

W-M-1496A

November 8, 1972

SUPERSEDING

Int. Fed. Spec. W-M-001496 (GSA-FSS)

December 31, 1968

FEDERAL SPECIFICATION

MONITORS, TELEVISION, MONOCHROME
(DIRECT VIEW, VIDEO)

This specification was approved by the Commissioner, Federal Supply Service, General Services Administration, for the use of all Federal agencies.

1. SCOPE AND CLASSIFICATION

1.1 Scope. This specification covers direct view monochrome television monitors that are used where the picture image is reproduced from a video frequency signal.

1.2 Classification.

1.2.1 Type, class, and style. Monitors furnished under this specification shall be of the following type, class, and style, as specified (see 6.1):

Types:

- Type I - General purpose monitor.
- Type II - Special purpose monitor.
- Type III - High resolution monitor, selectable scan rates.

Classes:

- Class 1. Monitor supplied with 8 to 9 inch picture tube. (Type I and type II only)
- Class 2. Monitor supplied with 13 to 15 inch picture tube.
- Class 3. Monitor supplied with 17 to 19 inch picture tube.
- Class 4. Monitor supplied with 20 to 21 inch picture tube. (Type I and type III only)
- Class 5. Monitor supplied with 22 to 23 inch picture tube. (Type I and type III only)
- Class 6. Monitor supplied with 24 to 25 inch picture tube. (Type I only)
- Class 7. Monitor supplied with 26 to 27 inch picture tube. (Type I only)

Styles:

- Style a. Monitor supplied as single chassis and picture tube complete in metal cabinets.
- Style b. Monitor supplied complete as single chassis and picture tube only.
- Style c. Monitor supplied complete as single chassis and picture tube installed in 19-inch rack mount (class 1, class 2, and 17-inch of class 3 only) (see 6.1).

2. APPLICABLE DOCUMENTS

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

Federal Specifications:

J-C-175	Cable assembly, Power electrical
W-C-1422	Camera, Television, Monochrome, Closed Circuit (General Specification)
W-C-1422/1	Camera, Television, Type I. (Detail specification)

Federal Standards:

Fed. Std. No. 123 - Marking for Domestic Shipment (Civil agencies).

(Activities outside the Federal Government may obtain copies of Federal Specifications, Standards, and Handbooks as outlined under General Information in the Index of Federal Specifications and Standards and at the prices indicated in the Index. The Index, which includes cumulative monthly supplements as issued, is for sale on a subscription basis by the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402.)

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(Single copies of this specification and other Federal Specifications required by activities outside the Federal Government, for bidding purposes, are available without charge at the General Services Administration Regional Offices in Boston, New York, Washington, D.C., Atlanta, Chicago, Kansas City, Mo., Fort Worth, Denver, San Francisco, Los Angeles, and Seattle, Wash.)

(Federal Government activities may obtain copies of Federal Specifications, Standards, and Handbooks and the Index of Federal Specifications and Standards from established distribution points in their agencies.)

Military Standards:

MIL-STD-129 Marking for shipment & storage.
 MIL-STD-170 Moisture Resistance Test Cycle for Ground Signal Equipment.
 MIL-STD-252 Wired Equipment, Classification of Visual and Mechanical Defects for.

(Copies of Military Specifications and Standards required by contractors in connection with specified procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

Underwriters' Laboratories Inc. (UL) Standards:

UL 198 Fuses
 UL 512 Fuseholders
 UL 796 Printed Wiring Boards

(Copies may be obtained from the Underwriters' Laboratories, Inc., 207 East Ohio Street, Chicago, Illinois 60611; 1285 Walt Whitman Road, Melville, Long Island, New York 11746; 1655 Scott Boulevard, Santa Clara, California 95050.)

Electronic Industries Association (EIA) Standards:

EIA Industrial Electronics Bulletin No. 1 - Closed Circuit Television Definitions.
 EIA Resolution Chart - 1956, with Gray Scale overlay strips.
 RS-170 Monochrome Television Studio Facilities.
 RS-330 Electrical Performance Standards for Closed Circuit Television Camera 525-60 Interlaced 2:1.
 RS-343 Electrical Performance Standards for High Resolution Monochrome Closed Circuit Television Camera.

JEDEC Publications:

No. 52 - Electron Tube Registration List
 No. 53 - Semiconductor Device Registration List

(Copies may be obtained from the Electronic Industries Association, Engineering Department, 2001 Eye street, NW., Washington, D. C. 20006).

American National Standards Institute, Inc. (ANSI) Standards:

C99.1 - 1966 - Criteria for Inspection for Highly Reliable Soldered Connections in Electronic and Electrical Applications.

International Electrotechnical Commission Recommendations:

IEC 68-1 (1968) - Basic Environmental Testing Procedures for Electronic Components and Electronic Equipment Part 1: General
 IEC 68-2-1 (1966) - Part 2: Tests - Test A: Cold.
 IEC 68-2-2 (1966) - Part 2: Tests - Test B: Dry Heat.
 IEC 68-2-6 (1966) - Part 2: Tests - Test F: Vibration.
 IEC 68-2-13 (1966) - Part 2: Tests - Test M: Low Air Pressure.

(Copies may be obtained from the American National Standards Institute, Inc., 1430 Broadway, New York, New York 10018)

Institute of Electrical and Electronics Engineers (IEEE) Standards:

No. 202 Television: Aspect Ratio and Geometric Distortion, Methods of Measurement of.
 No. 205 Television: Luminance Signal Levels, Measurement of.
 No. 206 Television: Differential Gain and Differential Phase, Measurement of.

(Copies or reproductions may be obtained from the Institute of Electrical and Electronic Engineers, 345 East 47 Street, New York, N. Y. 10017.)

3. REQUIREMENTS

3.1 General. The monochrome monitors, when supplied with video and synchronizing signals that conform to the requirements as specified herein, shall provide a stable picture free of jitter, rolling, pulling, noise and any other noticeable impairments or picture deterioration that would detract from the picture presentation. The monitors shall be complete when delivered and shall have been inspected and tested for conformance to the requirements as specified herein. The monitors shall have all the devices and controls necessary for immediate operation, requiring only to be plugged into a local source of AC power to operate. The monitors shall be new and of the manufacturer's standard commercial design or model, current at the time of delivery except for such minor modifications from the manufacturer's standard commercial design or model as may be required to conform to the requirements as specified herein.

3.2 Fire, casualty and electrical hazards. Each contractor shall submit to the contracting agency proof that the fuses, fuseholders, and printed circuit boards (when used), of the television monitors he proposes to supply under this specification, conform to the requirements of the Underwriters' Laboratories, Inc., UL 198 Fuses; UL 512 Fuseholders; and UL 796 Printed Circuit Boards. The UL label, or listing mark, will be accepted as evidence that the fuses, fuseholders and printed circuit boards of the monitor conform to this requirement.

3.2.1 In lieu of the label, or listing mark, the contractor may submit independent proof, satisfactory to the contracting agency, that the fuses, fuseholders, and printed circuit boards conform to the applicable requirements of the published standards including methods of tests of the Underwriters' Laboratories, standards UL 198, UL 512, and UL 796.

3.2.2 Compliance with the above preliminary requirements in regard to fire, casualty and electrical hazard does not absolve the contractor from complete compliance with the other requirements of this specification in order to secure acceptance of his product.

3.3 Preproduction Model. Unless otherwise specified (see 6.1), a preproduction model, of each type and class offered, shall be submitted for examination, test, and inspection in accordance with section 4 (see 4.2), and such other tests as are necessary to determine compliance with the requirements as specified herein. In all respects not specifically covered in the specification the preproduction model shall represent the identical quality of materials, workmanship and design which will be used in the fabrication of the production units. The approved preproduction model shall be used as a guide to inspect production units and may be presented for acceptance as the last unit of the contract.

3.4 Design and construction. The monitors shall be designed for continuous unattended operation and for easy maintenance. Cabinets shall be constructed of steel or aluminum of not less than 18 gauge. Rack mounts and cabinets shall have a baked enamel or baked vinyl finish. Cabinets shall be complete with metal back. Front mounted controls shall be readily accessible on a recessed panel that has a hinged cover. Chassis shall be constructed of steel or aluminum of not less than 16 gauge. To maintain a standard of quality and reliability, all components shall be conservatively rated, circuit design shall incorporate safety margins of not less than 25 percent wherever possible with respect to dissipation ratings, voltage ratings, and current carrying capacity.

3.4.1 Maintainability. The monitor shall be capable of being maintained using commercially available standard tools and equipment.

3.5 Parts and material. The parts, material and processes used in the construction of the monitors, but not definitely specified, shall be equivalent to and interchangeable with the corresponding part, material, or process in the manufacturer's normal commercial product. "Normal commercial product" shall be interpreted to mean an end item(s) covered by this specification. The Government reserves the right to require any bidder to submit, for approval of the contracting officer, detailed engineering drawings of proposed end items or components differing from the "normal commercial products or standard component(s)" prior to and as a condition precedent to the award of the contract.

3.5.1 Nonselection of parts. Specified requirements of the monitor shall be met with standard available commercial electronic components, EIA registered tubes and transistors, and without selection of parts. Nonselection means that having determined that the parts meet their detailed specification or other detailed requirements to which they are manufactured no further consideration is given to their characteristics when they are assembled into the equipment. Nonselection precludes matching of parts or selective assemblies. Nonselection also precludes the necessity of interchange of parts during or after mounting in the equipment.

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3.6 Power supply. The monitors shall operate in accordance with the requirements specified herein from a normal source of 105 to 130 volts, 60 ± 1 Hz ac single phase. The internal dc power supply shall be isolated from the power source line by a power transformer. Where electron tubes are used, there shall be no series connected filaments.

3.6.1 Power cord. A six foot power cord utilizing three wires, with one of the wires a common ground, shall be supplied as part of each monitor. The cord shall be in accordance with Type I of J-C-175 except that the color of the cord may be black, brown, or gray.

3.6.2 Fuses, fuseholders. The monitors shall be protected from circuit overloads by a fuse or fuses in the power source line and the high voltage supply shall also be protected by adequate fusing. The power source line fuses shall be mounted in finger-operated extractor fuse posts. Fuseholders shall be located in a readily accessible position. The fuses and fuse holders shall meet the requirements of UL 198 and UL 512.

3.7 Safety and protective devices. Adequate safeguards shall be provided to protect personnel from exposure to high voltage during operation or adjustment. The monitor shall operate safely and in accordance with requirements herein with either side of the power source line grounded.

3.8 Aspect ratio. Unless otherwise specified (see 6.1), the width-to-height ratio of the normal picture shall be 4:3.

3.9 Geometric distortion and linearity. The geometric distortion shall not exceed 2 percent of picture height.

3.10 Video input. Unless otherwise specified (see 6.1), the monitor shall accept a composite or noncomposite video input signal.

3.10.1 Input impedance. Unless otherwise specified (see 6.1), the video input impedance shall be selectable, either 75 ohms terminated or high impedance bridging. Changing from one impedance to another shall be accomplished by a simple procedure, such as, a switch.

3.10.1.1 Terminated input. The terminated input shall be 75 ohms \pm 5 percent over the video frequency range of the monitor.

3.10.1.2 Bridging input. Bridging impedance shall be 15,000 ohms minimum shunt resistance and 20 pfd maximum shunt capacitance under operating and nonoperating conditions. Parallel connection shall be provided for loop through operation to allow multiple monitors to be operated from a single cable run.

3.10.2 Input signal levels.

3.10.2.1 Composite video input signal. The monitors shall operate in accordance with the appropriate requirements as specified herein from composite video signal levels ranging between 0.3 and 2.0 volts peak-to-peak, with the amplitude of the synchronizing pulses being 28.6 ± 5 percent of the total peak-to-peak signal level.

3.10.2.2 Noncomposite video input signal. The monitors shall operate in accordance with the appropriate requirements as specified herein from noncomposite video input signal levels ranging between 0.25 and 2.0 volts peak-to-peak.

3.10.3 Polarity. The polarity of the video input signals shall be black negative and the sync signals shall be negative.

3.11 Scanning.

3.11.1 Vertical scanning. The vertical scanning rate shall be 60 fields, 30 frames per second.

3.11.1.1 Retrace blanking. The monitor shall provide positive blanking of the vertical retrace scanning lines at all settings of the brightness and contrast control.

3.11.1.2 Interlace. The displacement of any scanning line from a center position between lines of the alternate field shall not exceed the percentage of the distance between the lines of the alternate field as specified in the following:

Type I	20 percent
Type II	10 percent
Type III	10 percent

3.11.2 Horizontal scanning. Type I and type II monitors shall have a horizontal scanning rate of 525 lines-per-frame. The horizontal scanning rate of the type III monitors shall be selectable between any two of the lines-per-frame rates specified herein. Changing from one lines-per-frame rate to another shall be accomplished by a simple procedure, such as, a switch or plug-in unit. It shall not be necessary to disassemble the monitor or to solder or unsolder any wires or connections to effect the change. When delivered, the monitor shall operate at the lines-per-frame rates specified in the contract or purchase order and shall be set to the lines-per-frame rate specified in the contract or purchase order (see 6.1).

3.11.2.1 When operating from sync signals that meet the requirements of 3.12 no bending or hooking of vertical lines at the top of the picture shall occur when the horizontal hold control is properly adjusted. Bending or hooking is permissible only at extreme settings of the horizontal hold control. The extreme setting is the last $1/8$ of a complete turn in either direction.

3.11.2.2 Picture stability. The monitor shall provide a stable synchronized picture at all usable settings of the contrast control.

3.12 Synchronizing inputs.

3.12.1 Internal synchronization (composite video). Each type monitor shall operate in accordance with the requirements as specified herein from a composite video signal having synchronizing signal dimensions and tolerances as specified in the following:

Type I. Type I monitors shall operate from composite video sync signals that comply with EIA RS-170, EIA RS-330, and random interlace sync signals that meet the requirements of W-C-1422/1 paragraph 3.9.3.

Type II. Type II monitors shall operate from composite video sync signals that comply with EIA RS-170 and EIA RS-330.

Type III. Type III monitors shall operate from composite video sync signals that comply with EIA RS-343 for lines-per-frame rates of 675, 729, 875, and 945.

3.12.2 External synchronization. Unless otherwise specified (see 6.1) each monitor shall have switch selectable provisions for external synchronization and shall operate in accordance with the requirements as specified herein from synchronizing signals that comply with the following requirements for each type monitor:

Type I. Type I monitors shall operate from external sync signals that comply with EIA RS-170 and EIA RS-330.

Type II. Type II monitors shall operate from external sync signals that comply with EIA RS-170 and EIA RS-330.

Type III. Type III monitors shall operate from external sync signals that comply with EIA RS-343 for lines-per-frame rates of 675, 729, 875, and 945.

3.12.2.1 External sync signal input level. The monitors shall meet the requirements as specified herein with sync signal input levels ranging from 1.0 volts to 4.5 volts, peak-to-peak.

3.12.2.2 The external sync circuit shall have parallel connectors wired for loop-through operation.

3.13 Resolution. With a composite video signal in accordance with 3.10.2.1 or a noncomposite video signal in accordance with 3.10.2.2 applied at the video input terminal, the resolution shall meet or exceed the following requirements for each type monitor.

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Type I. Type I monitors shall provide horizontal resolution of not less than 600 lines center and 500 lines each corner. The vertical resolution shall be not less than 300 lines at any point in the picture.

Type II. Type II monitors shall provide horizontal resolution of not less than 700 lines center and 600 lines each corner. The vertical resolution shall be not less than 325 lines at any point in the picture.

Type III. Type III monitors shall provide horizontal resolution that exceeds 800 lines center and 700 lines each corner for all lines-per-frame rates from 675 to 945. Vertical resolution for individual lines-per-frame rates shall be equal to or exceed that listed as follows:

<u>Lines-Per-Frame Rate</u>	<u>Vertical Resolution</u>
675	425
729	475
875	575
945	600

3.14 Video amplifier.

3.14.1 Amplitude frequency response. The amplitude frequency response of the video amplifier (measured between the video input terminal(s) and the driven element of the picture tube) relative to the amplitude of the response at 100 KHz, shall meet or exceed the following requirements for the individual type monitor.

Type I. The video frequency response of the type I monitors shall measure \pm 2db from 60 Hz to 8 MHz.

Type II. The video frequency response of the type II monitors shall measure \pm 2db from 60 Hz to 10 MHz.

Type III. The video frequency response of the type III monitors shall measure \pm 2db from 60 Hz to 25 MHz.

3.14.2 Differential gain or amplitude linearity. When measured in accordance with 4.7.13 the differential gain shall meet or exceed the following requirements for each type monitor.

Type I. The differential gain, as measured between the largest and smallest step gain, shall not exceed 10 percent of the amplitude of the larger gain. The differential gain as measured between any two adjacent steps shall be less than 2 percent of the maximum gain.

Type II. The differential gain, as measured between the largest and smallest step gain, shall not exceed 5 percent of the amplitude of the larger gain. The differential gain as measured between any two adjacent steps shall be less than 2 percent of the maximum gain.

Type III. The differential gain, as measured between the largest and smallest step gain, shall not exceed 10 percent of the amplitude of the larger gain. The differential gain as measured between any two adjacent steps shall be less than 2 percent of the maximum gain.

3.14.3 Low-frequency square-wave response. The tilt to a low-frequency square-wave test signal, whose width measures between 40 to 50 percent of one field time, shall not exceed 5 percent of the peak-to-peak square-wave amplitude for any usable setting of the contrast control.

3.14.4 High frequency transient response. The amount of overshoot or ringing, caused by a step function signal, having a rise time that measures less than 50 nanoseconds for type I and type II monitors, and 30 nanoseconds for type III monitors, shall not exceed 5 percent of the peak amplitude of the transition for type I and type II monitors, and shall not exceed 10 percent of the peak amplitude of the transition for type III monitors, at any usable setting of the contrast control.

3.15 Gray scale and contrast ratio. The monitor shall provide a minimum visual definition of 10 levels of gray (including black and white) from a video signal that conforms to the range of input signal levels of 3.10.2. When tested in accordance with 4.7.5 the monitors shall provide a contrast ratio between white and black of not less than 25:1.

3.16 Picture tube. The picture tube supplied with each monitor shall be EIA registered. The picture tube shall conform to the EIA registration ratings and to the manufacturers' published characteristics. The picture tube shall be a high efficiency aluminized type that has a safety shield bonded to the face plate. Size of the picture tube shall be determined by diagonal measurement of the picture area from corner to corner. Should the diagonal measurement be less than a whole number, the size rating, for purposes of this specification, shall be the next smallest whole number. This means, for instance, that a 9SP4, which has only an 8.3 inch viewable diagonal, shall be rated as an 8-inch picture tube.

3.17 Brightness. The peak brightness, corresponding to reference white, where other dependent parameters, such as, raster size, aspect ratio, contrast ratio, geometry, and resolution, are adjusted for specified and optimum performance, shall meet or exceed the following requirements for each class of monitor.

Class 1 - 50 foot-lamberts
 Class 2 - 100 foot-lamberts
 Class 3 - 100 foot-lamberts
 Class 4 - 35 foot-lamberts
 Class 5 - 35 foot-lamberts
 Class 6 - 30 foot-lamberts
 Class 7 - 30 foot-lamberts

3.17.1 Brightness Stability. When a monitor supplied under this specification is adjusted to produce 50 percent of the specified peak brightness and with a white window signal covering 20 percent of the total raster area, the monitor shall be capable of maintaining brightness level within 20 percent of the reference value as the brightness signal duty cycle is varied from 20 percent to 100 percent.

3.18 Raster modulation. There shall be no noticeable impairments or raster modulation on the synchronized monitor raster in the absence of a picture signal.

3.19 DC restoration. Unless otherwise specified (see 6.1), a method of DC insertion shall be provided to maintain the reference black level at a substantially constant brightness of the picture tube. The monitors shall have a switch to allow in-out switching of the DC restorer.

3.20 Controls. Controls shall be provided to assure ease of operation and regulation of all specified characteristics, and shall include controls for regulating focus, width, horizontal linearity, vertical linearity, and vertical size; with front mounted operational controls consisting of not less than a brightness, contrast, horizontal hold, vertical hold, and on/off switch. All controls shall be clearly labeled, conveniently located, and grouped together according to function. Operating controls shall be equipped with suitable knobs for ease of operation. Where applicable, clockwise rotation of all controls shall result in an increasing function. Type II monitors shall have provisions for adjustment of the raster size to simultaneously show all four corners and sides while geometric distortion is maintained within 2 percent. All functional markings shall be of a permanent and legible type.

3.20.1 Noninteraction of controls. The adjustment of the brightness shall not effect the focus; the picture shall not bloom or change size when the brightness or contrast is adjusted; the vertical hold control shall not effect vertical size and linearity within the hold-in range; and adjustment of horizontal synchronization shall not effect width and sweep linearity.

3.21 Connectors. The monitor shall accept male 75 ohm BNC or UHF type signal connectors. If a monitor as manufactured is equipped to accept other type connectors and is provided with "between series" adapters to accommodate male 75 ohm BNC or UHF type connectors, it shall be acceptable.

3.22 Interference suppression. Sufficient shielding shall be provided to the horizontal oscillator, high voltage circuitry, and any other circuitry that may require it, to prevent their radiating interference into adjacent monitors and other electronic equipment (see 4.7.17).

3.23 X-Ray radiation. The maximum X-ray radiation shall not exceed 0.5 milliroentgen/hour averaged over an area of 10 cm² at any point located 5 centimeters from the monitors outer surface.

3.24 Environment. When specified (see 6.1), the monitors shall show no evidence of mechanical defects, corrosion, or degradation in performance, below that specified herein, when subjected to any of the following conditions.

3.24.1 Humidity. 85 percent relative humidity.

3.24.2 Altitude. Up to 10,000 feet.

3.24.3 Temperature. 5°C to 55°C.

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3.24.4 Vibration. Vibration (without vibration isolators) varying uniformly over a 5 to 35 Hz frequency range, with a total excersion of .014 inches for a total period of 30 minutes (10 minutes each plane).

3.25 Instruction Manual. The contractor shall supply with each monitor an instruction manual containing all pertinent electrical and mechanical specifications. The instruction manual shall contain comprehensive operation, installation and maintenance instructions and shall provide supplemental information such as, schematics, wiring diagrams and component location diagrams. Maintenance data shall show circuit waveforms at specific test points throughout the circuit. A complete electrical and mechanical parts list shall be contained in the manual. The electrical parts lists shall contain the components commercial designation as well as the circuit symbol and electrical ratings. Manufacturer's identification drawing numbers alone will not suffice.

3.26 Workmanship. Each monitor shall be manufactured and finished in such a manner as to meet all the requirements specified herein and shall be free from characteristics or defects which affect the appearance, or which might affect the serviceability or render the monitor unsuitable for the intended purpose.

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, the supplier may utilize his own facilities or any commercial laboratory acceptable to 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 that supplies and services conform to the prescribed requirements. (see 6.1).

4.1.1 Classification of inspections. The inspections specified herein are classified as follows:

- (a) Preproduction inspection (see 3.3 and 4.2).
- (b) Quality conformance inspection (see 4.3).
- (c) Examination of preparation for delivery (see 4.8).

4.2 Preproduction inspection. The preproduction inspection shall consist of the group A and group B examinations and tests of table I (except for the environmental tests, which will be required only when specified, see 6.1).

4.2.1 Sample size for preproduction inspection. Sample size for preproduction inspection shall consist of one complete unit of the type and class the contractor proposes to supply.

4.3 Quality conformance inspection. In accordance with 4.1, the contractor shall be responsible for the performance of the quality conformance inspections. Sample units, selected in accordance with 4.4, shall be subjected to the appropriate examinations and tests of table I. Alternate tests may be used provided it can be shown that such tests are in fact adequate to insure compliance with specification requirements.

4.4 Sampling for quality conformance inspection.

4.4.1 Sampling for group A examinations and tests. Each unit offered for acceptance shall be subjected to the group A examinations and tests of table I with acceptance based on 4.5.1.

4.4.2 Sampling for group B examinations and tests. Group B examinations and tests shall be required initially (except for environmental tests, which will be required only when specified, see 6.1) and thereafter only when the basic design of the monitor or the material of a vital part has been changed. One complete unit, of the type and class the contractor proposes to supply, shall be selected and subjected to the group B tests specified in table I, with acceptance based on 4.5.2.

4.5 Acceptance.

4.5.1 Acceptance group A examinations and tests. The results of each examination and test shall be compared with the applicable requirements of this specification. Failure to conform to the requirements of this specification for any group A examination or test shall be counted as a defect and the unit shall be rejected. Rejected units may be offered again, for inspection, provided the defect(s) causing rejection have been corrected.

4.5.2 Acceptance group B examinations and tests. In the event of failure to conform to the requirements of any group B examination and test, the contractor shall correct the cause of failure in both the test sample and all future production units.

TABLE I. Examinations and tests

Examinations and tests	Requirement Paragraph	Test Paragraph
<u>Group A</u>		
Visual inspection	All	4.6
Operation test	All	4.7.2
Resolution test	3.13	4.7.4
Brightness test	3.17	4.7.6
Raster modulation test	3.18	4.7.7
<u>Group B</u>		
Aspect ratio test	3.8	4.7.3
Geometric distortion test	3.9	4.7.3
Gray scale test	3.15	4.7.5
Voltage test	3.6	4.7.8
Composite input signal level test	3.10.2.1	4.7.9
Non-composite input signal level test	3.10.2.2	4.7.10
External sync input level test	3.12.2.1	4.7.11
Amplitude frequency response test	3.14.1	4.7.12
Differential gain test	3.14.2	4.7.13
Low-frequency square-wave response test	3.14.3	4.7.14
High frequency transient response test	3.14.4	4.7.15
Brightness stability test	3.17.1	4.7.16
Interference test	3.22	4.7.17
X-ray radiation test	3.23	4.7.18
Polarity test	3.10.3	4.7.19
Impedance test	3.10.1	4.7.20
(The following tests are to be performed only when specified, see 6.1)		
Humidity test	3.24.1	4.7.21.1
Altitude test	3.24.2	4.7.21.2
Temperature test	3.24.3	4.7.21.3
Vibration test	3.24.4	4.7.21.4

4.6 Visual and mechanical inspection. Each unit shall be subjected to a thorough visual inspection for the Major defects listed in MIL-STD-252A and the mechanical requirements as specified herein. Use ANSI C99.1 - 1966 for inspection criteria when inspecting soldered connections.

4.7 Test methods.

4.7.1 Standard test conditions.

4.7.1.1 Standard test signal synchronization and input levels. Except as otherwise specified herein, monitor measurements shall be made with a composite video signal input having sync, and signal levels, that conform to either EIA RS-170 or EIA RS-330 for type I and type II monitors, and EIA RS-343, at the 675 lines-per-frame rate, for type III monitors.

4.7.1.2 Signal level, method of measurement. Measure signal levels in accordance with IEEE No. 205, except that the frequency response filters shall not be used.

4.7.1.3 Standard test signal source impedance. The input signal shall be fed to the 75 ohm video input of the monitor by means of 75 ohm coaxial cable. The source impedance of the equipment feeding the monitor shall be 75 ohms.

4.7.1.4 Initial test signals. The monitor shall be initially set-up using electronically generated composite test signals, such as, a white window, multiburst with white reference, or a staircase signal providing not less than 10 steps in equal amplitude increments from reference white to reference black. The APL (average picture level) should be 60 percent or less.

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4.7.1.5 Initial adjustment. If provisions are included for normal-scan/under-scan operation the monitor shall be operated in normal-scan mode. If the monitor includes a switch for DC Restoration "on-off" it shall be operated in the "on" mode. Adjust all controls not otherwise specified for normal operation. Using appropriate test signals adjust the setup controls, such as, focus, centering, scan size, and scan linearity, to their optimum operating position. The aspect ratio, relating width to height, of the active scanned area should be 4:3. Apply a staircase signal to the monitor. By means of the brightness and contrast controls adjust the black reference to where the scanning lines just disappear and adjust the white reference for maximum focused brightness. Observe the picture on the monitor, all ten (10) levels of gray (which include black and white) should be visible and clearly discernible. Observe the highlight areas on the picture tube to determine that the scan lines are clearly visible, well focused, stable and separated from each other by approximately equal spaces. Over scan shall not exceed 8 percent of active raster height along the horizontal or vertical axis.

4.7.1.6 Ambient light levels on picture tube. For tests requiring the use of a brightness meter the ambient light falling on the picture tube faceplate shall not exceed 0.1 foot-candles.

4.7.1.7 Foot-lambert meter. The foot-lambert meter required for certain tests shall have an acceptance angle such that it measures only the specified area without spill over into the surrounding area.

4.7.2 Operating test. Each monitor shall be subjected to an operating test of not less than 24 hours continuous operation. Adjust controls in accordance with 4.7.1.5. Apply a composite video test signal that conforms to standard input levels of 4.7.1.1. The composite video test signal shall be derived from the EIA Resolution Chart with Gray Scale overlay strips or equivalent electronically generated test signal. Make final adjustments and determine functional conformance of controls to the requirements specified herein (see 3.20 and 3.20.1). At the end of the 24 hour period subjectively examine the picture over the normal range of operating conditions for any degradation of picture quality. Particular emphasis should be given to the effect of variation in the setting of the operating controls. The following are some types of degradation that should be looked for.

- (a) Improper size and aspect ratio.
- (b) Horizontal and vertical nonlinearity.
- (c) Raster distortion, in the form of deviation from a true rectangle.
- (d) Poor interlace.
- (e) Fold-over.
- (f) Luminance irregularities and poor focus.
- (g) Interference generated internally, such as, extraneous oscillations in the deflection system (Barkhausen or other retarding field oscillation.)
- (h) Unstable synchronization, characterized as, jumping, jittering, pulling, rolling, flaging, and etc.
- (i) Hum and noise in picture.
- (j) Poor resolution.
- (k) Insufficient gray scale and contrast range.

4.7.3 Aspect ratio and geometric distortion test. Aspect ratio and geometric distortion shall be measured, in accordance with IEEE No. 202, to determine conformance to the requirements of 3.8 and 3.9.

4.7.4 Horizontal resolution test. Horizontal resolution shall be measured using an electronically generated composite video test signal which, develops an alternate black-and-white vertical bar pattern display and is variable over a range of repetition rates above and below the rate necessary to develop the desired number of resolution lines. Refer to 4.7.1 for test conditions, setup procedures, signal levels, etc., except that the picture signal amplitude shall not exceed 0.6 volts. While maintaining the test signal amplitude constant, apply the test signal at different repetition rates starting at a rate below that necessary to develop the desired number of resolution lines and progressing toward a repetition rate higher than that necessary to develop the desired number of resolution lines. As the repetition rate is increased the horizontal resolution is read at the point at which each individual line cannot be recognized with certainty. The horizontal resolution is measured in the center and in the four corners of the picture, to determine conformance to the requirements of 3.13. The horizontal resolution shall be measured in each corner at a point approximately 35 percent of the raster height from the horizontal axis and approximately 45 percent of the raster height from the vertical axis.

4.7.5 Gray scale and contrast ratio test. The gray scale and contrast ratio shall be measured using an electronically generated composite video staircase signal providing not less than 10 steps in equal amplitude increments including reference black and reference white. Refer to 4.7.1 for test conditions, set up procedures, signal levels, etc. With the staircase signal applied to the monitor, observe the picture on the monitor. All ten levels of gray (which includes black and white) shall be visible and clearly discernible. Connect a wide-band oscilloscope to the driven element of the picture tube to monitor the out put of the video amplifier. Synchronize the oscilloscope to the line scanning frequency. Observe the video wave form, it should consist of ten steps in equal amplitude increments. Adjust the contrast control over its usable range, each individual step should maintain its relative amplitude to the peak-to-peak amplitude of the total signal as observed on the oscilloscope. Use a foot-lambert meter and measure the brightness level at both extremes of the gray scale. Use caution, do not include portions of other steps in the meter viewing angle. Tabulate the contrast ratio to determine conformance to the requirement of 3.15.

4.7.6 Brightness test. Brightness shall be measured using an electronically generated composite video white window signal with an APL (average picture level) of less than 60 percent. Refer to 4.7.1 for test conditions, setup procedures, signal levels, etc. The brightness shall be measured in the center of the white window display, using a calibrated foot-lambert meter, to determine conformance to the requirement of 3.17.

4.7.7 Raster modulation test. Raster modulation shall be measured using a composite video test signal which produces an all white picture, and with the monitor brightness control set to provide 50 percent of rated maximum brightness level. Refer to 4.7.1 for standard test conditions, setup procedures, signal levels, etc. The raster shall then be inspected for noticeable impairments and raster modulation to determine conformance to the requirements of 3.18.

4.7.8 Voltage test. Refer to 4.7.1 for test conditions, setup procedures, signal levels, etc. Connect the monitor to a variable source of ac that has a range of not less than 105 to 130 volts, 60 Hz. Operate the monitor at 105 volts for one hour and at 130 volts for one hour. At the end of each test period, with the voltage remaining at the test value, check the monitor performance for conformance to the requirements of 3.8, 3.9, 3.13, and 3.15.

4.7.9 Composite input signal level test. The composite input signal level requirements shall be measured using a composite video test signal derived from the EIA Resolution Chart 1956, with gray scale overlay strips, or an equivalent electronically generated test signal. The test signal shall be variable in amplitude between 0.3 and 2.0 volts peak-to-peak with the amplitude of the synchronizing pulses being 28.6 ± 5 percent of the total peak-to-peak signal. Refer to 4.7.1 for test conditions, setup procedures, etc. With the test signal applied to the monitor, adjust the input level of the test signal to not less than five representative settings from 0.3 to 2.0 volts peak-to-peak. Adjustment to the settings of the brightness and contrast controls may be made at each setting of the input signal level to meet specified requirements. Examine the picture at each setting of the input signal level to determine conformance to the requirements of 3.10.2.1.

4.7.10 Non-composite input signal level test. The non-composite input signal level requirement shall be measured using a non-composite video test signal derived from the EIA Resolution Chart 1956, with gray scale overlay strips, or an equivalent electronically generated test signal, and external sync signals that conform to 3.12.2 and 3.12.2.1. The test signal shall be variable in amplitude between 0.25 and 2.0 volts peak-to-peak. Refer to 4.7.1 for test conditions, setup procedures, etc. With the test signal and sync signals applied to the monitor, adjust the input level of the test signal to not less than five representative settings from 0.25 to 2.0 volts peak-to-peak. Adjustment to the settings of the brightness and contrast controls may be made at each setting of the input signal level to meet specified requirements. Examine the picture at each setting of the input signal level to determine conformance to the requirement of 3.10.2.2.

4.7.11 External sync input level test. The external sync input level requirement shall be measured using a synchronizing signal that conforms to the applicable requirements of 3.12.2 and is variable in amplitude between 1 volt and 4.5 volts peak-to-peak. With the monitor setup for the non-composite input signal level test of 4.7.10, adjust the video input signal level to 0.714 ± 0.1 volts peak to peak. Apply the sync signal to the monitor and adjust the input level to not less than five representative settings from 1 volt to 4.5 volts peak-to-peak. Adjustment to the settings of operating controls may be made at each setting of the input sync signal level to meet specified requirements. Examine the picture at each setting of the input sync signal level to determine conformance to the requirements of 3.12.2.1.

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4.7.12 Amplitude frequency response test. The amplitude frequency response shall be measured using a composite video signal having a constant level variable frequency sine-wave picture signal. A video sweep generator may be used for this measurement. Refer to 4.7.1 for test conditions, setup procedures, signal levels, etc. Connect a wide-band oscilloscope to the driven element of the picture tube to monitor the output of the video amplifier. With a 100 KHz test signal applied to the monitor, adjust the contrast control for standard video amplifier picture output at the input of the picture tube. Convert voltage readings to db and record. While maintaining the input test signal amplitude constant at the levels specified in 4.7.1.1, the test signal frequency shall be varied over the range of frequencies specified herein for the particular type monitor being tested. Measure the response at not less than 10 representative frequency settings. Convert voltage readings to db. Compare the representative frequency readings with the readings with the reading at 100 KHz to determine conformance to the requirements of 3.14.1.

4.7.13 Differential gain test. Differential gain shall be measured, in accordance IEEE No. 206, to determine conformance to the applicable requirements of 3.14.2.

4.7.14 Low-frequency square-wave response test. Low-frequency square-wave response shall be measured using a composite video test signal that consists of a low-frequency square-wave (such as a window signal) synchronized to the field frequency and having a pulse width that measures between 40 and 50 percent of one field time. The test signal shall be uniform with no tilt, shading, or transient disturbance. Refer to 4.7.1 for test conditions, setup procedures, signal levels, etc. Apply the test signal to the video input of the monitor. Connect a wide-band oscilloscope to the driven element of the picture tube to monitor the output of the video amplifier. Synchronize the oscilloscope to the field frequency. Measure both the peak-to-peak amplitude of the signal and any tilt or level shift that may be present, at not less than three representative settings of the contrast control over its usable range. Compare the amplitude of the signal with amplitude of any tilt or level shift, at each setting of the contrast control, to determine conformance to the requirements of 3.14.3.

4.7.15 High-frequency transient response test. High-frequency transient response shall be measured using a composite video test signal that consists of a step function transition (such as, a rectangular pulse) synchronized to the line scanning frequency and having sufficient duration for steady state to be reached. The rise and fall time of the transition shall measure less than 50 nanoseconds when measuring type I and type II monitors, and less than 30 nanoseconds when measuring type III monitors. The test signal shall be uniform with no tilt, overshoot, ringing or transient disturbance. Refer to 4.7.1 for test conditions, setup procedures, signal levels, etc. Apply the test signal to the video input of the monitor. Connect a wide-band oscilloscope to the driven element of the picture tube to monitor the output of the video amplifier. Synchronize the oscilloscope to the line scanning frequency. Measure both the peak-to-peak amplitude of the step function transition and any ringing or overshoot that occurs just after the transition, at not less than three representative settings of the contrast control over its usable range. Compare the amplitude of the transition with the amplitude of any ringing or overshoot, at each setting of the contrast control, to determine conformance to the requirements of 3.14.4.

4.7.16 Brightness stability test. The brightness stability shall be measured using two electronically generated test signals. The first test signal shall be a composite white window signal which produces a centrally positioned white window display having a 4:3 aspect ratio and an area equal to 20 percent of the normal active raster area. The second test signal shall be a composite white field signal (having the same levels as the first test signal) which produces an all white display covering 100 percent of the active raster. Refer to 4.7.1 for test conditions, setup procedures, signal levels, etc. Apply the first test signal to the video input of the monitor; adjust the brightness and contrast controls so that the area surrounding the white window is set at black or slightly above and the window brightness (as measured with a calibrated foot-lambert meter) is equal to 50 percent of the rated maximum brightness of the monitor. The brightness shall be measured in the center of the picture tube using a calibrated foot-lambert meter. Record this reading as the reference value. Apply the second test signal to the video input of the monitor. Without readjusting the brightness and contrast control, measure and record the brightness in the center of the picture tube. Calculate the percentage difference between the two readings obtained to determine conformance to the requirements of 3.17.1.

4.7.17 Interference test. Connect two or more like monitors to a common power line. Set the monitors side by side, drive the monitors from video sources operated from nonsynchronous sync generators. Visually look for interference. The power shall be individually interrupted during this test. (see 3.22).

4.7.18 X-Ray radiation test. X-Ray radiation shall be measured by thoroughly exploring the area immediately adjacent to all exterior surfaces of the monitor with a suitable X-Ray radiation measuring instrument (see 3.23).

4.7.19 Polarity test. The polarity shall be measured using an oscilloscope of known deflection to determine conformance to the requirement of 3.10.3.

4.7.20 Impedance test. The terminated 75 Ohm input impedance shall be measured by means of an impedance bridge capable of an accuracy of ± 1 percent in the vicinity of 75 ohms. The bridging impedance shall be measured with any suitable impedance measuring instrument to determine conformance to the requirement of 3.10.1.3.

4.7.21 Environmental tests. When environmental tests are specified (see 6.1), the following tests shall be a part of this specification. The performance measurements referred to in the following tests shall be as specified in 4.7.2, 4.7.4, and 4.7.5 to determine conformance to the requirements for operation, resolution, and gray scale specified herein (see 3.24).

4.7.21.1 Humidity test. The monitor to be tested shall be subjected to the following:

- (a) Dry the monitor for 24 hours at $130^{\circ}\text{F.} \pm 5^{\circ}\text{F.}$ and not more than 5 percent relative humidity.
- (b) Set up the monitor in accordance with the requirements of 4.7.2 for operation.
- (c) Subject the monitor to two 48-hour test cycles as indicated in MIL-STD-170, except that the maximum temperature shall be 130°F.
- (d) Make performance measurements to determine conformance to the requirements listed in 4.7.21. The measurements are to be made during the period specified in MIL-STD-170, while the monitor is exposed to the humidity conditions shown therein.

4.7.21.2 Altitude test. Test in accordance with the recommended testing procedures for low air pressure test of IEC 68-2-13 (1966). Test at a pressure equivalent to the altitude in feet as specified herein and at the low temperatures specified in 4.7.21.3, for a period of not less than 2 hours. During the conditioning and the recovery period the unit shall remain on and shall be checked for any degradation in performance of the requirements listed in 4.7.21.

4.7.21.3 Temperature test. Test in accordance with the recommended testing procedures for low temperature and high temperature of IEC 68-2-1 (1966) and IEC 68-2-2 (1966) Section Two - Test Ab: using the operational test procedure, at temperatures of $5^{\circ} \pm 3^{\circ}\text{C.}$ and $55^{\circ} \pm 3^{\circ}\text{C.}$ Check for any degradation in performance of the requirements listed in 4.7.21. During the recovery period the unit shall remain on and shall be checked for normal operation during the recovery period.

4.7.21.4 Vibration test. Test in accordance with the recommended testing procedures of IEC 68-2-6 (1966). Use test procedure A without the final resonance search. Vibrate the unit over the frequency range, at the vibration amplitude, and for the period specified in 3.24.4. The unit shall then be inspected to ascertain that no fixed parts have become loose or damaged and that the performance requirements listed in 4.7.21 are maintained.

4.8 Inspection of preparation for delivery requirements. Packaging, packing, and marking of exterior containers shall be visually inspected for the defects listed in table II to determine conformance to the requirements in Section 5. One defect shall cause rejection of a unit. Rejected units may be offered again for inspection provided defects causing rejection have been corrected.

TABLE II. Classification of preparation for delivery defects

Examine	Defects
Markings (exterior)	Omitted; incorrect; illegible; improper size, location, sequence, or method of application.
Materials	Any component missing or damaged.
Workmanship	Inadequate application of components, such as, incomplete closure of container flaps, loose strapping, inadequate stapling. Distortion of container.

5. PREPARATION FOR DELIVERY.

5.1 Packaging. Unless otherwise specified (see 6.1), commercial packaging is acceptable under this specification.

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5.2 Packing. Unless otherwise specified (see 6.1), the subject commodity shall be packed in substantial commercial containers of the type, size and kind commonly used for the purpose, so constructed as to insure acceptance and safe delivery by common or other carriers, at the lowest rate at the point of delivery.

5.3 Marking. In addition to marking required by the procurement documents, the shipping container shall be marked in accordance with Fed. Std. No. 123 for civil agencies and MIL-STD-129 for military agencies, as applicable.

6. NOTES

6.1 Ordering data. Purchasers should select the preferred options permitted herein and include the following information in procurement documents:

- (a) Title, number, and date of this specification.
- (b) Quantity of items required.
- (c) Specify the type, class, and style required (see 1.2.1).
- (d) When ordering style c monitors specify either left side mounting; right side mounting; or center mounting; also class 1 monitors may be ordered twin mounted (see 1.2.1 style c).
- (e) Preproduction model, delete requirements for preproduction model when not required (see 3.3).
- (f) Preproduction model, specify place of inspection when required (see 3.3 and 4.2).
- (g) Specify 1:1 aspect ratio when required (see 3.8).
- (h) Delete non-composite video input requirements when not required (see 3.10 and 3.10.2.2).
- (i) Delete high impedance bridging video input impedance when not required (see 3.10.1).
- (j) Delete external synchronization requirements when not required (see 3.12.2).
- (k) When purchasing type III monitors, specify the two lines-per-frame rates required and the lines-per-frame rate at delivery (see 3.11.2).
- (l) Delete the DC restoration requirement when not required (see 3.19).
- (m) Inspection responsibility, if other than specified (see 4.1).
- (n) Specify whether environmental requirements are to apply (see 3.24).
- (o) Specify environmental testing when required (see table I and 4.7.21).
- (p) Specify packaging and packing required if other than specified (see 5.1 and 5.2).

6.2 Definitions. For the purpose of this specification, the definitions of EIA, Industrial Electronics Bulletin No. 1, Closed Circuit Television Definitions, shall apply.

MILITARY CUSTODIANS:

Army - EL
Navy - EC
Air Force - 71

Review activities:

Army - EL
Navy - EC
Air Force - 71

Preparing activity:

GSA - FSS

CIVIL AGENCY INTEREST:

GSA
NIH
FAA

★U. S. GOVERNMENT PRINTING OFFICE : 1973 O - 514-175 (255)

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