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# MILITARY SPECIFICATION
# MODULE, IMAGE INTENSIFIER
# 40 MILLIMETER, TYPE 8605

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

## 1. SCOPE

1.1 This specification covers the type 8605, 40 millimeter, image intensifier module.

## 2. APPLICABLE DOCUMENTS

2.1 The following documents of the issue in effect on date of invitation for bids or request for proposal form a part of this specification to the extent specified herein.

SPECIFICATION

Federal

| | |
|---|---|
| QQ-S-781 | - Steel Strapping, Flat |
| PPP-B-566 | - Box, Folding, Paperboard |
| PPP-B-585 | - Box, Wood, Wirebound |
| PPP-B-601 | - Box, Wood, Cleated-Plywood |
| PPP-B-621 | - Box, Wood, Nailed and Lock-Corner |
| PPP-B-636 | - Box, Fiberboard |
| PPP-B-676 | - Box, Set-Up |
| PPP-C-850 | - Cushioning Material Polystyrene, Expanded Resilient (for Packaging Uses) |
| PPP-F-320 | - Fiberboard, Corrugated and Solid, Sheet Stock (Container Grade) and Cut Shapes |
| PPP-T-60 | - Tape, Pressure-Sensitive Adhesive, Waterproof for Packaging |
| PPP-T-76 | - Tape, Pressure-Sensitive Adhesive Paper, Water-Resistant for Carton Sealing |
| PPP-T-97 | - Tape, Pressure-Sensitive Adhesive, Filament Reinforced |

Military

| | |
|---|---|
| MIL-P-116 | - Preservation, Methods of |
| MIL-F-22191 | - Films, Transparent, Flexible, Heat Sealable, for Packaging Applications |
| MIL-B-43014 | - Boxes, Water Resistant Paperboard, Folding, Set-Up and Metal Stayed |

STANDARDS

Military

| | |
|---|---|
| MIL-STD-105 | - Sampling Procedures and Tables for Inspection by Attributes |
| MIL-STD-129 | - Marking for Shipment and Storage |
| MIL-STD-130 | - Identification Marking of U. S. Military Property |
| MIL-STD-147 | - Palletized and Containerized Unit Loads 40 Inch X 48 Inch Pallets, Skids, Runners, or Pallet Type Base |
| MIL-STD-781 | - Reliability Tests, Exponential Distribution |

DRAWINGS

ECOM

| | |
|---|---|
| SC-C-611635 | - Image Intensifier Module (40 MM) Type 8605 |

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

## 3. REQUIREMENTS

3.1 Description. - The type 8605 image intensifier module shall be a single stage module assembled in accordance with SC-C-611635 and shall hereinafter be referred to as "module". It will be used in a three-stage assembly, each stage of which may have different performance characteristics, and shall be further identified as type 8605-1, 8605-2 or 8605-3 for first, second or third stage use respectively. Each module shall have an S-20 spectral response photocathode, an aluminized P-20 type phosphor, and shall operate at a nominal 15,000 volts direct current (dc).

3.1.1 Drawings. - The drawings forming a part of this specification are engineering design drawings. The supplier is responsible for preparing his own shop drawings. Where tolerances prescribed could cumulatively result in incorrect fit, the supplier shall provide tolerances within those prescribed on the drawings to insure correct fit, assembly and operation of the module. No deviation from the prescribed dimensions, or tolerances is permissible without prior approval of the contracting officer.

3.2 Preproduction model. - The contractor shall furnish two (2) each first, second and third stage modules to prove, prior to starting production, that his production methods and choice of design detail will produce modules that comply with the requirements of this specification. The contracting officer shall be notified ten (10) working days prior to submission of the preproduction models for tests and examination. Examination and tests shall be those specified herein (see 4.3) and shall be witnessed by an authorized representative of the contracting officer. Any changes or deviations from the preproduction models during production shall be subject to the approval of the contracting officer. Approval of the preproduction models by the contracting officer shall not relieve the contractor of his obligation to furnish modules conforming to this specification.

3.3 Initial production. - The supplier shall furnish the Government two (2) each first, second and third stage modules for inspection as specified in 4.4.

3.4 Material. - Material shall be as specified herein. Material not specified shall be selected by the contractor and shall be subject to all provisions of this specification.

3.5 Photocathode sensitivity. - The photoemissive material of each first stage photocathode (see 6.3.1) shall have an S-20 spectral response with extended red sensitivity. Photocathode sensitivity of first stage modules shall be measured at room temperature (see 6.3.2) and shall be not less than the following values for the condition specified.

a. Luminous sensitivity of 175 microamperes per lumen for 2870° K light.

b. Radiant sensitivity of 0.012 ampere per watt at 0.80 micron.

c. Radiant sensitivity of 0.005 ampere per watt at 0.85 micron.

3.6 Vibration. - The module shall not be damaged (see 6.3.3) and shall meet all operational requirements when vibrated with simple harmonic motion parallel to the optical axis (see 6.3.4) and perpendicular to the optical axis over a frequency range of 10 to 55 Hertz (Hz) at an amplitude of not less than 0.10 inch total excursion for 10 minutes in each plane with no voltage applied during the vibration.

3.6.1 Shock. - The module shall not be damaged and shall exhibit no flashing, flickering, or electrical breakdown, when subjected to six shock impacts applied perpendicular to the optical axis and six shock impacts applied parallel to the optical axis. The shock impacts shall have a minimum of 75 g's (see 6.3.5) at the peak amplitude.

3.7 Environmental. - The module shall not be damaged by storage, operation or thermal shock and shall meet specified operational requirements under the following conditions (see figure 1):

| | | |
|---|---|---|
| a. | Storage: | At plus 68° C for 1 hour and minus 54° C for 1 hour. |
| b. | Operation: | When subjected to a temperature of plus 52° C for 1 hour, and while operating at plus 52° C, with no radiation incident on the photocathode and with radiation incident on the photocathode |

Adjusted to obtain best spot contrast, the module shall show no evidence of ion spots (see 6.3.6), field emission (see 6.3.7), or internal arcing.

When subjected to a temperature of minus 54° C for 1 hour, the module shall show no evidence of damage.

c. Thermal Shock: When subjected to thermal shock of plus 52° C to room temperature and minus 54° C to room temperature.

3.8 Equivalent background input. - The equivalent background input shall not exceed $2 \times 10^{-11}$ lumen per square centimeter (lumen/cm$^2$) for 1st stage, $2 \times 10^{-10}$ for 2nd stage and $2 \times 10^{-9}$ for 3rd stage modules at any voltage between 10 and 15 kilovolts (KV).

3.9 Luminance gain.

3.9.1 First stage module. - The first stage module shall have a luminance gain of not less than 65 with input radiation of $3 \times 10^{-2}$ to $5 \times 10^{-2}$ footcandle measured at the identical voltage used in 3.8.

3.9.2 Second and third stage modules. - The second and third stage modules shall have a green light gain of 22 measured at the identical voltage used in 3.8 using a calibrated green light source of 0.1 to 0.3 footlambert.

3.10 Cathode and screen quality. - With 15,000 volts applied and no radiation on the photocathode, there shall be no bright streaks, blemishes, cold emission (see 6.3.8) or clusters of scintillations (see 6.3.9) on the image screen. With 15,000 volts applied and with radiation on the photocathode, there shall be no signal induced scintillations, crosshatch, checkerboard, herring bone patterns, large mottled areas that appear as multi-fiber shading or heavy dark boundary areas between the multi-fiber bundles on the image screen. All bright or dark spots which exceed a contrast of 30 percent to their surrounding area shall not exceed the size and quantities specified in Table I. Size of noncircular spots shall be determined on the basis of equal area to circular spots. When the distance between two spots is less than the maximum dimension of either spot, the two spots shall be considered as one spot with a size equal to the sum of the maximum dimensions of the two spots plus the amount of separation between them. For the cathode and screen quality tests, the input radiation for first stage modules shall be white light and for second and third stage modules shall be green light.

TABLE I CATHODE AND SCREEN SPOTS

| SIZE OF SPOTS (INCH) | Number Spots Within 0.30 Inch Diameter Circle | Number of Spots Within Area Bounded by 2 Circles 0.30 and 1.20 Inches in Diameter | Number of Spots Within Area Bounded by 2 Circles 1.20 and 1.47 Inches in Diameter |
|---|---|---|---|
| Greater than 0.015 | 0 | 0 | 0 |
| 0.012 to and including 0.015 | 0 | 1 | 1 |

| | | | |
|---|---|---|---|
| 0.009 to less than 0.012 | 0 | 1 | 3 |
| 0.006 to less than 0.009 | 0 | 4 | 8 |
| 0.003 to less than 0.006 | 1 | 20 | 40 |
| 0.001 to less than 0.003 | 6 | Minimum | Minimum |

NOTE: The 0.30, 1.20 and 1.47 inch circles on the image screen shall be concentric with the optical axis.

3.11 Image alinement. - The center of an image produced on the screen of the module by focusing a test reticle on the photocathode concentric with the optical axis shall fall within a 0.040 inch diameter circle that is concentric with the optical axis.

3.11.1 Image shift. - The center of an image produced on the screen of the module by focusing a test reticle on the photocathode concentric with the optical axis shall shift not more than 0.005 inch during 30 seconds of operation.

3.12 Center resolution. - The center resolution of the module shall be not less than 64 line pairs per millimeter.

3.12.1 Peripheral resolution. - The peripheral resolution of the module shall be not less than 57 line pairs per millimeter at 11 mm from center of the photocathode.

3.13 Center magnification. - The module center magnification shall be not less than 0.94 or greater than 1.0.

3.13.1 Distortion. - The module distortion from center to 16 mm from the center shall be not greater than 7.0 percent.

3.14 Useful cathode diameter. - The useful cathode diameter shall be not less than 40 millimeters.

3.15 Luminance uniformity, first stage module. - The luminance uniformity of the screen shall vary not more than 2 to 1 over a circular area 38.0 mm in diameter concentric with the optical axis. Variations in screen brightness shall not fall outside of the tolerance band shown in figure 2 when the photocathode is uniformly illuminated with 2870° K tungsten lamp radiation.

3.15.1 Luminance uniformity, second and third stage modules. - The luminance uniformity of the image screen shall vary not more than 2 to 1 over a circular area 38.0 mm in diameter concentric with the optical axis. Variations in screen brightness shall not fall outside the tolerance band shown in figure 2 when the photocathode is uniformly illuminated with green light.

3.16 Breakdown. - With no radiation incident on the photocathode there shall be no evidence of damage when the module is energized with an input voltage of 16,000 volts for 10 seconds at room temperature.

3.17 Mean time between failure. - The module shall have a specified mean time between failure of 4000 hours.

3.18 Dimensions. - The module shall be in accordance with SC-C-611635.

3.19 Identification marking. - Each module shall be identified in accordance with MIL-STD-130. The marking shall include a coded acceptance date. The first two numbers of the code shall be the last two digits of the number of the year. The second two numbers of the code shall be two digits indicating the calendar week of the year (01 through 52). Reading from left to right (or top to bottom), the code number shall designate the year and week of acceptance in that order. Each module shall be identified for first, second or third stage use.

3.20 Workmanship. - All parts and components of the module shall be free from dirt, grease, oil or other extraneous material and from defects that could impair the performance of the module.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. - Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier 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.

4.2 Classification of inspection. - Inspection shall be classified as follows:

a. Preproduction inspection (4.3).

b. Initial production inspection (4.4).

c. Quality conformance inspection (4.5).

d. Inspection comparison (4.7).

e. Inspection of preparation for delivery (4.8).

4.3 Preproduction inspection.

4.3.1 Examination. - Each preproduction module shall be examined in accordance with Table II. Presence of one or more defects shall be cause for rejection of that module and may be cause for termination of the examination.

TABLE II EXAMINATION

| DEFECT | | REQUIREMENT PARAGRAPH |
|---|---|---|
| 101. | Components missing or not as specified | 3.1 |
| 102. | Dimensions not as specified | 3.18 |
| 103. | Identification or special marking missing or illegible | 3.19 |
| 104. | Workmanship not as specified | 3.20 |

4.3.2 Tests - Following successful completion of the examination specified in 4.3.1 each preproduction module shall be subjected to all the tests in Table III. Failure of any test shall be cause for rejection of that preproduction module and may be cause for termination of preproduction testing.

4.4 Initial production inspection. - When specified (see 3.3) initial production modules shall be selected at random by the Government from the first production lot being produced from production tooling. The modules shall be examined as specified in Table II and shall be tested as specified in Table III to determine conformance to the requirements of this specification. The inspection will be performed by the contractor under supervision of a representative of the contracting officer. Acceptance of the initial production modules shall not exclude the remaining modules from the quality conformance inspection and acceptance provisions specified in section 4.

4.4.1 Inspection failure. - Failure of an initial production module to meet any requirement specified herein during and as a result of the examination and tests specified in 4.4 shall be cause for rejection of the initial production modules and shall be cause for refusal by the Government to continue acceptance of production modules until evidence has been provided by the supplier that corrective action has been taken to eliminate the deficiencies. Correction of such deficiencies shall be accomplished by the supplier at no cost to the Government on deficiencies found as a result of the initial production inspection and will be considered prima facie evidence that all modules accepted prior to the completion of initial production inspection are similarly deficient unless evidence to the contrary is furnished by the supplier and such evidence is acceptable to the contracting officer.

4.4.2 Inspection schedule. - Tables II through VI shall be used for preproduction, initial production and quality conformance inspection as specified in 4.3, 4.4 and 4.5. The first five (5) tests listed in Table III shall be conducted first and in the order listed. The remaining tests may be performed in any order, except "Mean time between failure", which shall be conducted last.

TABLE III TEST SCHEDULE

| TEST | REQUIREMENT PARAGRAPH | TEST PARAGRAPH |
|---|---|---|
| 1 | 2 | 3 |
| First stage photocathode sensitivity | 3.5 | 4.6.2 |
| Shock | 3.6.1 | 4.6.4 |
| Equivalent background input | 3.8 | 4.6.6 |
| Luminance gain (room temperature) | 3.9 | 4.6.7 |
| Cathode and screen quality | 3.10 | 4.6.8 |
| Center resolution | 3.12 | 4.6.10 |
| Peripheral resolution | 3.12.1 | 4.6.10.1 |
| Environmental | 3.7 | 4.6.5 |
| Image alinement | 3.11 | 4.6.9 |
| Image shift | 3.11.1 | 4.6.9.1 |
| Breakdown | 3.16 | 4.6.14 |
| Luminance uniformity | 3.15 | 4.6.13 |
| Center magnification | 3.13 | 4.6.11 |
| Distortion | 3.13.1 | 4.6.11.1 |
| Useful cathode diameter | 3.14 | 4.6.12 |
| Mean time between failure | 3.17 | 4.6.15 |

4.5 Quality conformance inspection.

4.5.1 Inspection lot. - Unless otherwise specified in the contract or order, for purposes of inspection all modules offered for inspection at one time shall be considered a lot as defined in MIL-STD-105.

4.5.2 Sampling. - Samples shall be selected in accordance with MIL-STD-105. AQL and inspection level shall be as specified in 4.5.4.2 and 4.5.4.3.

4.5.3 Examination. - Each module shall be examined in accordance with Table II. Presence of one or more defects shall be cause for rejection of that module.

4.5.4 Tests.

4.5.4.1 Group A, individual tests. - Unless otherwise specified, each module shall be subjected to the tests in Table IV. Failure of any test shall be cause for rejection of that module.

TABLE IV GROUP "A" TEST SCHEDULE

| TEST | REQUIREMENT PARAGRAPH | TEST PARAGRAPH |
|---|---|---|
| First stage photocathode sensitivity (8605-1 module only) | 3.5 | 4.6.2 |
| Shock | 3.6.1 | 4.6.4 |
| Equivalent background input | 3.8 | 4.6.6 |
| Luminance gain (room temperature) | 3.9 | 4.6.7 |
| Cathode and screen quality | 3.10 | 4.6.8 |
| Center resolution | 3.12 | 4.6.10 |
| Peripheral resolution | 3.12.1 | 4.6.10.1 |

4.5.4.2 Group B, sampling. - Samples selected in accordance with 4.5.2, which have passed the tests specified in 4.5.4.1, Group "A", shall be subjected to the tests in Table V. AQL shall be 1.5 percent defective, inspection level III combined.

TABLE V GROUP "B" TEST SCHEDULE

| TEST | REQUIREMENT PARAGRAPH | TEST PARAGRAPH |
|---|---|---|
| Environmental | 3.7 | 4.6.5 |
| Center magnification | 3.13 | 4.6.11 |
| Distortion | 3.13.1 | 4.6.11.1 |
| Breakdown | 3.16 | 4.6.14 |
| Luminance uniformity | 3.15 | 4.6.13 |

4.5.4.3 Group C, special sampling. - This inspection shall consist of the tests specified in Table VI and shall be performed on sample units that have been subjected to and met the tests in 4.5.4.1 and 4.5.4.2. Sample units shall be selected in accordance with 4.5.2. AQL shall be 6.5 percent defective inspection level S-4 combined, except for "Mean time between failure" (see 4.6.15).

TABLE VI GROUP "C" TEST SCHEDULE

| TEST | REQUIREMENT PARAGRAPH | TEST PARAGRAPH |
|---|---|---|
| Vibration | 3.6 | 4.6.3 |
| Image alinement | 3.11 | 4.6.9 |
| Image shift | 3.11.1 | 4.6.9.1 |
| Useful cathode diameter | 3.14 | 4.6.12 |
| Mean time between failure | 3.17 | 4.6.15 |

4.5.4.3.1 Special sampling for inspection. - Sample modules shall be selected at random for testing as specified in Table VI each 30 days. The lot size shall be the number of modules accepted in the preceding 30 days.

4.5.4.3.2 Special sampling lot failure. - In the event of failure of the special sampling lot, the contractor shall immediately report in writing each failure occurrence including details of the failure and characteristics affected. The contractor shall immediately investigate the cause of failure and within 5 working days report the results of the investigation. As soon as practicable the contractor shall submit a report on details of the proposed corrective action on (a) the processes and materials, as applicable and (b) all modules which were manufactured under the same conditions and which may be considered subject to the same failure. Reports shall be forwarded to the responsible technical activity designated in the contract or purchase order through the Government Quality Assurance Representative. After corrective action has been taken, an additional sample, equal in size to the first sample, shall be subjected to the special sampling inspection (all inspections or the inspection which the sample failed, at the option of the Government). Final acceptance and shipment will be withheld until the special sampling reinspection results have shown that the corrective action is effective. When it is the Government's decision that the failure does not affect module performance the special sampling lot will be accepted.

4.6 Inspection procedure.

4.6.1 Test conditions. - Tests shall be conducted in accordance with the test procedures specified herein. Unless otherwise specified the following conditions shall apply:

a. The radiation source used in the test shall be a tungsten filament lamp operated at a color temperature of 2870° K ± 50° K.

b. The green light source used to calibrate the photometer for screen brightness measurements shall have a tungsten lamp, opal glass and filters as specified below:

(1) Tungsten filament lamp operated at 2400° K plus or minus 100° K color temperature.

(2) Corning spectral filters Nos. 3-71 and 4-67 or equal.

(3) Opal glass that will produce uniform, diffuse output.

(4) Output brightness to be 0.5 to 0.7 foot lambert uniformly distributed over an aperture of not less than 40 millimeters.

c. The photometer used for screen brightness measurement shall be an eye-corrected Pritchard Model 1970 PR or equal and shall have an acceptance angle of not greater than 2 degrees. In performing photometric measurements the photometer shall be placed perpendicular to the surface being measured.

d. The radiation from the source incident on the photocathode for each test shall be the amount specified for that test. Tolerance on specified radiation levels shall be ± 10 percent.

e. Operating potential applied to the module shall be 15,000 ± 150 volts dc.

f. Tests shall be performed at room temperature.

g. Meters used for monitoring lamp current and voltage shall be accurate within 0.25 percent of full scale reading. Meters used for monitoring module input voltage shall be accurate within 1.0 percent of full scale reading.

h. Neutral density filters used in test equipment shall have transmission characteristics within 10 percent of the nominal filter transmission from 0.35 micron to 1.0 micron.

i. Environmental test chambers shall maintain specified temperatures within plus or minus 2° C.

4.6.2 First stage photocathode sensitivity. - Illuminate the photocathode with 0.01 to 0.03 lumen of 2870° K tungsten filament lamp radiation evenly distributed over a 1.10 inch diameter spot centered on the photocathode fiber optic faceplate. Apply a nominal 300 volts dc across the module and read the current with a microammeter connected in the ground side of the circuit. The microammeter reading divided by the input flux in lumens is the photocathode sensitivity. Determine the spectral sensitivity in a like manner except that a 0.80 micron filter and a 0.85 micron filter shall be inserted consecutively between the light source and the photocathode. The 0.80 and 0.85 micron filters shall have the following characteristics:

a. Far infrared blocking out to 4 microns.

b. Peak wavelength of 0.8000 ± 0.0025 micron an 0.8500 ± 0.0010 micron.

c. Bandwidth at the 10 percent points of 0.0125 ± 0.0015 micron.

d. Minimum peak transmission of 50 percent.

The spectral sensitivity of the photocathode is the microammeter reading divided by the radiant energy input in watts. Sensitivity values less than those specified in 3.5 shall constitute failure of this test.

4.6.3 Vibration. - The operating potential shall not be applied to the modules during vibration testing. Tolerances on specified frequencies shall be plus or minus 2 Hz, and tolerance on total excursion shall be plus or minus 0.005 inch. Prior to beginning vibration testing the modules shall be visually inspected for

physical damage (see 6.3.3.b). No module shall be vibrated which shows evidence of physical damage. Mount the modules singly, or in groups, with the photocathode end up. Subject the modules to simple harmonic motion applied in planes parallel and perpendicular to the optical axis. In one minute, vary the frequency from 10 Hz to 55 Hz and return to 10 Hz. The amplitude of vibration shall be 0.05 inch (0.10 inch total excursion) in each plane. Repeat this frequency sweep 10 times in each plane. At the conclusion of the vibration testing, inspect the modules visibly for any physical damage. The operating potential shall then be applied to the module, with no light incident on the photocathode and the module shall be observed for damage. Evidence of damage shall constitute failure of this test.

4.6.4 Shock. - This test shall be conducted in a darkened room. Apply the operating potential to the module for a minimum stabilization period of three minutes. At the end of this stabilization period, with the operating potential applied and no light incident on the photocathode subject the module to six (6) shock impacts parallel to the optical axis and six (6) shock impacts perpendicular to the optical axis. Apply the shock impacts in such a way as to generate nominal half-sine wave pulses having a minimum peak amplitude of 75 g's on the module. The duration of each shock pulse shall be 6 milliseconds $\pm$ 2 milliseconds measured between the 10 percent values of peak amplitudes. The energy under the shock curve shall be not less than 0.25 g-seconds, and the after-oscillations shall be not greater than 15 percent of the peak amplitude of the nominal half-sine wave pulse. Evidence of damage during or at the conclusion of the shock test shall constitute failure of this test.

4.6.5 Environmental. - Place the module in the test chamber at room temperature. Raise the temperature of the chamber to plus 68° C in 30 minutes and hold at this temperature for 1 hour. At the end of this 1 hour holding period, reduce the temperature of the chamber to plus 52° C in 15 minutes and hold this temperature for 1 hour. During the last 30 minutes of this period, operate the module with no radiation incident on the photocathode. With radiation incident on the photocathode adjusted to obtain best spot contrast, examine the module for ion spots, field emission and internal arcing. At the end of this hour remove the module from the chamber to room temperature and inspect it for damage. After 30 minutes replace the module in the chamber at room temperature and reduce the temperature of the chamber to minus 54° C in 30 minutes and hold at this temperature for 1 hour. At the end of this 1 hour period remove the module from the chamber at minus 54° C to room temperature and examine it for damage. Any evidence of ion spots, field emission, internal arcing, or damage during or at the conculsion of this test shall constitute failure of this test.

4.6.6 Equivalent background input.

4.6.6.1 First stage module. - With the operating potential applied to the module and with no radiation incident on the photocathode measure the output brightness, $B_1$ of a 22.5 mm $\pm$ 1 mm diameter area, centered on the output screen, with an S-11 photomultiplier tube. Illuminate the center 1.10 inch diameter of the photocathode uniformly with $2 \times 10^{-11}$ lumen/cm$^2$ from a 2870° K tungsten source and measure the output brightness, $B_2$. $B_2$ shall be equal to or greater than 2 $B_1$. $B_2$ less than 2 $B_1$ shall constitute failure of this test.

4.6.6.2 Second and third stage modules. - The test for the second and third

stage modules shall be the same as that specified in 4.6.6.1 except that the input light shall pass through green matching filters Corning CS 3-71 and CS 4-67, or equal. The illumination shall be 2 X $10^{-10}$ lumen/$cm^2$ for second stage modules and 2 X $10^{-9}$ lumens/$cm^2$ for third stage modules. Failure to meet the requirements of 3.8 for second and third stage modules shall constitute failure of this test.

4.6.6.3 An alternate method for measuring EBI may be used in lieu of that specified in 4.6.6.1 and 4.6.6.2. When used the following method shall apply:

$$EBI = \frac{I_1 - I_0}{I_2 - I_1} \times A$$

Failure to meet the requirements for 3.8 shall constitute failure of this test.

In this formula:

$I_0$ = Dark current of photomultiplier tube

$I_1$ = Photomultiplier current due to brightness of module with no incident radiation

$I_2$ = Photomultiplier current due to brightness of module when illuminated with A.

A = First, second and third stage EBI requirements (see 3.8).

4.6.7 Luminance gain.

4.6.7.1 First stage module. - Illuminate the photocathode with 3 X $10^{-2}$ to 5 X $10^{-2}$ footcandle of 2870° K tungsten filament radiation uniformly distributed over a 1.10 inch diameter spot centered on the fiber optic faceplate. Apply the operating potential to the module and measure the output brightness of the screen with the photometer. The photometer shall be positioned such that it subtends a 22.5 mm ± 1 mm diameter area centered on and perpendicular to the output screen. Divide the light output brightness in foot lamberts by the input illumination in footcandles. Values less than those specified in 3.9.1 shall constitute failure of this test.

4.6.7.2 Second and third stage modules. - The test for the second and third stage modules shall be the same as that specified in 4.6.7.1 except that the input light shall pass through green matching filters, Corning CS 3-71 and CS 4-67 or equal and the illumination on the photocathode shall be 0.1 to 0.3 footcandles. Divide the output brightness by the input brightness. Values less than those specified in 3.9.2 shall constitute failure of this test.

4.6.8 Cathode and screen quality. - With the operating potential applied and no radiation on the photocathode, observe the image screen with a 10 power or higher magnifier or microscope. Using white light for first stage modules and green light for second and third stage modules, adjust the light level for best spot contrast. Two additional stages of amplification shall be used to inspect the module under test for ion spots and scintillations. Observe the image screen with and without the viewing system specified above. Failure to meet the requirements of 3.10 shall constitute failure of this test.

4.6.9 Image alinement. - Place or image a test pattern (such as is shown in figure 3 or its equivalent) so that its center dot falls on the optical center of the photocathode. With the operating potential applied, illuminate the photocathode to provide a high contrast image of the test pattern. Aline a 10 power (or higher) measuring microscope, with the optical axis of the module under test. The center of the test pattern shall fall within a 0.040 inch diameter circle centered on the optical center of the image screen. Failure to meet the requirements of 3.11 shall constitute failure of this test.

4.6.9.1 Image shift. - Determine image shift with the same equipment used in 4.6.9. At the conclusion of the image alinement test (4.6.9), position the center of the reticle in the measuring microscope on the center of the test reticle and remove the operating potential from the module. After the module is completely discharged, apply the operating potential and observe the test reticle for the first 30 seconds of operation. Should the test reticle be displaced from its original position (prior to removing the operating potential) measure the displacement. Image shift greater than that specified in 3.11.1 shall constitute failure of this test.

4.6.10 Center resolution. - Perform this test using:

a. A radiation source (2870° K not required).

b. A projection system having an f number not greater than 10.

c. A positive resolving power test target (1951 Air Force Resolving Power Test Pattern or equivalent) (see figure 4).

d. A 10 power or higher viewing system.

The resolving power target shall be placed or imaged onto the photocathode such that the center of the target is alined with the optical center of the photocathode and is focused to provide best image contrast. The input radiation level shall not exceed $5 \times 10^{-2}$ footcandle and shall be adjusted to give maximum contrast. The image of the center resolving power target formed on the screen of the tube shall be observed for limiting resolution (see 6.3.10). Resolution less than that specified in 3.12 shall constitute failure of this test.

4.6.10.1 Peripheral resolution. - Determine peripheral resolution with the same equipment used in 4.6.10. The resolving power target shall be placed or imaged onto the photocathode such that the center of the target is positioned on the optical center of the photocathode and is focused to provide best image contrast. The images of the peripheral resolving power targets formed on the screen of the module shall be observed for limiting. Resolution less than that specified in 3.12.1 shall constitute failure of this test.

4.6.11 Center magnification. - Perform this test with the same equipment used in 4.6.9. With operating potential applied to the module place or image the test pattern on the optical center of the photocathode and adjust input radiation level for best image contrast. The test pattern on the photocathode, shall have the same dimensions specified in figure 3. Measure the separation of the center one (1) millimeter graduation ($M_1$) as imaged on the screen of the module with a 10-power (or higher) traveling microscope. Compute center magnification as follows:

$$\text{CENTER MAGNIFICATION} = \frac{M_1}{2.000}$$

WHERE: a. 2.000 is the separation in millimeters of the test points on the photocathode.

b. $M_1$ is the measured separation in millimeters at the test points as imaged on the output screen of the module.

Failure to meet the requirements of 3.13 in both the vertical and horizontal directions shall constitute failure of this test.

4.6.11.1 Distortion. - Perform this test with the same equipment used in 4.6.9 and in the same manner as in 4.6.11. Measure the chordal separation of the 16 mm graduation ($M_2$) as imaged on the screen of the module. Compute distortion as follows:

$$\text{PERCENT DISTORTION} = \frac{\left(\frac{M_2}{32.00}\right) - \left(\frac{M_1}{2.00}\right)}{\left(\frac{M_1}{2.00}\right)} \times 100$$

Distortion greater than that specified in 3.13.1 shall constitute failure of this test.

4.6.12 Useful cathode diameter. - Perform this test with the same equipment used in 4.6.9. With the operating potential applied to the module, place or image the test pattern on the optical center of the photocathode and adjust input radiation level for best image contrast. The test pattern projected onto the photocathode shall have the same dimensions specified in figure 4. The image screen shall be viewed with a 10 power (or higher) microscope. Useful cathode diameter is determined by the number of millimeter graduations visible on the screen of the module and shall be determined in both vertical and horizontal directions. Failure to meet the requirements of 3.14 in both the vertical and horizontal directions shall constitute failure of this test.

4.6.13 Luminance uniformity.

4.6.13.1 First stage module. - Uniformly illuminate the photocathode with 0.02 footcandle of 2870° K tungsten lamp radiation and scan the image screen with a spot brightness scanner. The spot brightness scanner shall view the image screen such that a 0.040 inch (or 1 millimeter) diameter area of the screen is observed at any one time. The scanner shall begin its scan at the optical center of the image screen and move in a spiral motion to the edge of the illuminated area of the screen. The spiral scan shall be such that the entire screen area is viewed by the 0.040 inch spot. Correction factors shall be generated for any non-uniformities introduced by either the input illumination system or the scanning device. The scanner shall travel from center to edge at a maximum rate of 1.0 mm per second. Spot brightness shall be measured with an eye-corrected, high sensitivity, fast response detector, and the detector output shall be displayed on an X-Y or strip chart recorder. The spot brightness reading at the center of the module shall be normalized to 2.0. Failure to meet the requirements of 3.15 shall constitute failure of this test.

4.6.13.2 Second and third stage module luminance uniformity. - The uniformity requirements for second and third stage modules are the same as for first stage modules except that the input light shall pass through green matching filters (Corning CS 3-71 and CS 4-67 or equal) and the illumination level shall be 0.1 to 0.3 footcandle. Failure to meet the requirements of 3.15.1 shall constitute failure of this test.

4.6.14 Breakdown. - With 16,000 volts applied to the module and with no radiation incident on the photocathode, observe the output screen for evidence of damage. Evidence of any damage shall constitute failure of this test.

4.6.15 Mean time between failure. - Module MTBF testing shall be performed each 30 days on sample modules selected at random from the previous 30 day production period. The sample size shall be a minimum quantity of 10. For preproduction testing no replacements are permitted; for production testing, replacement of failed modules is required. Sample modules selected for testing shall be selected from lots which have passed the inspection of 4.3.1 and 4.5.4.1. The operating potential shall be applied and the photocathode shall be illuminated with 5 X $10^{-2}$ to 5 X $10^{-3}$ footcandle. The modules shall be operated intermittently as follows:

a. On time 55 minutes

b. Off time 5 minutes

The total number of operating hours for all units, failed and unfailed, original and replacement, shall be monitored and recorded. Once each 96 hours the following inspections shall be performed. Time to failure for any module failing any test shall be computed to the beginning of the 96 hour period during which the failure occurred.

c. Luminance gain 4.6.7.

d. Cathode and screen quality (spots measurement deleted) 4.6.8.

e. Luminance uniformity (screen brightness scan deleted) 4.6.13, (1st stage modules), and 4.6.13.1, (2nd and 3rd stage modules).

f. Evidence of breakdown, flashing, intermittent operation or failure to operate.

g. First stage modules shall be tested as specified in 4.6.2.

Failure shall be recorded and acceptability of the lot computed. When the computation requires test continuation, any failed module shall be replaced before the test is continued. Failure to meet the requirements of d, e, f, and g above shall constitute module failure. Test shall be conducted in accordance with MIL-STD-781, Test Level A-1, test plan VI.

4.7 Inspection comparison. - When initial production inspection is specified, the Government may select modules at any time during the contract production period and subject these modules to the examination and tests specified in 4.4, to determine that the quality of the selected modules is equal to the quality standards established during initial production inspection. The inspection will be performed by the Government at a site selected by the Government. Modules

will be selected at random from those which have been accepted by the Government and will not include the previously inspected preproduction or initial production modules.

4.7.1 Inspection failure. - Failure of any module when inspected as specified in 4.7 may be considered cause for refusal by the Government to continue acceptance of modules until objective evidence furnished by the supplier reveals that corrective action has been taken to eliminate the condition that caused the rejection.

4.8 Inspection of preparation for delivery.

4.8.1 Quality conformance inspection of pack.

4.8.1.1 Unit of product. - For the purpose of inspection a completed pack prepared for shipment shall be considered a unit of product.

4.8.1.2 Sampling. - Sampling for examination shall be in accordance with MIL-STD-105.

4.8.1.3 Examination. - Samples selected in accordance with 4.8.1.2 shall be examined for the following defects. AQL shall be 2.5 percent defective, inspection level II.

105. Materials not as specified for level A.

106. Each module not preserved, cushioned and placed in a box as specified for level A.

107. Modules not intermediate packaged as specified in level A.

108. Each module not cushioned and placed in a container as specified for level A.

109. Marking illegible, incorrect or incomplete for levels A, B and C.

5. PREPARATION FOR DELIVERY.

5.1 Preservation and packaging. - Preservation and packaging shall be level A or C as specified (see 6.2).

5.1.1 Level A.

5.1.1.1 Cleaning. - Each module, image intensifier, 40 millimeter, type 8605, shall be cleaned in accordance with process C-1 of MIL-P-116.

5.1.1.2 Drying. - Each module, image intensifier, 40 millimeter, type 8605 shall be dried in accordance with the applicable procedures of MIL-P-116.

5.1.1.3 Preservation application. - None required.

5.1.1.4 Unit packaging. - Unit packaging shall be in accordance with the methods prescribed in MIL-P-116 as specified herein.

5.1.1.4.1 Module, image intensifier, 40 millimeter. - Each module, image intensifier, 40 millimeter shall be individually packaged method 1A8 as follows: A protective rubber or plastic cap shall be placed over the photocathode and screen end of each module. Place each item within a bag fabricated of material conforming to MIL-F-22191, Type 1, evacuate the air and heat seal. Cushion each bagged item between two inter-locking blocks of expandable polystyrene in accordance with PPP-C-850 (density 1.7 pounds per cubic foot) the blocks shall have cavities molded to fit the contour of the item. The blocks shall be taped around the seams with tape conforming to PPP-T-60. Place the cushioned item within a close-fitting paper board carton conforming to PPP-B-566, variety 2 or PPP-B-676. Each unit package shall be marked to indicate the photocathode to be in an upright position. Box closure shall be as specified in the appendix of the applicable box specification.

5.1.1.4.2 Intermediate container. - A quantity of 12 each items packaged as specified in 5.1.1.4.1 shall be placed within a close-fitting fiberboard box conforming to PPP-B-636 or MIL-B-43014, weather resistant, with the photocathode end up. The box shall be marked to indicate the upright position. Close the box as specified in the appendix of the box specification.

5.1.2 Level C. - Each module, image intensifier, 40 millimeter, shall be preserved and packaged in a manner that will afford adequate protection against physical and environmental damage during shipment, handling and limited intransit storage.

5.2 Packing. - Packing shall be level A, B or C as specified.

5.2.1 Level A.

5.2.1.1 Consolidation. - A quantity of modules, image intensifier, 40 millimeters packaged as specified in 5.1 shall be packaged within a close-fitting fiberboard box conforming to PPP-B-636, type CF, class weather-resistant. Box closure shall be as specified in the appendix of the box specification. To facilitate palletization, fiberboard boxes shall be uniform in size and contain equal quantities of the packaged items to the greatest extent practicable.

5.2.1.2 Palletized load. - A quantity of containers packed as specified in 5.2.1.1 shall be placed on a pallet, load type 1, conforming to MIL-STD-147. A fiberboard cap shall be employed over the load having two sides extending down the stacked load at least 12 inches to accommodate marking requirements. The cap shall be fabricated of fiberboard conforming to PPP-F-320, class weather-resistant, W5s or V3c. The load shall be "bonded" to the pallet by strapping.

5.2.1.3 Less than palletized load. - When quantities per destination are less than a pallet load, the containers packed as specified in 5.2.1.1 shall be waterproofed, with tape conforming to PPP-T-76, in accordance with the taping requirements of the appendix of the box specification. A quantity of the waterproofed containers shall be placed within a close-fitting box conforming to PPP-B-601, overseas type; PPP-B-621, Style 4, Class 2, or PPP-B-585, Style 2 or 3, Class 3. Closure and strapping shall be in accordance with the applicable container specification or appendix thereto except that metal strapping shall conform to QQ-S-781, Type 1, Class B.

5.2.2 Level B.

5.2.2.1 A quantity of modules, image intensifier, 40 millimeter packaged as specified in 5.1 shall be packed as specified in 5.2.1.1.

5.2.2.2 Palletized load. - A quantity of containers, packed as specified in 5.2.2.1 shall be palletized as specified in 5.2.1.2.

5.2.2.3 Less than palletized load. - When quantities per destination are less than a pallet load, the containers packed as specified in 5.2.2.1 shall be reinforced by pressure-sensitive filament tape conforming to PPP-T-97, type IV as specified in the appendix of the box specification. No further packing shall be required.

5.2.3 Level C.

5.2.3.1 A quantity of modules, image intensifier, 40 millimeter packaged as specified in 5.1, shall be packed as specified in 5.2.1.1, except that the fiberboard boxes shall be class domestic.

5.2.3.2 Palletized load. - A quantity of containers, packed as specified in 5.2.3.1, shall be palletized as specified in 5.2.1.2, except that the fiberboard caps shall be class domestic.

5.2.3.3 Less than palletized load. - When quantities per destination are less than a pallet load, the containers packed as specified in 5.2.3.1 shall be used as the shipping container. No further packing shall be required.

5.3 Marking. - In addition to any special marking required by the contract or order, interior packages and exterior shipping containers shall be marked in accordance with MIL-STD-129.

6. NOTES

6.1 Intended use. - The modules covered by this specification are intended for use as replacements for first, second and third stage modules of the 40 millimeter image intensifier assemblies.

6.2 Ordering data. - Procurement documents should specify the following:

a. Title, number and date of this specification.

b. Level of preservation and packaging and level of packing required (see 5.1 and 5.2).

6.3 Definition of terms.

6.3.1 Photocathode. - The input fiber optic faceplate of the type 8605 module.

6.3.2 Room temperature. - Room temperature is defined as 23° C ± 3° C.

6.3.3 Damage. - Damage is defined as:

a. Electrical failure or malfunctioning including arcing, corona, flashing, flickering or blanking.

b. Cracks, breakage, deformation, corrosion, or deterioration of any part or finish.

c. Mottled areas, blotches, dark spots or other visual indications of module defects.

6.3.4 Optical axis. - Optical axis is defined as the mean centerline of the two fiber optic faceplates of the module.

6.3.5 "g". - "g" is defined as the force which results in an acceleration or deceleration of 32.17 feet per second per second.

6.3.6 Ion spots. - An ion spot appears as a bright area in the center of the tube several magnitudes brighter than scintillations or field emission. Ion spots brightness remains steady or increases in brightness (does not flicker or appear randomly) and can be observed with or without radiation incident on the photocathode.

6.3.7 Field emission. - Field emission is an undesirable or extraneous emission (excluding thermionic emission) which appears as bright spots or patterns that flicker or appear intermittently on the image screen in one general position. Field emission is voltage dependent and is best observed with no radiation incident on the photocathode.

6.3.8 Cold emission, spots, streaks, or blemishes. - Bright spots, steaks, or other configuration of greater intensity than the background brightness of the module and visible on the image screen with no radiation incident on the photocathode.

6.3.9 Scintillations. - Scintillations are a form of noise which appear as faintly luminous spots which appear randomly or in small clusters over the screen. Scintillations are best observed with no radiation incident on the photocathode.

6.3.10 Limiting resolution. - Limiting resolution is defined as the smallest resolution pattern which the observer can see and distinguish between the black lines and the clear area between the black lines. The observer must be able to determine the number of line pairs in the test pattern and the direction of the line pairs in both the vertical and horizontal test patterns.

CUSTODIAN:
Army - EL
Navy -SH
Air Force - 84
REVIEW ACTIVITY:
Army - MU-ME
Navy - OS-AS
Air Force - 13
USER ACTIVITY:
Army - AT-AV-WC
Navy - EC-MC

PREPARING ACTIVITY:
Army - EL

PROJECT NUMBER: 5855-0003

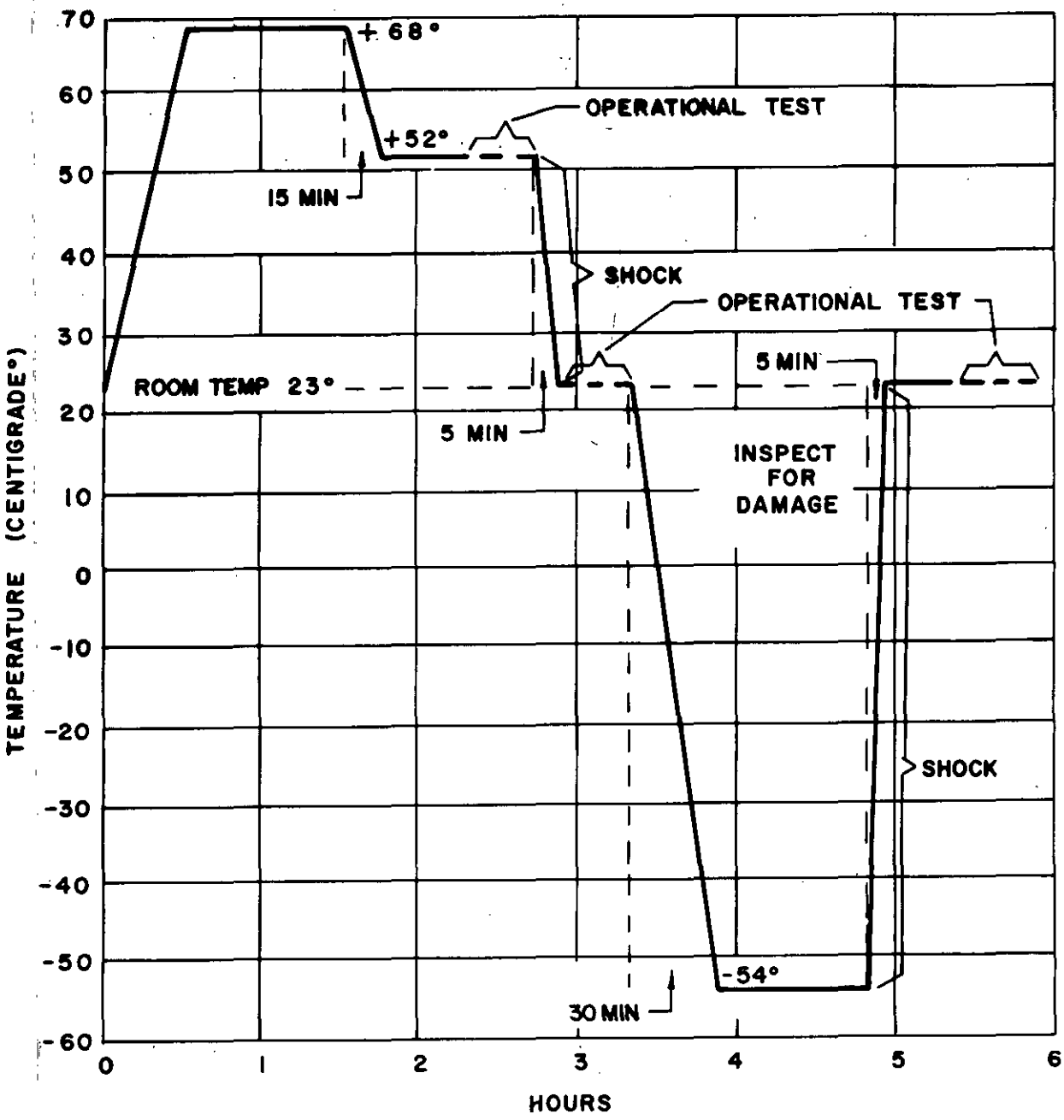
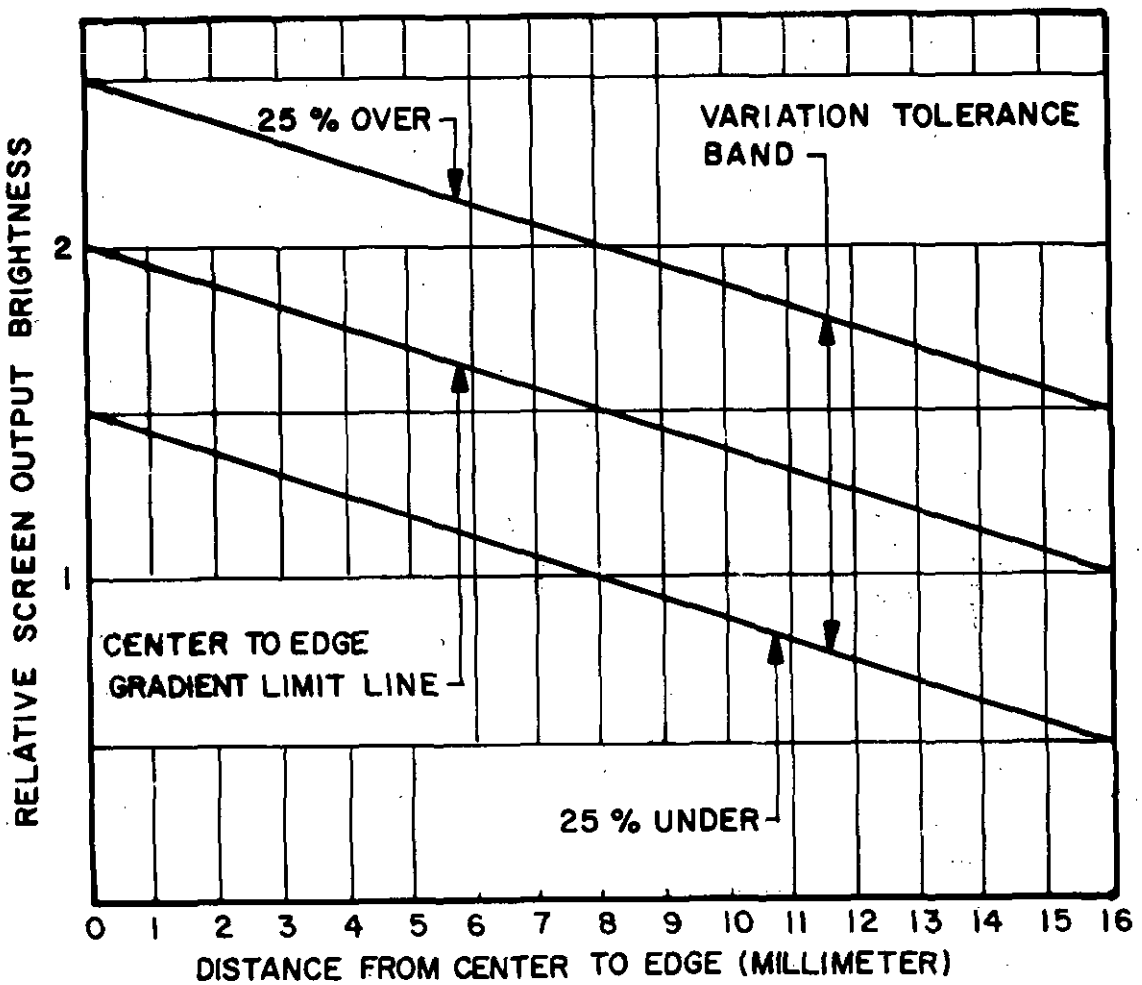



FIGURE 1

ENVIRONMENTAL CYCLE

40mm MODULE

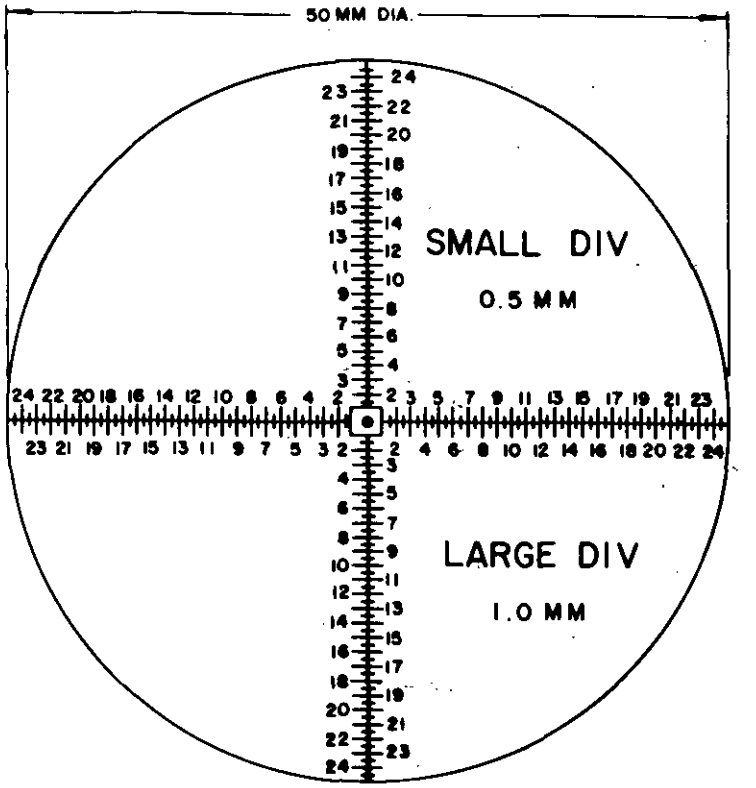



NOTE: THE VARIATION TOLERANCE BAND IS DETERMINED BY DRAWING TWO LINES PARALLEL TO A STRAIGHT LINE GRADIENT FROM 2.0 IN CENTER TO 1.0 AT 16mm FROM CENTER. ONE LINE IS 25% ABOVE (OR AT 2.5) AND THE OTHER 25 % UNDER (OR AT 1.5)

FIGURE 2 40mm MODULE

NOTES:

1. THE TEST RETICLE SHALL CONSIST OF EQUALLY SPACED LINES FROM THE CENTER OF THE 50 MM DIAMETER CIRCLE TO THE EDGE OF THE CIRCLE, IN 4 DIRECTIONS 90° APART. SPACING BETWEEN A LARGE GRADUATION AND A SMALL GRADUATION SHALL BE 0.5 MILLIMETER ± .03 MILLIMETER. SPACING BETWEEN TWO LARGE GRADUATIONS SHALL BE 1.0 MILLIMETER ± .03 MILLIMETER. THE CENTER OF THIS TEST RETICLE SHALL BE A SQUARE 2 MILLIMETER ON A SIDE WITH A 0.1270 MILLIMETER DIAMETER SPOT CONCENTRIC WITH THE CENTER OF THE TEST RETICLE. WIDTH OF ALL LINES TO BE 0.127 MILLIMETER ± .0254 MILLIMETER . ALL LINES, LETTERS AND NUMBERS SHALL BE HIGH CONTRAST, BLACK ON A CLEAR GLASS SUBSTRATE 2 INCHES WIDE X 2 INCHES LONG X .060 TO .10 INCHES THICK. THE LETTERING SHOWN IN THE FIRST AND FOURTH QUADRANTS SHALL BE AS LARGE AS POSSIBLE WITHOUT INTERFERING WITH THE GRADUATIONS AND NUMBERS AND SHALL FALL WITHIN A CIRCLE 10 MILLIMETER RADIUS, WHICH IS CONCENTRIC WITH THE 50MM DIA.

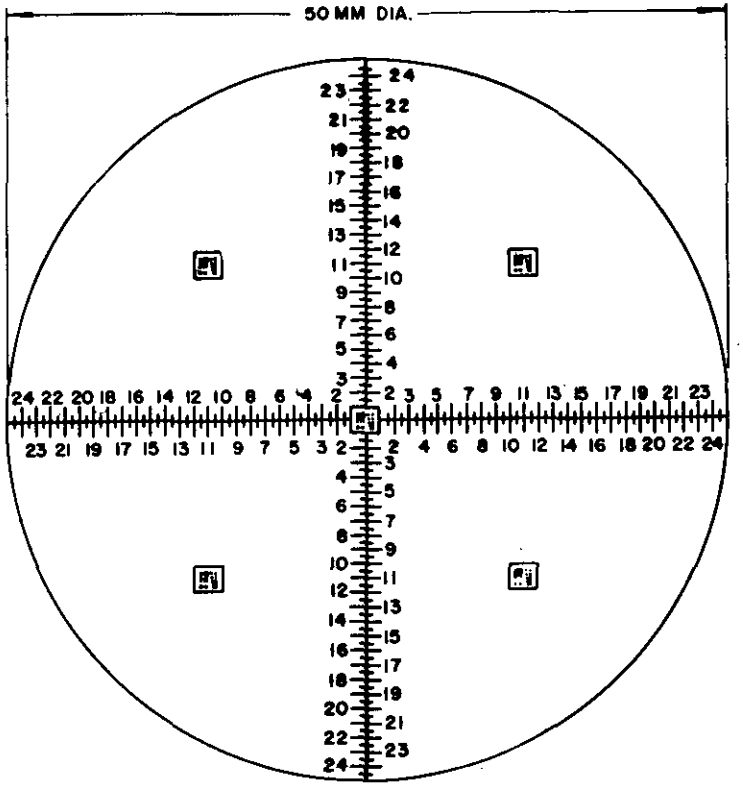



40mm MODULE

FIG. 3 MAGNIFICATION, IMAGE ALINEMENT AND USEFUL CATHODE DIAMETER TEST RETICLE

NOTES:

1. THE TEST RETICLE SHALL CONSIST OF EQUALLY SPACED LINES FROM THE CENTER OF THE 50 MM DIAMETER CIRCLE TO THE EDGE OF THE CIRCLE, IN 4 DIRECTIONS 90° APART. SPACING BETWEEN A LARGE GRADUATION AND A SMALL GRADUATION SHALL BE 0.5 MILLIMETER ±.03 MILLIMETER. SPACING BETWEEN TWO LARGE GRADUATIONS SHALL BE 1.0 MILLIMETER ±.03 MILLIMETER. THE CENTER OF THIS TEST RETICLE SHALL BE A SQUARE 2 MILLIMETER ON A SIDE WITH A 0.1270 MILLIMETER DIAMETER SPOT CONCENTRIC WITH THE CENTER OF THE TEST RETICLE. WIDTH OF ALL LINES TO BE 0.127 MILLIMETER ±.0254 MILLIMETER . ALL LINES, LETTERS AND NUMBERS SHALL BE HIGH CONTRAST, BLACK ON A CLEAR GLASS SUBSTRATE 2 INCHES WIDE X 2 INCHES LONG X .060 TO .10 INCHES THICK. THE LETTERING SHOWN IN THE FIRST AND FOURTH QUADRANTS SHALL BE AS LARGE AS POSSIBLE WITHOUT INTERFERING WITH THE GRADUATIONS AND NUMBERS AND SHALL FALL WITHIN A CIRCLE 10 MILLIMETER RADIUS, WHICH IS CONCENTRIC WITH THE 50MM DIA.
2. THE USAF 1951 RESOLVING POWER TEST TARGET IN THE CENTER SQUARE IS TO BE USED FOR MEASURING CENTER RESOLUTION.
3. THE FOUR EDGE USAF 1951 RESOLVING POWER TEST TARGETS ARE TO BE USED TO MEASURE PERIPHERAL RESOLUTION.




40mm MODULE

FIG. 4 RESOLVING POWER TEST TARGET, [illegible] ER, AND RESOLUTION TEST RETICLE

# SPECIFICATION ANALYSIS SHEET

Form Approved
Budget Bureau No. 22-R255

INSTRUCTIONS: This sheet is to be filled out by personnel, either Government or contractor, involved in the use of the specification in procurement of products for ultimate use by the Department of Defense. This sheet is provided for obtaining information on the use of this specification which will insure that suitable products can be procured with a minimum amount of delay and at the least cost. Comments and the return of this form will be appreciated. Fold on lines on reverse side, staple in corner, and send to preparing activity. Comments and suggestions submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or serve to amend contractual requirements.

SPECIFICATION

MIL-M-55555A, MODULE, IMAGE INTENSIFIER 40 MILLIMETER, TYPE 8605

ORGANIZATION

CITY AND STATE

CONTRACT NUMBER

MATERIAL PROCURED UNDER A

☐ DIRECT GOVERNMENT CONTRACT ☐ SUBCONTRACT

1. HAS ANY PART OF THE SPECIFICATION CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE?

A. GIVE PARAGRAPH NUMBER AND WORDING.

B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES

2. COMMENTS ON ANY SPECIFICATION REQUIREMENT CONSIDERED TOO RIGID

3. IS THE SPECIFICATION RESTRICTIVE?

☐ YES ☐ NO *(If "yes", in what way?)*

4. REMARKS *(Attach any pertinent data which may be of use in improving this specification. If there are additional papers, attach to form and place both in an envelope addressed to preparing activity)*

SUBMITTED BY *(Printed or typed name and activity - Optional)*

DATE

DD FORM 1 JAN 66 1426

REPLACES EDITION OF 1 OCT 64 WHICH MAY BE USED.

ESC-FM 1068-68