

INCH-POUND

MIL-DTL-12713E  
1 August 2012  
SUPERSEDING  
MIL-Q-12713D (MU)  
10 August 1970

## DETAIL SPECIFICATION

## QUADRANT, FIRE CONTROL: M1A3

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

## 1. SCOPE

1.1 Scope. This specification covers Fire Control Quadrant: M1A3, used primarily for measuring angles of cant or elevation for various trajectory weapons. This item is commonly referred to as the Gunner's Quadrant.

## 2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all requirements of documents cited in sections 3 and 4 of this specification, whether or not documents are listed in this section.

Comments, suggestions, or questions on this document should be addressed to: Commander, US Army ARDEC, ATTN: RDAR-QES-E, Picatinny, New Jersey 07806-5000 or emailed to [picaardecdtdznbranch@conus.army.mil](mailto:picaardecdtdznbranch@conus.army.mil). Since contact information can change, you may want to verify the currency of this address information using the ASSIST online database at <https://assist.dla.mil>.

AMSC N/A

FSC 1290

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2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-F-13926 - Fire Control Materiel, Manufacture, and Inspection, General Specification for

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-1916 - DOD Preferred Methods for Acceptance of Product

(Copies of federal and military specifications, standards, and handbooks are available online at <https://assist.dla.mil/quicksearch/> or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.2.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

U.S. ARMY ARMAMENT RESEARCH, DEVELOPMENT AND ENGINEERING CENTER (ARDEC) DRAWINGS

13032529 - Quadrant, Fire Control: M1A3

(Application for copies of these drawings may be requested through email to [pica.drawing.request@conus.army.mil](mailto:pica.drawing.request@conus.army.mil) or from U.S. Army ARDEC, ATTN: RDAR-EIS-PE, Picatinny, NJ 07806-5000)

2.3 Order of precedence. Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this document and the references cited herein, the text of this document shall take precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Required inspections.

3.1.1 First article. When specified (see 6.2), a sample shall be subjected to first article inspection in accordance with 4.2.1.

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3.1.2 Conformance. A sample shall be subject to conformance inspection in accordance with 4.2.2.

3.2 Final assembly. Item shall conform to drawing 13032529.

3.3 Environmental.

3.3.1 Storage temperature. The quadrant shall be thermally stabilized at temperatures of  $+160 \pm 5$  °F and  $-60 \pm 5$  °F for a minimum of 4 hours at each temperature. Upon return to and stabilization at standard ambient temperature,  $+60$  °F to  $+90$  °F, the quadrant shall show no evidence of physical damage or failure and meet the requirements of 3.4 through 3.12 inclusive.

3.3.2 Operating temperature. The quadrant shall meet the requirements of 3.4 through 3.9 inclusive while exposed and thermally stabilized at temperatures of  $+145 \pm 5$  °F and  $-50 \pm 5$  °F for a period of not less than 4 hours at each temperature.

3.4 End-for-end. The quadrant shall end-for-end with a correction no greater than  $\pm 0.4$  mil.

3.5 Micrometer. An increase of 10 mils of the gunner's quadrant micrometer shall result in a 10 mil increase in elevation within the width of a level vial graduation line as read using the gunner's quadrant level vial.

3.6 High angle shoes. The gunner's quadrant shall provide the same reading within  $\pm 0.4$  mils at 800 mils elevation using the quadrant's high angle shoes as when using the low angle shoes.

3.7 Accuracy. The gunner's quadrant shall indicate angular readings from -10 mils to 1600 mils (with respect to the horizontal plane) accurate within  $\pm 0.4$  mils.

3.8 Torque. The running torque required to rotate the micrometer knob shall not exceed 2.0 inch-pounds throughout the operating temperature range of  $-50$ °F to  $+145$ °F inclusive.

3.9 Index alignment. With the micrometer dial indicating zero, the zero index line on the level vial holder shall coincide with the index line on the arm within the width of the index line on the arm.

3.10 Perpendicularity. The high angle shoes shall be perpendicular to the low angle shoes within .0004 inches.

3.11 Bubble size. The level vial bubble length shall be  $.60 \pm .02$  inches at 75°F.

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3.12 Workmanship. Workmanship of the M1A3 fire control quadrant shall be in accordance with the requirements of MIL-F-13926.

## 4. VERIFICATION

TABLE I. Requirement/verification cross reference matrix.

Method of Verification 1 - Analysis 2 - Demonstration 3 - Examination 4 - Test		Class of Verification A - First Article B - Conformance						
Section 3 Requirement	Description	Verification Method				Verification Class		Section 4 Verification
		1	2	3	4	A	B	
3.1.1	First article			X	X	X		4.2.1
3.1.2	Conformance			X	X		X	4.2.2
3.2	Final assembly			X	X	X	X	4.3
3.3.1	Storage temperature				X	X	X	4.4.1
3.3.2	Operating temperature				X	X	X	4.4.2
3.4	End-for-end				X	X	X	4.5
3.5	Micrometer				X	X	X	4.6
3.6	High angle shoes				X	X	X	4.7
3.7	Accuracy				X	X	X	4.8
3.8	Torque				X	X	X	4.9, 4.4.2
3.9	Index alignment			X		X	X	4.10
3.10	Perpendicularity			X		X	X	4.11
3.11	Bubble size			X		X	X	4.12
3.12	Workmanship			X		X	X	4.13

4.1 Classification of inspection. The inspection requirements specified herein are classified as follows:

- a. First article inspection (see 4.2.1)
- b. Conformance inspection (see 4.2.2)

4.2.1 First article. When specified, a sample shall be subjected to first article verification in accordance with Table II.

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TABLE II. First article inspection criteria.

Examination or Test	Requirement Paragraph	Verification Paragraph
Final assembly	3.2	4.3
Storage temperature	3.3.1	4.4.1
Operating temperature	3.3.2	4.4.2
End-for-end	3.4	4.5
Micrometer	3.5	4.6
High angle shoes	3.6	4.7
Accuracy	3.7	4.8
Torque	3.8	4.9, 4.4.2
Index alignment	3.9	4.10
Perpendicularity	3.10	4.11
Bubble size	3.11	4.12
Workmanship	3.12	4.13

4.2.1.1 First article quantity. First article inspections shall be performed on three (3) complete units.

4.2.1.2 First article inspection to be performed. The first article inspection shall be performed in accordance with Table II.

4.2.1.3 First article rejection. If any item of the sample fails to comply with any of the first article requirements, the first article shall be rejected.

#### 4.2.2 Conformance inspection.

4.2.2.1 Lot formation. Lot formation shall be in accordance with the lot formation requirements of MIL-STD-1916, paragraph “Formation and identification of lots and batches.”

4.2.2.2 Conformance inspection quantity. Conformance inspection quantities shall be in accordance with Table III and MIL-STD-1916, paragraph “Sampling of lots or batches.” Conformance criteria shall be in accordance with Table III and MIL-STD-1916, paragraph “Verification level (VL).”

4.2.2.3 Conformance inspection to be performed. The conformance inspection shall be performed in accordance with Table III.

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TABLE III. Conformance inspection criteria.

Examination or Test	Conformance Criteria	Requirement Paragraph	Verification Paragraph
Final assembly	VL-IV	3.2	4.3
Storage temperature	3 units per lot / <u>1</u>	3.3.1	4.4.1
Operating temperature	3 units per lot / <u>1</u>	3.3.2	4.4.2
End-for-end	100%	3.4	4.5
Micrometer	VL-IV	3.5	4.6
High angle shoes	VL-IV	3.6	4.7
Accuracy	100%	3.7	4.8
Torque	VL-IV	3.8	4.9, 4.4.2
Index alignment	VL-IV	3.9	4.10
Perpendicularity	VL-IV	3.10	4.11
Bubble size	VL-IV	3.11	4.12
Workmanship	VL-II	3.12	4.13
NOTES:			
/1 Lot shall be accepted if there are 0 failures, and rejected if there are 1 or more failures.			

4.2.2.4 Conformance rejection. If any item of the sample fails to comply with any of the conformance requirements, the lot shall be rejected.

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4.3	<u>Final assembly.</u>			Drawing number 13032529
Classification	Examination or test	Conformance criteria	Requirement paragraph	Next higher assembly 7197156
				Inspection method reference
<u>Critical</u>	None defined			
<u>Major</u> 101	Presence of Plate, Identification, 8228871	100%	3.2	Visual
102	Level vial cover shall be movable by hand, but not spin freely	Level IV	3.2	Tactile
<u>Minor</u> 201	Evidence of poor workmanship	Level II	3.12	4.13

4.4 Environmental.

4.4.1 Storage temperature. The gunner's quadrant shall be placed in the test chamber and the temperature of the chamber reduced gradually to  $-60 \pm 5^{\circ}\text{F}$  and shall remain at this temperature for a minimum of 4 hours. At the completion of this 4 hour period, the temperature shall then be gradually raised to  $+160 \pm 5^{\circ}\text{F}$  and the quadrant shall remain at this temperature for a minimum of 4 hours. At the completion of this 4 hour period the temperature of the test chamber shall be gradually reduced to room ambient temperature ( $+60^{\circ}\text{F}$  to  $+90^{\circ}\text{F}$ ) at which time the quadrant shall be removed from the test chamber. The quadrant shall then be subjected to a visual and tactile examination to determine that there is no evidence of distortion, cracks, level vial breakage, or undue irregularities of moving parts. Then conduct the tests of 4.5-4.13. The same units may be used for both storage temperature and operating temperature verifications, if desired. (See 6.7 Thermal shock.)

4.4.2 Operating temperature. The quadrant shall be placed in the environmental chamber and the temperature of the chamber reduced gradually to  $-50 \pm 5^{\circ}\text{F}$ . The quadrant shall remain at this temperature for a minimum of 4 hours. At the completion of this 4 hour period, and within 10 minutes of removal from the environmental chamber, the quadrant shall meet requirements listed in 3.3.2. Upon completion of this portion of the test, the quadrant shall then be placed back in the environmental chamber and the

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temperature shall be raised gradually to  $+145 \pm 5^{\circ}\text{F}$ . The quadrant shall remain at this temperature for a minimum of 4 hours. At the completion of this 4 hour period, and within 10 minutes of removal from the environmental chamber, the quadrant shall again meet requirements listed in 3.3.2. Upon completion of this test, the quadrant shall be returned to the environmental chamber and the temperature shall be gradually reduced to room ambient temperature ( $+60^{\circ}\text{F}$  to  $+90^{\circ}\text{F}$ ) at which time the quadrant shall be removed from the test chamber. The same units may be used for both storage temperature and operating temperature verifications, if desired. (See 6.7 Thermal shock.)

4.5 End-for-end. The end-for-end correction is the reading shown on the gunner's quadrant when it can be placed on a level surface in two opposing directions that both result in a level vial bubble that is centered within the width of a graduation line. This correction shall not be greater than the tolerance specified. (See 6.6 for suggested test method.)

4.6 Micrometer. Zero the index arm and micrometer of the gunner's quadrant. Place the quadrant on an adjustable elevation fixture and adjust the fixture to center the level vial bubble of the gunner's quadrant. Remove the gunner's quadrant from the fixture, set the index arm to -10 mils, set the micrometer to 10 mils, and place the gunner's quadrant back on the elevation fixture in the same orientation. Without adjusting the elevation fixture, the level vial bubble shall be centered within the tolerance specified.

4.7 High angle shoes. Adjust the elevation angle test fixture to 800 mils elevation. Place the gunner's quadrant on the fixture using the low angle shoes, adjust the quadrant to center the level vial bubble, and record the elevation as read from the gunner's quadrant. Without adjusting the elevation angle test fixture, remove the gunner's quadrant, set to 800 mils elevation on the high angle scale, and then replace it on the fixture using the high angle shoes. Adjust the quadrant to center the level vial bubble, and record the elevation as read from the gunner's quadrant. The difference between the recorded elevation for the low angle shoes at 800 mils and the recorded elevation for the high angle shoes at 800 mils shall be within the tolerance specified.

4.8 Accuracy. Set a calibrated inspection aid to zero mils elevation then position it on the seat provided on the elevation angle test fixture. Adjust the test fixture until the inspection aid level vial bubble is centralized when the elevation angle test fixture is set for zero mils elevation. Set the quadrant under test to zero mils elevation and place it on the seat provided on the test fixture in the same position as the inspection aid. Adjust the gunner's quadrant micrometer until the level vial bubble is centered within a level vial graduation line. If a negative correction is necessary, lower the quadrant's index arm 10 mils and then use the micrometer to center the level vial bubble. The difference between the actual elevation and the elevation indicated by the gunner's quadrant is the amount of error at that elevation. The error shall not be greater than the tolerance specified in 3.7.

In addition, accuracy shall be tested at a minimum of 4 diversified angles of elevation while on the low angle shoes of the quadrant (e.g. 200, 400, 600, and 800 mils) and a minimum of 4 diversified angles of elevation while on the high angle shoes of the quadrant (e.g. 800, 1000, 1200, and 1400 mils). This is accomplished by checking the

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quadrant under test with the settings of the inspection aid and following the procedure outlined above as required for each scale settings. Any error, not cumulative, shall be observed and shall not exceed the tolerance specified.

4.9 Torque. A commercial type torque wrench capable of measuring to the torque values specified shall be utilized for this test. An appropriate adapter to accommodate the micrometer knob shall be used with the torque measuring device. Readings taken with the torque wrench shall be observed in both directions and while in motion. The running torque required to rotate the micrometer knob shall conform to 3.8 when tested at ambient temperature and checked at the high and low operating temperatures during verification 4.4.2.

4.10 Index alignment. With the micrometer dial indicating zero, the zero index line on the level holder shall coincide with the index line on the arm within the tolerance specified in 3.9. This index alignment is required on each side of the quadrant. Index alignment at the settings specified shall be determined by a visual and tactile examination. As a means to facilitate the measuring of any misalignment of the indices a commercial type optical comparator with appropriate tolerance mark may be utilized.

4.11 Perpendicularity. Perpendicularity of the two sets of shoes shall be inspected on either a Coordinate-Measuring Machine (CMM) or on a leveled surface plate, utilizing gage blocks, and a universal right-angle plate. If using the leveled surface plate method, the amount of error is obtained by inserting gage blocks of known value between the right angle knee plate and the lower vertical shoe of the frame. Then, insert a build up of gage blocks between the knee plate and the upper vertical shoe of the frame until both shoes are lightly touching the gage blocks. Perpendicularity as measured by the CMM or as the difference between the two sets of gage blocks in the surface plate method is the total error and shall be within the tolerance specified.

4.12 Bubble size. Bubble size shall be measured using a comparator with a magnification of at least 3X. The comparator should contain a reticle calibrated scale to the approximate size as a means to determine compliance. The bubble size shall be within the size range specified at 75°F.

4.13 Workmanship. Workmanship of the M1A3 fire control quadrant shall be confirmed in accordance with the verifications of MIL-F-13926.

## 5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the military service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's

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automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

## 6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The M1A3 Gunner's Quadrant is primarily intended to lay various guns and field artillery pieces (towed or self propelled) in elevation and to measure elevation angles.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number and date of this specification.
- b. Selection of an applicable level of preservation, packaging, and packing in accordance with MIL-STD-2073-1, Department of Defense Standard Practice for Military Packaging.
- c. Packaging Data Sheet SPI 13042173 as applicable (See 6.5).
- d. Applicable National Stock Number (NSN).
- e. Provisions for first article testing.

6.3 Submission of inspection equipment designs for approval. Contractor designs for final acceptance inspection must be approved by the Government prior to fabrication or procuring the equipment. The contractor is referred to MIL-HDBK-204 for guidance. Submission of design concept on inspection equipment is permissible for tentative approval. The completion date for design review will be based on the date of the final submission of designs and the required delivery schedule as stipulated in the contract. Submit designs as required to: Commander, U.S. Army Armament Research, Development and Engineering Center, ATTN: RDAR-QEW-A, Picatinny Arsenal, NJ 07806-5000. This address will be specified on the Contract Data Requirements List DD Form 1433 in the contract. When the contractor submits inspection equipment designs to the Government for approval, he must give the following information in his letter of transmittal:

- a. The contract number.
- b. The contract item (name, model number, etc).
- c. The designs remaining to be submitted and the expected date of submittal.

6.4 Drawings. Drawings listed in Section 2 of this specification under the heading U.S. Army Armament, Research Development and Engineering Center (ARDEC)

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Drawings may also include drawings prepared by, and identified as Edgewood Arsenal, Frankford Arsenal, Rock Island Arsenal, or Picatinny Arsenal drawings. Technical data originally prepared by these activities is now under the cognizance of ARDEC.

6.5 Packaging data sheet drawings. The following packaging data sheet drawings should be obtained from U.S. Army ARDEC, ATTN: RDAR-EIL-P B455, Picatinny, NJ 07806-5000.

SPI 13042173 - Packaging of Quadrant, Gunner's, M1A3 W/Case, Carrying

6.6 Suggested end-for-end procedure. Zero the index arm and micrometer of the gunner's quadrant. Place the quadrant on an adjustable elevation fixture and adjust the fixture to center the level vial bubble of the gunner's quadrant. Reverse the direction of the gunner's quadrant; if the level vial bubble centers without adjustment, then the end-for-end correction is 0.

If the level vial bubble does not center, adjust the gunner's quadrant using the micrometer (or, for a negative correction, lower the index arm by 10 mils and adjust the micrometer) until the level vial bubble is centered. Take this gunner's quadrant reading, divide it by 2, and input that value into the gunner's quadrant utilizing the micrometer. With the above correction value set on the gunner's quadrant, place the quadrant on an adjustable elevation fixture and adjust the fixture to center the level vial bubble of the gunner's quadrant. Reverse the direction of the gunner's quadrant; if the level vial bubble centers without further adjustment, then the reading that is shown on the gunner's quadrant is the end-for-end correction.

6.7 Thermal shock. Caution should be exercised during environmental testing to avoid subjecting the quadrant to thermal shock.

6.8 Subject term (key word) listing.

Howitzer  
M119  
M777  
M198  
Self Propelled Artillery  
Towed Artillery

6.9 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

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Custodian:  
Army-AR  
Navy - OS  
Air Force – 99

Preparing activity:  
Army-AR  
(Project 1290-2012-001)

Review activities:  
Army – AV, MI  
Navy – AS  
Air Force – 84  
DLA – CC

Civil agency:  
GSA - FAS

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