

MIL-R-28803
21 March 1975MILITARY SPECIFICATION
READOUTS, SEGMENTED,
GENERAL SPECIFICATION FORThis specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the general requirements for segmented readouts, backlighted with diffused lenses.

1.2 Classification. Readouts shall be of the following styles and types as specified (see 3.1 and 6.2).

1.2.1 Styles.

<u>Style</u>	<u>Light source</u>
I	Incandescent lamps
II	Light emitting diodes

1.2.2 Types. The type is identified by a one-letter symbol R followed by a two-digit number to indicate the dash number of the specification sheet (for example, R01 identifies segmented readouts covered by MIL-R-28803/1).

2. APPLICABLE DOCUMENTS

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

SPECIFICATIONS

FEDERAL

ZZ-R-765 - Rubber Silicone - Low and High Temperature.

MILITARY

MIL-M-14 - Molding Plastics and Molded Plastic Parts, Thermosetting.
MIL-A-8625 - Anodic Coatings, for Aluminum and Aluminum Alloys.
MIL-S-28786 - Switches, Preparation for Delivery of.
MIL-R-28803/1 - Readouts, Segmented, (RFI Shielded, Moisture Sealed, High Impact Shock) Style II, Type R01.
MIL-C-45662 - Calibration System Requirements.

STANDARDS

FEDERAL

FED-STD-406 - Plastics, Method of Testing.

MILITARY

MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes.
MIL-STD-108 - Definitions of and Basic Requirements for Enclosures for Electric and Electronic Equipment.
MIL-STD-202 - Test Methods for Electronic and Electrical Component Parts.
MIL-STD-128C - Marking of Electrical and Electronic Parts.

MIL-R-28803

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

2.2 Other publications. The following document forms 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.

NATIONAL BUREAU OF STANDARDS

Handbook H28 - Screw-Thread Standards for Federal Services.

(Application for copies should be addressed to the superintendent of Documents, Government Printing Office, Washington, D.C. 20402.)

3. REQUIREMENTS

3.1 Specification sheets. The individual part requirements shall be as specified herein and in accordance with the applicable specification sheets. In the event of any conflict between requirements of this specification and the specification sheets, the latter shall govern (see 6.2).

3.1.1 Readouts covered by specification sheets and identified by military part numbers. Readouts which are completely defined by a military specification sheet (see 7.1) shall be ordered in accordance with 6.2.1.

3.1.2 Readouts covered by specification sheets but not identified by military part numbers. For readouts not covered by a military part number, the type (see 1.2.2) shall be specified in the complementary documents, such as service drawings or ordering data sheets (see 6.2.2). Such readouts shall be procured from sources listed on the qualified products list for the applicable type.

3.2 Qualification. Readouts identified by military part number or type designation furnished under this specification and covered by specification sheets shall be products which are qualified for listing on the applicable qualified products list at the time set for opening of bids (see 4.5 and 6.2). The variations allowed from the specification sheet, included in 6.2.2 are as follows and must be within the physical, functional, and environmental parameters of the specification sheet.

- (a) Character
- (b) Terminations
- (c) Character's colors

3.3 Material. The material for each part shall be as specified herein. However, when a definite material is not specified, a material shall be used which will enable the readouts to meet the performance requirements of this specification. Acceptance or approval of any constituent material shall not be construed as a guaranty of the acceptance of the finished product.

3.3.1 Metals. All metal parts, other than current-carrying parts, shall be of corrosion-resistant material or shall be suitably protected to resist corrosion.

3.3.1.1 Dissimilar metals and compatible couples. When dissimilar metals are used in intimate contact with each other, protection against electrolysis and corrosion shall be provided. The use of dissimilar metals in contact, which tend toward active electrolytic corrosion (particularly brass, copper, or steel used in contact with aluminum or aluminum alloy) is not acceptable. However, metal plating or metal spraying of dissimilar base metals to provide similar or suitable abutting surfaces is permitted. The use of dissimilar metals separated by a suitable insulating material is also permitted. Dissimilar metals and compatible couples are defined in 6.4.

MIL-R-28803

3.3.2 Plastic. Unless otherwise specified, thermosetting plastics shall be flame retardant material in accordance with MIL-M-14; however, cellulose filled materials shall not be used. When used, thermoplastics shall be self-extinguishing when tested in accordance with method 2021 or method 2022 of FED-STD-406, as applicable to the thinnest section. When used in lenses, material shall be as specified (see 3.1 and 6.2).

3.3.2.1 Fiber sheathing. Plasticized polyvinyl chloride shall not be used as a sheathing material for optical fibers.

3.3.3 Silicone rubber. All silicone rubber parts shall be in accordance with ZZ-R-765.

3.3.4 Finish. Unless otherwise specified (see 3.1), all external aluminum parts shall be anodized in accordance with MIL-A-8625. The exterior surfaces, designed to be exposed at the front of the panel after assembly, shall have a black lusterless finish.

3.4 Design and construction. The readouts shall be of the design, construction, temperature range, and physical dimensions specified (see 3.1).

3.4.1 Mounting hardware. Each readout shall be provided with mounting hardware as specified (see 3.1 and 6.2). For direct Government orders, the hardware shall be assembled in proper order.

3.4.2 Housing. The housing shall be capable of independent or combination mounting as specified (see 3.1).

3.4.3 Screw threads. Screw threads on external threaded parts or parts subjected to replacement or removal, shall be in accordance with Handbook H28.

3.4.4 Termination. Termination shall be as specified (see 3.1).

3.4.4.1 Plug-in units. The plug-in units shall be positive keyed to achieve proper alignment of legend in relation to fixed assembly when removed (see 3.1).

3.4.5 Weight. The weight shall be as specified (see 3.1 and 6.2).

3.4.6 Light source. The light source shall be as specified (see 3.1 and 6.2).

3.4.6.1 Light source circuitry. The light source circuits shall be isolated electrically from the readout assembly case and its mounting means.

3.4.6.2 Light source replacement. Light source replacement shall be as specified (see 3.1 and 6.2).

3.4.6.3 Light source contacts. Light source contacts shall be of suitable material or plated to resist electrolytic corrosion of the contact or the light source base.

3.4.7 Lens. The lens shall be free from defects which will prevent it from meeting luminous distribution and color requirements. Unless otherwise specified, there shall be no highlight reflective surfaces on the displays.

3.4.8 Color filters. Material for lamp color filters (used to convert clear incandescent lamps to colored lighting) shall be silicone rubber, unless otherwise specified (see 3.1).

3.4.9 Panel seals. Material for panel seals shall be silicone rubber.

3.5 Performance. The readouts shall be capable of meeting the tests specified in 4.7, and the specification sheets, as applicable. Lamp failure shall not be considered a unit failure when the lamp failure is noted immediately and a new lamp is installed and functions, then the test shall be continued, as required. However, a light source failure for a nonreplaceable item (see 3.1), shall be considered a unit failure.

MIL-R-28803

3.5.1 Operating characteristics. When readouts are tested as specified in 4.7.2, the operating characteristics shall be as specified (see 3.1 and 6.2).

3.5.1.1 Character distortion. When readouts are tested as specified in 4.7.2.1, the displayed character(s) shall appear clear and legible.

3.5.2 Thermal shock. When readouts are tested as specified in 4.7.3, there shall be no mechanical or electrical damage, or loosening of fastening devices. There shall be no discoloration or deformation of the ICs.

3.5.3 Vibration. When readouts are tested as specified in 4.7.4, there shall be no chipping or cracking of materials, or loosening, bending, warping or distortion of parts.

3.5.4 Shock.

3.5.4.1 Method I. When readouts are tested as specified in 4.7.5.1, there shall be no broken, loose, deformed or displaced parts at the conclusion of the test.

3.5.4.2 Method II (when specified). When readouts are tested as specified in 4.7.5.2, there shall be no displaced parts and the readout shall be electrically and mechanically operable at the conclusion of the test.

3.5.5 Moisture resistance. When readouts are tested as specified in 4.7.6, there shall be no evidence of excessive corrosion, breaking, cracking, or other defects detrimental to the intended function of the readout. When readouts are tested in the wet condition, the insulation resistance shall not be less than 10 megohms. At the end of the drying period, the insulation resistance shall not be less than 1,000 megohms. Excessive corrosion is defined as that which interferes with the electrical or mechanical performance and has penetrated the plating and has attacked the base material.

3.5.6 Dielectric withstanding voltage. When readouts are tested as specified in 4.7.7, there shall be no flashover, arcing, breakdown or current flow in excess of 100 microamperes.

3.5.7 Seal (when applicable).

3.5.7.1 Dripproof (45°). When readouts are tested as specified in 4.7.8.1, there shall be no leakage of water through the panel seal as determined by visual examination. Following the test, readouts shall meet the requirements of 3.5.6.

3.5.8 Terminal strength. When readouts are tested as specified in 4.7.9, there shall be no movement or loosening of parts, or other mechanical damage.

3.5.9 Solderability (applicable to solderable terminals). When readouts are tested as specified in 4.7.10, the dipped surface of the terminals shall be at least 95 percent covered with a new, smooth solder coating. The remaining 5 percent of the terminal surface shall show only small pinholes or rough spots. These shall not be concentrated in one area. Bare base metal and areas where the solder dip failed to cover the original coating are indications of poor solderability.

3.5.10 Resistance to soldering heat (when specified (see 3.1 and 6.2)). When readouts are tested as specified in 4.7.11, there shall be no evidence of electrical or mechanical damage.

3.5.11 Salt spray (corrosion). When readouts are tested as specified in 4.7.12, there shall be no evidence of excessive corrosion that interferes with the electrical or mechanical performance, penetrates the plating, and attacks the base material. There shall be no warping, cracking or other damage to the readouts.

3.5.12 Chromaticity. When readouts are tested as specified in 4.7.13, the requirements shall be as specified in table I.

TABLE 1. Illuminated chromaticity limits. ^{1/}

Color	@ 2100° Kelvin	
	X	Y
Red	.695	.285
	.703	SL ^{2/}
	.655	.347
	.660	SL ^{2/}
Green	.260	.570
	.300	.630
	.160	.660
	.200	.720
Yellow	.562	.415
	.570	SL ^{2/}
	.596	.382
	.605	SL ^{2/}
White	.400	.420
	.460	.420
	.400	.380
	.460	.380
Amber	.596	.380
	.607	SL ^{2/}
	.625	.351
	.636	SL ^{2/}

^{1/} The chromaticities of the color character expressed as X and Y coordinates on the CIE chromaticity diagram shall be within areas bounded by the coordinates listed for each color, using a source illuminate of Kelvin value as stated.

^{2/} SL - Spectrum Locus (where intersected by other coordinate pair).

3.5.13 Overload. When readouts are tested as specified in 4.7.14, there shall be no evidence of electrical or mechanical damage.

3.5.14 Life (electrical). Upon completion of tests specified in 4.7.15, readouts shall meet the luminance and dot-to-dot ratio requirements of 3.5.15 and 3.5.16, respectively.

3.5.15 Luminance. When readouts are tested as specified in 4.7.16, the measured photometric brightness in the visible spectrum shall be 10-foot lamberts minimum at rated voltage (see 3.1).

3.5.16 Dot-to-dot ratio. When tested as specified in 4.7.17, the dot-to-dot ratio shall be as specified (see 3.1).

3.5.17 Contrast ratio. When tested as specified in 4.7.18, the contrast ratio shall be as specified (see 3.1).

3.5.18 Field of view. When readouts are tested as specified in 4.7.19, the visibility of the display shall not be restricted by the periphery of the enclosure for the display.

3.5.19 Mechanical endurance (applicable to plug-in units only). When readouts are tested as specified in 4.7.20, there shall be no breakage of parts or degradation of performance. The removable plug-in unit shall remain capable of removal by normal external pressure.

MIL-R-28803

3.6 Marking. Readouts shall be marked in accordance with MIL-STD-1285 with the following information:

- (a) Military part number or type with manufacturer's part number as applicable.
- (b) Readout manufacturer's name, trademark or code symbol, and date code.
- (c) When 3.6(a) is not applicable, the manufacturer's part number, the government drawing number, or prime contractor's number shall be marked on the unit package.

3.6.1 Terminal identification (see 3.1 and 6.2). Terminals shall be marked to indicate the contact arrangement of the readout. When specified (see 3.1 and 6.2), terminal markings shall be augmented by a circuit schematic. There shall be no over-marking of the terminal identification.

3.7 Workmanship. Readouts shall be processed in such a manner as to be uniform in quality and shall be free from cracked or displaced parts, sharp edges, burrs, and other defects which will affect life, serviceability or appearance.

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.

4.1.1 Test equipment and inspection facilities. Test and measuring equipment and inspection facilities of sufficient accuracy, quality and quantity to permit performance of the required inspection shall be established and maintained by the supplier. The establishment and maintenance of a calibration system to control the accuracy of the measuring and test equipment shall be in accordance with MIL-C-45662.

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

- (a) Materials inspection (see 4.3).
- (b) Qualification inspection (see 4.5).
- (c) Quality conformance inspection (see 4.6).

4.3 Materials inspection. Materials inspection shall consist of certification supported by verifying data that the materials used in fabricating the readouts, are in accordance with the applicable referenced specifications or requirements prior to such fabrication.

4.4 Inspection conditions. Unless otherwise specified herein, all inspections shall be performed in accordance with the test conditions specified in the "GENERAL REQUIREMENTS" of MIL-STD-202.

4.5 Qualification inspection. Qualification inspection shall be performed at a laboratory acceptable to the Government (see 6.3), on sample units produced with equipment and procedures normally used in production.

4.5.1 Sample size. The specified number of readouts for which qualification is sought shall be submitted for qualification inspection. The sample submitted shall consist of readouts as specified in the applicable specification sheet, and in the quantity specified (see 3.1).

4.5.2 Inspection routine. Sample units of readouts shall be subjected to the qualification inspection specified in table II in the order shown. All sample units shall be subjected to the inspection of group I. The sample units shall then be divided as specified in table II and subjected to the inspection for their particular group.

TABLE II. Qualification and group B inspection.

Examination or test	Requirement paragraph	Method paragraph
Group I (all sample units)		
Visual and mechanical examination 1/	3.1, 3.3, 3.4, 3.6 and 3.7	4.7.1
Operating characteristics	3.5.1	4.7.2
Character distortion	3.5.1.1	4.7.2.1
Group II (4 sample units)		
Thermal shock	3.5.2	4.7.3
Vibration	3.5.3	4.7.4
Shock	3.5.4	4.7.5
Moisture resistance	3.5.5	4.7.6
Dielectric withstanding voltage	3.5.6	4.7.7
Operating characteristics	3.5.1	4.7.2
Character distortion	3.5.1.1	4.7.2.1
Seal (when applicable)	3.5.7	4.7.8
Group III (2 sample units)		
Terminal strength	3.5.8	4.7.9
Solderability (when applicable)	3.5.9	4.7.10
Heat (when applicable)	3.5.10	4.7.11
Salt spray (corrosion)	3.5.11	4.7.12
Group IV (six samples with 4.7.13, 4.7.14, 4.7.15, 4.7.16, 4.7.17, 4.7.18, 4.7.19, 4.7.20, 4.7.21, 4.7.22, 4.7.23, 4.7.24, 4.7.25, 4.7.26, 4.7.27, 4.7.28, 4.7.29, 4.7.30, 4.7.31, 4.7.32, 4.7.33, 4.7.34, 4.7.35, 4.7.36, 4.7.37, 4.7.38, 4.7.39, 4.7.40, 4.7.41, 4.7.42, 4.7.43, 4.7.44, 4.7.45, 4.7.46, 4.7.47, 4.7.48, 4.7.49, 4.7.50, 4.7.51, 4.7.52, 4.7.53, 4.7.54, 4.7.55, 4.7.56, 4.7.57, 4.7.58, 4.7.59, 4.7.60, 4.7.61, 4.7.62, 4.7.63, 4.7.64, 4.7.65, 4.7.66, 4.7.67, 4.7.68, 4.7.69, 4.7.70, 4.7.71, 4.7.72, 4.7.73, 4.7.74, 4.7.75, 4.7.76, 4.7.77, 4.7.78, 4.7.79, 4.7.80, 4.7.81, 4.7.82, 4.7.83, 4.7.84, 4.7.85, 4.7.86, 4.7.87, 4.7.88, 4.7.89, 4.7.90, 4.7.91, 4.7.92, 4.7.93, 4.7.94, 4.7.95, 4.7.96, 4.7.97, 4.7.98, 4.7.99, 4.7.100)		
Chromaticity	3.5.12	4.7.13
Overload	3.5.13	4.7.14
Life (electrical)	3.5.14	4.7.15
Temperature	3.5.15	4.7.16
Dot-to-dot ratio	3.5.16	4.7.17
Contrast ratio	3.5.17	4.7.18
Field of view	3.5.18	4.7.19
Character distortion	3.5.1.1	4.7.2.1
Group V (4 sample units)		
Mechanical endurance (when applicable)	3.5.19	4.7.20

1/ 2 sample units only for dimensions.

4.5.3 Failures. One or more failures shall be cause for refusal to grant qualification approval.

4.5.4 Extent of qualification.

4.5.4.1 Single submission. Qualification shall be restricted to the type submitted.

4.5.4.2 Group submission. The extent of qualification shall be in accordance with the applicable specification sheet (see 3.1).

MIL-R-28803

4.5.5 Retention of qualification. To retain qualification, the supplier shall forward a report at 36-month intervals as the qualifying activity. The qualifying activity shall establish the initial reporting date. The report shall consist of:

- (a) A summary of the results of the tests performed for inspection of product for delivery, group A indicating as a minimum the number of lots that have passed and the number that have failed. The results of tests of all reworked lots shall be identified and accounted for.
- (b) The results of tests performed for qualification verification inspection, group B, including the number and mode of failures. If the test results indicate nonconformance with specification requirements, and corrective action acceptable to the qualifying activity has not been taken, action may be taken to remove the failing product from the qualified products list.

Failure to submit the report within 30 days after the end of each 36-month period may result in loss of qualification for the product. In addition to the periodic submission of inspection data, the supplier shall immediately notify the qualifying activity at any time that the inspection data indicates noncompliance of the product to meet the requirements of this specification.

4.6 Quality conformance inspection.

4.6.1 Inspection of product for delivery. Inspection of product for delivery shall consist of group A inspection. Except as specified in 4.6.2.1.4, delivery of products which have passed the group A inspection shall not be delayed pending the results of the group B inspection.

4.6.1.1 Inspection lot. An inspection lot shall consist of all readouts of the same specification sheet of the same enclosure design, temperature characteristic, vibration grade, shock type, and design and construction, produced under essentially the same conditions, and offered for inspection at one time. Similar readouts conforming to these requirements but having different circuitry may be combined to form a lot.

4.6.1.2 Group A inspection. Group A inspection shall consist of the examinations and tests specified in table III in the order shown.

4.6.1.2.1 Sampling plan. Statistical sampling and inspection shall be in accordance with MIL-STD-105 for general inspection level II. The acceptable quality level (AQL) shall be as specified in table III. Major and minor defects shall be as defined in MIL-STD-105.

4.6.1.2.2 Rejected lots. If an inspection lot is rejected, the supplier may rework it to correct the defects, or screen out the defective units, and resubmit for reinspection. Resubmitted lots shall be inspected using tightened inspection. Such lots shall be separate from new lots, and shall be clearly identified as reinspected lots.

TABLE III. Group A inspection.

Examination or test	Requirement paragraph	Method paragraph	AQL (percent defective)	
			Major	Minor
Visual and mechanical examination - -	3.1, 3.3, 3.4, 3.6 and 3.7	4.7.1	1.0 ^{1/}	4.0
Operating characteristics - - - - -	3.5.1	4.7.2	1.0	---
Character distortion - - - - -	3.5.1.1	4.7.2.1	1.0	---

^{1/} At the option of the supplier, in-process inspection may be used to meet the materials (see 3.3), and design and construction (sec 3.4), requirements provided they meet the acceptable quality level and all of the supplier's in-process control data on the tests are made available to the Government on request.

MIL-R-28803

4.6.2 Qualification verification inspection. Qualification verification inspection shall consist of group B. Except where the results of these inspections show noncompliance with the applicable requirements (see 4.6.2.1.3), delivery of products which have passed group A shall not be delayed pending the results of these qualification verification inspections.

4.6.2.1 Group B inspection. Group B inspection shall be completed in accordance with table II within 3 years after initial qualification and within each 3-year period thereafter. A manufacturer's normal quality control tests, production control tests, production tests, environmental tests, and so forth, may be used to fulfill all or part of group B inspection; however, all or group B inspection shall be completed as specified.

4.6.2.1.1 Failures. If one or more sample units fail to pass group B inspection, the sample shall be considered to have failed.

4.6.2.1.2 Disposition of sample units. Sample units subjected to group B inspection shall not be delivered on a contract or order; however, they shall be forwarded to the qualifying activity.

4.6.2.1.3 Noncompliance. If a sample fails to pass group B inspection, the supplier shall take corrective action on the materials or processes, or both, as warranted, and on all units of product which can be corrected and which were manufactured under essentially the same conditions, with essentially the same materials, processes, etc., and which are considered subject to the same failure. Acceptance of the product shall be discontinued until corrective action, acceptable to the Government, has been taken. After the corrective action has been taken, group B inspection shall be repeated on additional sample units (all inspection, or the inspection which the original sample failed, at the option of the Government). Group A inspection may be reinstated; however, final acceptance shall be withheld until the group B reinspection has shown that the corrective action was successful. In the event of failure after reinspection, information concerning the failure and corrective action taken shall be furnished to the cognizant inspection activity and the qualifying activity.

4.6.3 Inspection of preparation for delivery. Sample packages and packs and the inspection of the preservation-packaging, packing, and marking for shipment and storage shall be in accordance with MIL-S-28786.

4.7 Methods of examination and test.

4.7.1 Visual and mechanical examination. Readouts shall be examined to verify that the materials, design, construction, physical dimensions, markings, and workmanship are in accordance with the applicable requirements (see 3.1, 3.3, 3.4, 3.6, and 3.7). Only two of the sample units shall be inspected for compliance to physical dimensions.

4.7.2 Operating characteristics (see 3.5.1). Readouts shall be measured for operating characteristics in accordance with the applicable requirements (see 3.1 and 3.2).

4.7.2.1 Character distortion (see 3.5.1.1). The lighted character(s) shall be visually examined for uniformity of character brightness, legibility, and closeness of display. The lighted character(s) shall be visually examined while being viewed at a distance of 18 inches in a plane normal to the lens face to determine distortion (see 3.1).

4.7.3 Thermal shock (see 3.5.2). Readouts shall be tested in accordance with method 107 of MIL-STD-207. The following details shall apply:

- (a) Test condition letter - A.
- (b) Measurements before and after cycling - Not applicable.
- (c) Examinations after test - Readouts shall be examined for mechanical and electrical damage and loosening of fastening devices and deterioration or damage to lenses.

MIL-B-78803

4.7.4 Vibration (see 3.5.3). Readouts shall be tested in accordance with MIL-STD-202. The following details and exceptions shall apply:

- (a) Test conditions:
 - (1) For vibration grade 1 - Method 201 (10-55 Hz).
 - (2) For vibration grade 2 - Method 204, test condition A (10-500 Hz).
 - (3) For vibration grade 3 - Method 204, test condition B (10-2000 Hz).
- (b) Tests and measurements prior to vibration - Not applicable.
- (c) Mounting - Readouts shall be rigidly mounted by their normal mounting means on a rigid metal panel. The mounting fixture shall be free from resonances over the test frequency range. Readouts that are designed to mate with connectors shall be tested using the complete connector assembly.
- (d) During the test, the readout shall be monitored for circuit discontinuities by measuring the electrical continuity of the circuit. All readout segments shall be illuminated at rated voltage. A circuit discontinuity shall be defined as a voltage discontinuity of 20 milliseconds or greater.
- (e) Test and measurements after vibration - Readouts shall be examined for evidence of broken, deformed, displaced or loose parts.

4.7.5 Shock (see 3.5.4). Readouts shall be tested as specified in 4.7.5.1, method I, and in addition, when specified (see 3.1), readouts shall also be tested as specified in 4.7.5.2, method II. The following details and exceptions shall apply:

4.7.5.1 Method I. Readouts shall be tested in accordance with method 213 of MIL-STD-202. The following details shall apply:

- (a) Mounting means - Readouts shall be mounted on a rigid metal panel by their normal mounting means.
- (b) Test condition letter - A.
- (c) Measurement after test - Readouts shall be examined for evidence of broken, deformed or displaced parts.

4.7.5.2 Method II. Readouts shall be tested in accordance with method 207 of MIL-STD-202. The following details shall apply:

- (a) Mounting means - Readouts shall be mounted on the standard mounting fixture detailed by figure 207-4A in MIL-STD-202, method 207.
- (b) Measurement after test - Readout shall be electrically operable.

4.7.6 Moisture resistance (see 3.5.5). Readouts shall be tested in accordance with method 106 of MIL-STD-202. The following details and exceptions shall apply:

- (a) Mounting - By normal mounting means on a corrosion-resistant metal panel extending beyond the readout device, positioned 15 degrees from the vertical and uninsulated.
- (b) Polarisation - During steps 1 to 6 inclusive, a polarizing voltage of 100 volts direct current (dc) shall be applied between all terminals tied together and the metal panel. Steps 7a and 7b are not applicable.
- (c) Load voltage - Not applicable.
- (d) Final measurement - Insulation resistance. Within 5 minutes after conclusion of the test and while the readouts are still wet, insulation resistance shall be measured in accordance with method 302 of MIL-STD-202, test condition letter B. Points of measurements shall be between each terminal and housing.

4.7.7 Dielectric withstanding voltage (see 3.5.6). Readouts shall be tested in accordance with method 301 of MIL-STD-202, at atmospheric pressure. The following details and exceptions shall apply:

- (a) Test voltage - 1,000 volts root-mean-square (rms).
- (b) Duration of application - 1 minute for qualification and group B tests; 5 seconds for other tests.
- (c) Points of application - Between all terminals and housing.

4.7.8 Seal (when applicable) (see 3.1 and 6.2).

4.7.8.1 Dripproof (46°). With the readout mounted by its normal mounting means, the readout shall be subjected to the dripproof test of MIL-STD-108 with a 5 gallon quantity of water flowing over the specimen for 5 minutes duration. The water shall be directed within 12 inches above the test specimen. Following the test, the dielectric withstanding voltage shall be measured as specified in 4.7.7.

4.7.9 Terminal strength (see 3.5.8). Readouts shall be mounted by their normal mounting means. No terminal shall be tested in more than one direction. Terminals shall be tested in accordance with method 211 of MIL-STD-202. The following details and exceptions shall apply:

- (a) Test condition letter - As specified (see 3.1).
- (b) Applied force - As specified (see 3.1).
- (c) Following the test, readouts shall be examined for movement or loosening of parts, visible permanent set, or evidence of mechanical damage.

4.7.10 Solderability (see 3.5.9) (applicable to solderable terminals). Solder type terminations shall be tested in accordance with method 208 of MIL-STD-202. The following details and exceptions shall apply:

- (a) Number of terminations to be tested - Two terminals per unit.
- (b) Examination of termination - Terminals shall be examined for solder coating, pinholes or rough spots, or whether concentrated in one area.

4.7.11 Resistance to soldering heat (when specified, see 3.5.10 (see 3.1 and 6.2)). Readouts shall be tested in accordance with method 210 of MIL-STD-202. The following detail shall apply:

- (a) Test condition letter - B.

4.7.12 Salt spray (corrosion) (see 3.5.11). Readouts shall be tested in accordance with method 101 of MIL-STD-202 with associated mounting and terminal hardware assembled. The following details and exceptions shall apply:

- (a) Test condition letter - B.
- (b) Measurements after exposure - Readouts shall be examined for evidence of excessive corrosion, warping, cracking, or other damage.

4.7.13 Chromaticity (see 3.5.12). The chromaticity shall be determined by spectrographic means as specified (see 3.1 and 6.2) as follows:

- (a) Method I. Spectrophotometer - flat slab: Chromaticity shall be determined using a spectrophotometer, flat slab material of the same density and thickness of the shaped filter, and necessary calibration filters.
- (b) Method II. Spectroradiometric - Chromaticity shall be determined using a spectroradiometer, a complete illuminated readout assembly, calibrated lamps of specified color temperature, and necessary calibration filters.
- (c) Method III: Visual comparator - Chromaticity shall be determined by a color comparator, necessary high and low limit plastic or glass filters of known chromaticity, and calibrated light sources of specific color temperature.

4.7.14 Overload (see 3.5.13). With all segments illuminated, readouts shall be subjected to 140 percent of rated voltage at the power supply for 10 milliseconds minimum. Readouts shall then be examined for evidence of damage.

MIL-R-28803

4.7.15 Life (electrical) (see 3.5.14). Readouts shall be subjected to 300 hours of continuous operations with the light source of the highest wattage energized at its maximum voltage. The following test procedures shall apply:

- (a) Twelve readout units shall be mounted on a vertical aluminum panel, matrixed in three horizontal rows of four readouts per row.
- (b) Tests shall be conducted at the maximum operating temperature specified.
- (c) At the completion of the test, the readouts shall be tested in accordance with the luminance and dot-to-dot ratio tests of 4.7.16 and 4.7.17, respectively.

4.7.16 Luminance (see 3.5.15). All luminance measurements shall be taken in completely dark surroundings and all segments shall be illuminated. All readings shall be point readings and averaged. Luminance readings shall be taken by a calibrated photoelectric photometer. With the photometer element fully illuminated, at least two readings shall be taken at equidistant points along each illuminated segment of the character.

4.7.17 Dot-to-dot ratio (see 3.5.16). Using the luminance values recorded during the luminance test (see 4.7.16), the dot-to-dot ratio (D) shall be determined by using the highest recorded point reading and the lowest recorded point reading and calculation:

$$D = \frac{\text{highest recorded point reading}}{\text{lowest recorded point reading}}$$

4.7.18 Contrast ratio (see 3.5.17). Readouts shall be tested in accordance with 4.7.18.1 and 4.7.18.2. All luminance readings shall be taken with an incidental illumination of 100,000 lux (9,260 foot candles). All readings shall be point readings taken by a calibrated photoelectric photometer. The photometer sensor element shall be fully illuminated during readings of illuminated segments.

4.7.18.1 Contrast ratio with all segments illuminated. At least two readings shall be taken at equidistant points on each illuminated segment. The readings shall be averaged. At least two readings shall then be taken at equidistant points in the background immediately next to each illuminated segment. The background readings shall also be averaged. The contrast ratio shall be determined by measuring B1 (average brightness of background) and B2 (average brightness of segment) and calculating:

$$C = \frac{B2 - B1}{B1}$$

4.7.18.2 Contrast ratio with alternate segments illuminated. The odd numbered segments shall be fully illuminated and the even numbered segments shall be nonilluminated. At least two readings shall be taken at equidistant points on each segment. The luminance readings of illuminated segments shall be averaged, and the readings of the nonilluminated segments shall be averaged. The contrast ratio shall be determined by measuring B2 (brightness of illuminated segment) and B3 (brightness of nonilluminated segment) and calculating:

$$C2 = \frac{B2 - B3}{B3}$$

4.7.19 Field of view (see 3.5.18). The readouts shall be mounted in a horizontal position with the character(s) lighted. The lens face shall be viewed from a distance of 3 feet, unless otherwise specified (see 3.1), all angles up to 45° to a line perpendicular to the viewing surface.

4.7.20 Mechanical endurance (see 3.5.19) (applicable to plug-in units only). Readouts shall be subjected to 150 insertions and removals, either manually or automatically.

MIL-R-28803

5. PREPARATION FOR DELIVERY

5.1 Preparation for delivery. Preparation for delivery shall be in accordance with MIL-S-28786.

6. NOTES

6.1 Intended use. The readouts covered by this specification are intended for use as panel displays.

6.2 Ordering data.

6.2.1 Readouts covered by specification sheets and identified by military part numbers. The procurement document should specify the following:

- (a) Title, number and date of this specification.
- (b) Title, number and date of the applicable specification sheet and the part number.

6.2.2 Readout types covered by specification sheets and identified by type designations. Procurement documents should specify the following:

- (a) Title number and date of this specification.
- (b) Title, number and date of applicable specification sheet.
- (c) Type of qualified readout.
- (d) Manufacturer's part number of modified readout.
- (e) Details of the variations from the specification sheet (see note 1).
- (f) If mounting hardware is not to be assembled (see 3.4.1).
- (g) Lamp, if required (see 3.4.6).

NOTE: A copy of the drawing furnished under (e) including the description of the variations from the specification sheet, should be sent to the preparing activity as listed in the individual specification sheet. Preparation and submission of data should be in accordance with step II, MIL-STD-749.

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are at the time set for opening of bids, qualified for inclusion in the applicable Qualified Products List whether or not such products have actually been so listed by that date. The attention of the suppliers is called to this requirement, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. The activity responsible for the qualified products list is the Naval Electronics Systems Command; however, information pertaining to qualification of products may be obtained from the Defense Electronics Supply Center (DESC-E), 1507 Wilmington Pike, Dayton, Ohio 45444, agent for administration of the qualified products list.

6.4 Intermetallic contact. The finishing of metallic areas to be placed in intimate contact by assembly presents a special problem, since intermetallic contact of dissimilar metals results in electrolytic couples which promote corrosion through galvanic action. To provide the required corrosion protection, intermetallic couples are restricted to those permitted by table IV. Table IV shows metals and alloys (or plates) by groups which have common electromotive forces (EMF) within 0.05 volt when coupled with a saturated calomel electrode in sea-water at room ambient temperatures. All members of a group are considered as completely compatible, one with the other. Compatible couples between groups have been specified in table IV based on a potential difference of 0.25 volt maximum. To simplify any arithmetic involved, table IV shows, in addition to EMF against a calomel electrode a derived anodic index with group 1 (gold, and so forth) as 0 and group 18 (magnesium, and so forth) as 175. Subtraction of a lower group anodic index gives the EMF difference in hundredths of a volt.

MIL-R-28803

TABLE IV. Compatible couples (see 6.4.2) ^{1/}

Group No.	Metallurgical category	EMF (volt)	Anodic index (0, 01 v)	Compatible couples
1	Gold, solid and plated; gold-platinum alloys; wrought platinum (most cathodic)	+ 0.15	0	
2	Rhodium plated on silver-plated copper	+ 0.05	10	
3	Silver, solid or plated; high silver alloys	0	15	
4	Nickel, solid or plated; monel metal, high nickel-copper alloys	- 0.15	30	
5	Copper, solid or plated; low bronzes or bronzes; silver solder; German silver; high copper-nickel alloys; nickel-chromium alloys; austenitic corrosion-resistant steels	- 0.20	35	
6	Commercial yellow bronzes and bronzes	- 0.25	40	
7	High bronzes and bronzes; naval brass; Muntz metal	- 0.30	45	
8	18 percent chromium type corrosion-resistant steels	- 0.35	50	
9	Chromium, plated; tin, plated; 12 percent chromium type corrosion-resistant steels	- 0.45	60	
10	Tin-plate; terneplate; tin-lead solder	- 0.50	65	
11	Lead, solid or plated; high lead alloys	- 0.55	70	
12	Aluminum, wrought alloys of the duralumin type	- 0.60	75	
13	Iron, wrought, gray, or malleable; plain carbon and low alloy steels, armco iron	- 0.70	85	
14	Aluminum, wrought alloys other than duralumin type; aluminum, cast alloys of the silicon type	- 0.75	90	
15	Aluminum, cast alloys other than silicon type; cadmium, plated and chromated	- 0.80	95	
16	Hot-dip-zinc plate; galvanized steel	- 1.05	120	
17	Zinc, wrought; zinc-base die-casting alloys; zinc, plated	- 1.10	125	
18	Magnesium and magnesium-base alloys, cast or wrought (most anodic)	- 1.60	175	

^{1/} Compatible couples - potential difference of 0.25 volt maximum between groups.

MIL-R-28803

6.4.1 Groups. Table IV sets up 18 primary groups. It may be noted that neither the metallurgical similarity or dissimilarity of metals is the parameter for selection of compatible couples. All members within a group, regardless of metallurgical similarity, are considered inherently nonsusceptible to galvanic action when coupled with any member within the group; for example, such dissimilar metals as platinum and gold. Similarly, such basically dissimilar alloys as austenitic stainless steel, silver-solder, and low brass (all members of group 5) are inherently nonsusceptible when coupled together.

6.4.2 Compatibility graphs. Permissible couple series are shown in table IV by the graphs at the right. Members of groups connected by lines will form permissible couples. An O indicates the most cathodic member of each series, an ● an anodic member, and the arrow indicates the anodic direction.

6.4.3 Selection of compatible couples. Proper selection of metals in the design of equipment will result in fewer intermetallic contact problems. For example, for sheltered exposure, neither silver nor tin requires protective finishes. However, since silver has an anodic index of 15 and tin 65, the EMF generated as a couple is 0.50 volt which is not allowable by table IV. In this case, other metals or plates will be required. It should be noted that, in intermetallic couples, the member with the higher anodic index is anodic to the member with the lower anodic index and will be susceptible to corrosion in the presence of an electrolytic medium. If the surface area of the cathodic part is significantly greater than that of the anodic part, the corrosive attack on the contact area of the anodic part may be greatly intensified. Material selection for intermetallic contact parts, therefore, should establish the smaller part as the cathodic member of the couple, whenever practicable.

6.4.4 Plating. When base metals intended for intermetallic contact form couples not allowed by table IV, they are to be plated with those metals which will reduce the potential difference to that allowed by table IV.

Custodians:
 Army - EL
 Navy - EC
 Air Force - 11

Review activities:
 Army - MI, SM
 Navy - AS
 Air Force - 17, 80
 DSA - ES

User activities:
 Army - ME
 Navy - MC

Preparing activity:
 Navy - EC

Agent:
 DSA - ES

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