the associated detail specification:

a. Part number (see 1.2.1).

b. Design, construction and material (see 3.3 and 3.4).

c. Source marking if other than as specified in 3.9.1.

d. Inspection performance (if other than specified herein):

(1) Inspections to be performed under qualification inspection.

(2) Inspections to be performed under quality conformance inspection.

(3) Inspections to be performed under screening inspection.

e. End-point measurements to be made for groups B and C inspections (see 4.5.6).

f. Product assurance levels covered.

g. Sequence of test, test method, test condition, limit, cycles, temperature, axis, etc., when not specified, or if other than specified herein.

h. Interim (pre- and post-burn-in) electrical and optical parameters.

i. Delta parameter measurements or provisions for PDA.

j. Final electrical and optical measurements.

k. Requirements for data recording and reporting, where applicable.

l. Applicable details required by MIL-STD-750, other than as specified herein.

6.5 Security of completed devices. Marked sources which have passed all screening and quality conformance requirements shall be retained in a secure area prior to shipment or delivery. Source inventory shall be controlled by type, quantity, product assurance level, and transaction date. Provision shall be made for surveillance by Government representatives. This requirement applies to the manufacturer and contractors.

6.6 Definitions.

6.6.1 End points. End points are the parameters and limits specified which shall be met before and after the test exposure for optical source acceptance.

6.6.2 Lambda (λ). λ is a symbol defined as LTPD per 1,000 hours. This symbol is not to be confused with λ_p, the peak wavelength.

6.6.3 Linearity (L). The linearity of a continuous, periodic signal is represented by the ratio of the summation of the total harmonic power content of the signal to the power content of the signals fundamental frequency.

6.6.4 LTPD. LTPD (lot tolerance percent defective) is a method used for statistical sampling of parts being tested for qualification acceptance. LTPD has the form of a series where the numerical value selected represents the minimum percent of samples tested which rejects the inspection lot. Additional details are found in appendix C of MIL-S-19500.

6.6.5 Peak wavelength (λp). The peak wavelength is the emission wavelength at which the radiant intensity is a maximum.

6.6.6 Pigtail fiber. The pigtail is a short length of optical fiber integrally attached to the source package at the manufacturers plant, and aligned with the source's radiating elements for maximum optical power output.

6.6.7 Power output (Po). Optical source radiant power output is the total optical energy within the source spectral bandwidth and angular radiation cone of the radiating pigtail fiber.

6.6.8 Spectral bandwidth ($\Delta\lambda$). Given a plot of output radiant intensity versus wavelength from the fiber pigtail, the spectral bandwidth is the wavelength difference between locations on the plot where the radiant intensity is 50 percent of the peak emission wavelength intensity.

APPENDIX

STATISTICAL SAMPLING, LIFE TEST PROCEDURES

10. SCOPE

10.1 This appendix contains statistical sampling and life test procedures used with fiber optic sources. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance only.

20. APPLICABLE DOCUMENT

20.1 Government document.

MIL-HDBK-H53 - Guide for Attribute Lot Sampling Inspection and MIL-STD-105.

30. GENERAL

30.1 Definitions. The following definitions shall apply for all statistical sampling procedures:

a. LTPD series. The lot tolerance percent defective (LTPD) series is defined as the following decreasing series of LTPD or lambda (λ) values: 50, 30, 20, 15, 10, 7, 5, 3, 2, 1.5, 1, 0.7, 0.5, 0.3, 0.2, 0.15, 0.1.
b. Tightened inspection. Tightened inspection is defined as inspection performed using the next LTPD or lambda value in the LTPD series lower than that specified.
c. Acceptance number (c). The acceptance number is defined as an integral number associated with the selected sample size which determines the maximum number of defectives permitted for that sample size.
d. Rejection number (r). Rejection number is defined as one plus the acceptance number.
e. Lambda (λ). Lambda is defined as LTPD per 1,000 hours.

30.2 Symbols. The following symbols shall apply for all statistical sampling procedures:

a. LTPD - Lot Tolerance Percent Defective
b. λ - Lambda
c. c - Acceptance number
d. r - Rejection number
e. n - Sample size

40. STATISTICAL SAMPLING PROCEDURES AND TABLE - LTPD METHOD

40.1 General. Statistical sampling shall be conducted using the LTPD method. The LTPD method as specified herein is a double sampling plan which provides a high degree of assurance that a lot having a proportion defective equal to or greater than the specified LTPD value will not be accepted. The choice of any one procedure is optional. The procedures specified herein are suitable for all qualification or quality conformance requirements, but are not suitable if the objective of the inspection is to determine that the proportion defective in the lot represented is greater than the specified LTPD value since the assurance for that purpose is normally only 10 percent (see 6.3).

40.1.1 Selection of samples. Samples shall be randomly selected from the inspection lot or inspection sublots. (For an explanation of random sampling, see MIL-HDBK-H53, Section 13.)

40.1.1.1 Identification of samples for quality conformance tests. The authorized Government Quality Assurance representative may, at his option, mark or authorize the marking of each sample to be subjected to qualification or quality conformance inspection in order to distinguish these units from those not intended for Government conformance inspection. This additional marking shall in no way interfere with or obscure the marking required (see 3.9).

40.1.2 Failures. Failure of a unit for one or more tests of a subgroup shall be charged as a single failure.

40.2 Single-lot sampling method. Quality conformance inspection information (sample sizes and number of observed defectives) shall be accumulated from a single inspection lot to demonstrate conformance to the individual subgroup criteria.

40.2.1 Sample size. The sample size for each subgroup shall be determined from table IX and shall meet the specified LTPD or lambda. The manufacturer may, at his option, select a sample size greater than that required; however, the number of failures permitted shall not exceed the acceptance number associated with the required sample size in table IX.

40.2.2 Acceptance procedure. For the first sampling, an acceptance number shall be chosen and the associated number of sampling devices for the specified LTPD selected and tested (see 40.2.1). If the observed number of defectives from the first sample is less than or equal to the preselected acceptance number, the lot shall be accepted. If the observed number of defectives exceeds the preselected acceptance number, an additional sample may be chosen such that the total sample complies with 40.2.3.

40.2.3 Additional sample. The manufacturer may add an additional quantity to the initial sample, but this may be done only once for any subgroup and the added samples shall be subjected to all the tests within the subgroup. The total sample size (initial and added samples) shall be determined by a new acceptance number selected from table IX.

40.2.4 Multiple criteria. Except where otherwise specified, when a subgroup contains more than one acceptance criterion, the entire sample for a subgroup shall be used for all criteria within the subgroup. In table IX, the acceptance number shall be that one associated with the largest sample size in the appropriate LTPD column which is less than or equal to the sample size used.

40.2.5 One-hundred percent inspection. Inspection of 100 percent of the lot shall be allowed, at the option of the manufacturer for any or all subgroups other than those which are considered "destructive." The maximum observed percent defective for the inspection lot shall not exceed the specified LTPD or λ value. Devices that fail any test shall be removed from the lot.

40.2.6 Disposition of failed lot. A lot that fails quality conformance inspection may, at the option of the manufacturer be screened for defectives or reworked and resubmitted for reinspection (see 4.3.5).

50. LIFE TEST

50.1 General. Life tests shall be conducted in accordance with the procedures in this section. Life tests performed on devices at or within their maximum ratings shall be considered nondestructive. If a lot is made up of a collection of sublots, each sublot shall pass all applicable electrical end points as specified.

50.2 Selection of samples. Samples for life tests shall be selected at random from the inspection lot (see 40.1.1). The sample size for a 1,000-hour test shall be chosen by the manufacturer from table IX from the column under the specified λ. The acceptance number shall be the one associated with the particular sample size chosen.

50.3 Failures. A semiconductor device which exceeds one or more of the end-point limits specified for life test at any specified or other reading interval shall be considered a failure and shall not be considered acceptable at any subsequent reading interval. For the purpose of computing device hours, the test-time hours credited to a failed device shall not exceed the test time associated with the last measurement time that the device was observed to be within the specified end-point limits. If the sample fails, the test may be terminated at the discretion of the manufacturer.

TABLE IX. LTPD Sampling plans. 1/ 2/

Minimum size of sample to be tested to assure, with a 90 percent confidence, that a lot having percent-defective equal to the specified LTPD will not be accepted (single sample).

Max Percent Defective (LTPD) or λ	50	30	20	15	10	7	5	3	2	1.5	1	0.7	0.5	0.3	0.2	0.15	0.1
Acceptance Number (c) (r = c + 1)	Minimum Sample Sizes (For device-hours required for life test, multiply by 1000)																
0	5 (1.03)	8 (0.64)	11 (0.46)	15 (0.34)	22 (0.23)	32 (0.16)	45 (0.11)	76 (0.07)	116 (0.04)	153 (0.03)	231 (0.02)	328 (0.02)	461 (0.01)	767 (0.007)	1152 (0.005)	1534 (0.003)	2303 (0.002)
1	8 (4.4)	13 (2.7)	18 (2.0)	25 (1.4)	38 (0.94)	55 (0.65)	77 (0.46)	129 (0.28)	195 (0.18)	258 (0.14)	390 (0.09)	555 (0.06)	778 (0.045)	1296 (0.027)	1946 (0.018)	2592 (0.013)	3891 (0.009)
2	11 (7.4)	18 (4.5)	25 (3.4)	34 (2.24)	52 (1.6)	75 (1.1)	105 (0.78)	176 (0.47)	266 (0.31)	354 (0.23)	533 (0.15)	759 (0.11)	1065 (0.080)	1773 (0.045)	2662 (0.031)	3547 (0.022)	5323 (0.015)
3	13 (10.5)	22 (6.2)	32 (4.4)	43 (3.2)	65 (2.1)	94 (1.5)	132 (1.0)	221 (0.62)	333 (0.41)	444 (0.31)	668 (0.20)	953 (0.14)	1337 (0.10)	2226 (0.062)	3341 (0.041)	4452 (0.031)	6681 (0.018)
4	16 (12.3)	27 (7.3)	38 (5.3)	52 (3.9)	78 (2.6)	113 (1.8)	158 (1.3)	265 (0.75)	398 (0.50)	531 (0.37)	798 (0.25)	1140 (0.17)	1599 (0.12)	2663 (0.074)	3997 (0.049)	5327 (0.037)	7994 (0.025)
5	19 (13.8)	31 (8.4)	45 (6.0)	60 (4.4)	91 (2.9)	131 (2.0)	184 (1.4)	308 (0.85)	462 (0.57)	617 (0.42)	927 (0.28)	1323 (0.20)	1855 (0.14)	3090 (0.085)	4638 (0.056)	6181 (0.042)	9275 (0.028)
6	21 (15.6)	35 (9.4)	51 (6.6)	68 (4.9)	104 (3.2)	149 (2.2)	209 (1.6)	349 (0.94)	528 (0.62)	709 (0.47)	1054 (0.31)	1503 (0.22)	2107 (0.155)	3509 (0.093)	5267 (0.062)	7019 (0.047)	10533 (0.031)
7	24 (16.6)	39 (10.2)	57 (7.2)	77 (5.3)	116 (3.5)	166 (2.4)	234 (1.7)	390 (1.0)	589 (0.67)	783 (0.51)	1178 (0.34)	1680 (0.24)	2355 (0.17)	3922 (0.101)	5886 (0.067)	7845 (0.051)	11771 (0.034)
8	26 (18.1)	43 (10.9)	63 (7.7)	85 (5.6)	128 (3.7)	184 (2.6)	258 (1.8)	431 (1.1)	648 (0.72)	864 (0.54)	1300 (0.36)	1854 (0.25)	2599 (0.18)	4329 (0.108)	6498 (0.072)	8660 (0.054)	12995 (0.036)
9	28 (19.4)	47 (11.5)	69 (8.1)	93 (6.0)	140 (3.9)	201 (2.7)	282 (1.9)	471 (1.2)	709 (0.77)	945 (0.58)	1421 (0.38)	2027 (0.27)	2842 (0.19)	4733 (0.114)	7103 (0.077)	9468 (0.057)	14206 (0.038)
10	31 (19.9)	51 (12.1)	75 (8.4)	100 (6.3)	152 (4.1)	218 (2.9)	306 (2.0)	511 (1.2)	770 (0.80)	1025 (0.60)	1541 (0.40)	2199 (0.28)	3082 (0.20)	5133 (0.120)	7704 (0.080)	10268 (0.060)	15407 (0.040)
11	33 (21.0)	54 (12.8)	83 (8.3)	111 (6.2)	166 (4.2)	238 (2.9)	332 (2.1)	555 (1.2)	832 (0.83)	1109 (0.62)	1664 (0.42)	2378 (0.29)	3323 (0.21)	5546 (0.12)	8319 (0.083)	11092 (0.062)	16638 (0.042)
12	36 (21.4)	59 (13.0)	89 (8.6)	119 (6.5)	178 (4.3)	254 (3.0)	356 (2.2)	594 (1.3)	890 (0.86)	1187 (0.65)	1781 (0.43)	2544 (0.3)	3562 (0.22)	5936 (0.13)	8904 (0.086)	11872 (0.065)	17808 (0.043)
13	38 (22.3)	63 (13.4)	95 (8.9)	126 (6.7)	190 (4.5)	271 (3.1)	379 (2.26)	632 (1.3)	948 (0.89)	1264 (0.67)	1896 (0.44)	2709 (0.31)	3793 (0.22)	6321 (0.133)	9482 (0.089)	12643 (0.067)	18964 (0.045)
14	40 (23.1)	67 (13.8)	101 (9.2)	134 (6.9)	201 (4.6)	288 (3.2)	403 (2.3)	677 (1.4)	1007 (0.92)	1343 (0.69)	2015 (0.46)	2878 (0.32)	4029 (0.23)	6716 (0.138)	10073 (0.092)	13431 (0.069)	20146 (0.046)
15	43 (23.3)	71 (14.1)	107 (9.4)	142 (7.1)	213 (4.7)	305 (3.3)	426 (2.36)	711 (1.41)	1066 (0.94)	1422 (0.71)	2133 (0.47)	3046 (0.33)	4265 (0.235)	7108 (0.141)	10662 (0.094)	14216 (0.070)	21324 (0.047)
16	45 (24.1)	74 (14.6)	112 (9.7)	150 (7.2)	225 (4.8)	321 (3.37)	450 (2.41)	750 (1.44)	1124 (0.96)	1499 (0.72)	2249 (0.48)	3212 (0.337)	4497 (0.241)	7496 (0.144)	11244 (0.096)	14992 (0.072)	22487 (0.048)
17	47 (24.7)	79 (14.7)	118 (9.86)	158 (7.36)	236 (4.93)	338 (3.44)	473 (2.46)	788 (1.48)	1182 (0.98)	1576 (0.74)	2364 (0.49)	3377 (0.344)	4728 (0.246)	7880 (0.148)	11819 (0.098)	15759 (0.074)	23639 (0.049)
18	50 (24.9)	83 (15.0)	124 (10.0)	165 (7.54)	248 (5.02)	351 (3.51)	496 (2.51)	826 (1.51)	1239 (1.0)	1652 (0.75)	2478 (0.50)	3540 (0.351)	4956 (0.251)	8260 (0.151)	12390 (0.100)	16520 (0.075)	24780 (0.050)
19	52 (25.5)	86 (15.4)	130 (10.2)	173 (7.76)	259 (5.12)	370 (3.58)	518 (2.56)	864 (1.53)	1296 (1.02)	1728 (0.77)	2591 (0.52)	3702 (0.358)	5183 (0.256)	8638 (0.153)	12957 (0.102)	17276 (0.077)	25914 (0.051)
20	54 (26.1)	90 (15.6)	135 (10.4)	180 (7.82)	271 (5.19)	386 (3.65)	541 (2.60)	902 (1.56)	1353 (1.04)	1803 (0.78)	2705 (0.52)	3864 (0.364)	5410 (0.260)	9017 (0.156)	13526 (0.104)	18034 (0.078)	27051 (0.052)
25	65 (27.0)	109 (16.1)	163 (10.8)	217 (8.08)	326 (5.38)	466 (3.76)	652 (2.69)	1086 (1.61)	1629 (1.08)	2173 (0.807)	3259 (0.538)	4656 (0.376)	6518 (0.269)	10863 (0.161)	16295 (0.108)	21726 (0.081)	32589 (0.054)

1/ Sample sizes are based upon the Poisson exponential binomial limit.

2/ The minimum quality (approximate AQL) required to accept (on the average) 19 of 20 lots is shown in parenthesis for information only.

50.4 Life-test time and sample size. Whenever a lambda (λ) is specified, the life-test time shall be 1,000 hours initially. Once a lot has passed the 1,000-hour test, life tests with minimums of 340 hours and maximums of 2,000 hours may be initiated for new lots provided that 180 days have not elapsed since a 1,000-hour life test on the same device type on the same structurally identical group (see 4.3.1.1.2). If 180 days have elapsed, the new lot shall pass a 1,000-hour life test. The sample size for a life-test time other than 1,000 hours shall be chosen according to the relationship of inverse proportionality between test time and sample size, such that the total unit test hours accumulated (sample sizes multiplied by test hours) equal the amount that would have been chosen for the 1,000-hour life test, had it been performed. The acceptance number shall also be determined from the sample size associated with the same 1,000-hour test, had it been performed. The lot shall be accepted if the number of failures at the end of the test period does not exceed the acceptance number.

50.5 Procedure to be used if number of observed failures exceeds the acceptance number. In the event that the number of failures observed on life test exceeds the acceptance number, the manufacturer shall choose one of the following options: (1) discontinue the life test, screen or rework and resubmit per paragraph 40.2.6, (2) add additional samples in accordance with 50.5.1, or (3) extend the test time to 1,000 hours in accordance with 50.5.2, if a test time less than 1,000 hours was originally chosen. Only one of these options shall be used for a given submission, and this option shall be used only once.

50.5.1 Additional samples. When this option is chosen, a new total sample size (initial plus added) shall be chosen by the manufacturer from table IX from the column under the specified λ. A quantity of additional units sufficient to increase the sample to the newly chosen total sample size shall be selected from the lot. A new acceptance number shall be determined and shall be the one associated with the new total sample size chosen. The added sample shall be subjected to the same life-test conditions and time period as the initial sample. If the total observed number of defectives (initial plus added) does not exceed the acceptance number for the total sample, the lot shall be accepted. If the observed number of defectives exceeds this acceptance number, the lot shall not be accepted but may be resubmitted (see 40.2.6).

50.5.2 Extension of life-test period. If a life test time period less than 1,000 hours is being used and the number of failures observed in the initial sample exceeds the acceptance number, the manufacturer may, in lieu of adding additional samples, choose to extend the test time of the entire initial sample to 1,000 hours and determine a new acceptance number from table IX. The new acceptance number shall be that one associated with the largest sample size in the specified column which is less than or equal to the sample size on test. A device which is a failure at the initial reading interval shall not be considered acceptable at the 1,000 hour reading interval. If the observed number of defectives at 1,000 hours does not exceed the new acceptance number, the lot shall be accepted. If the observed number of defectives exceeds this acceptance number, the lot shall not be accepted, but may be resubmitted (see 40.2.6).

50.5.3 Failure of life test. If a lot fails to meet life-test requirements (including resubmission per paragraph 40.2.6, if elected) such that it is eliminated or withdrawn from further quality conformance inspection consideration, then 1,000-hour life tests shall be required until three successive lots have passed the specified life tests. Then life testing in accordance with 50.2 and 50.4 may be resumed.

50.6 Failure of life test. If a lot fails to meet life-test requirements (including submission per paragraph 40.2.6, if elected) such that it is eliminated or withdrawn from further quality conformance inspection consideration, then a 1,000-hour life test shall be required for the failed subgroup until three successive lots have passed. If group B or C (table VI or VII) does not require 1,000-hour testing, then the specified life test, if other than 1,000 hours, shall be required for three successive lots.

Custodians:
Army - CR
Navy - SH
Air Force - 85

Review activities:
Navy - AS, EC
Air Force - 11, 17, 19, 99
DLA - ES

User activities:
Navy - CG, MC

Agent:
DLA - ES

Preparing activity:
Navy - SH

(Project 6030-0012)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions – Reverse Side)

1. DOCUMENT NUMBER	2. DOCUMENT TITLE
DOD-S-24622	Sources, LED, Fiber Optic, General Specification For (Metric)

3a. NAME OF SUBMITTING ORGANIZATION	4. TYPE OF ORGANIZATION *(Mark one)*
	☐ VENDOR ☐ USER ☐ MANUFACTURER ☐ OTHER *(Specify)*:
b. ADDRESS *(Street, City, State, ZIP Code)*	

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER *(Last, First, MI)* – Optional	b. WORK TELEPHONE NUMBER *(Include Area Code)* – Optional
c. MAILING ADDRESS *(Street, City, State, ZIP Code)* – Optional	8. DATE OF SUBMISSION *(YYMMDD)*

DD FORM 82 MAR 1426

PREVIOUS EDITION IS OBSOLETE.