INCH-POUND

MIL-DTL-48554B
29 December 2011
SUPERSEDING
MIL-T-48554A(AR)
w/AMENDMENT 2
10 January 2006

DETAIL SPECIFICATION

TELESCOPE, PANORAMIC - M137A2 AND M137A3

Inactive for new design after 29 December 2011

This specification is approved for use by the U.S. Army Armament Research, Development and Engineering Center (ARDEC) and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers Telescope, Panoramic – M137A2 and M137A3 which are two types of panoramic telescopes which provide four-power magnification and a ten-degree field of view. They are equipped with numerical counters which indicate azimuth settings and corrections.

1.2 Classification. The Panoramic Telescope is primarily intended to lay the howitzer in azimuth for indirect fire and there are the following types:

1.2.1 M137A2. This Panoramic Telescope is intended to support the M119 Series and M777 Series Howitzers and does not use tritium.

1.2.2 M137A3. This Panoramic Telescope is intended to support the M198 Howitzer and does not use tritium.

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 ardecstdzn@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.daps.dla.mil.

AMSC N/A FSC 1240

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

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.

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-PRF-13830	-	Optical Components for Fire Control Instruments; General Specification Governing the Manufacture, Assembly, and Inspection of
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.daps.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

5549108	-	Telescope, Collimating
7572447	-	Reticle
7680631	-	Dioptometer
8565556	-	Pressure Tester
9329535	-	Reticle for Collimator 7573291
10549198	-	Adapter, Vibration and/or Shock

10558252	-	Test Fixture
11747952	-	Adapter, Torque
11747953	-	Adapter, Torque
11747954	-	Adapter, Torque
11747955	-	Adapter, Torque
11747975	-	Gage, Interchangeability, Maximum
12984713	-	Telescope, Panoramic: M137A2
12984775	-	Telescope, Panoramic: M137A3

(Copies of these drawings may be requested online at 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 takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 First article. When specified (see 6.2), a sample shall be subjected to first article inspection in accordance with 4.2.

3.2 Conformance. A sample shall be subject to conformance inspection in accordance with 4.3.

3.3 Environmental.

3.3.1 Storage temperature. The telescope shall show no evidence of physical damage or failure when thermally stabilized at temperatures of +160 ± 5 °F (+71 ± 3 °C) and -60 ± 5 °F (-51 ± 3 °C) for a period of not less than 4 hours at each temperature. Upon return to and stabilization at standard ambient temperature, +60 °F to +90 °F (+16 °C to +32 °C), the telescope shall meet the requirements of 3.4 through 3.19 inclusive.

3.3.2 Operating temperature. The telescope shall meet the requirements of 3.8.1 through 3.15 inclusive while exposed and thermally stabilized at temperatures of +145 ± 5 °F (+63 ± 3 °C) and -50 ± 5 °F (-46 ± 3 °C) for a period of not less than 4 hours at each temperature.

3.3.3 Shock. The telescope shall withstand a total of 75 shock impulses along 3 mutually perpendicular axes as defined in Figure 1. Each shock impulse shall be a half sine wave with a time duration of .010 ± .001 seconds and peak amplitude for each shock impulse as shown in Table I. Subsequent to shock, the telescope shall show no evidence of damage or physical failure and shall meet the requirements of 3.4 through 3.19 inclusive.

TABLE I. Shock orientation and impulse.

Orientation	Shock impulse and direction	Number of impulses
Longitudinal	-50 g's, +50 g's	15 each direction
Vertical	+100 g's	15 total
Transverse	-100 g's, +100 g's	15 each direction

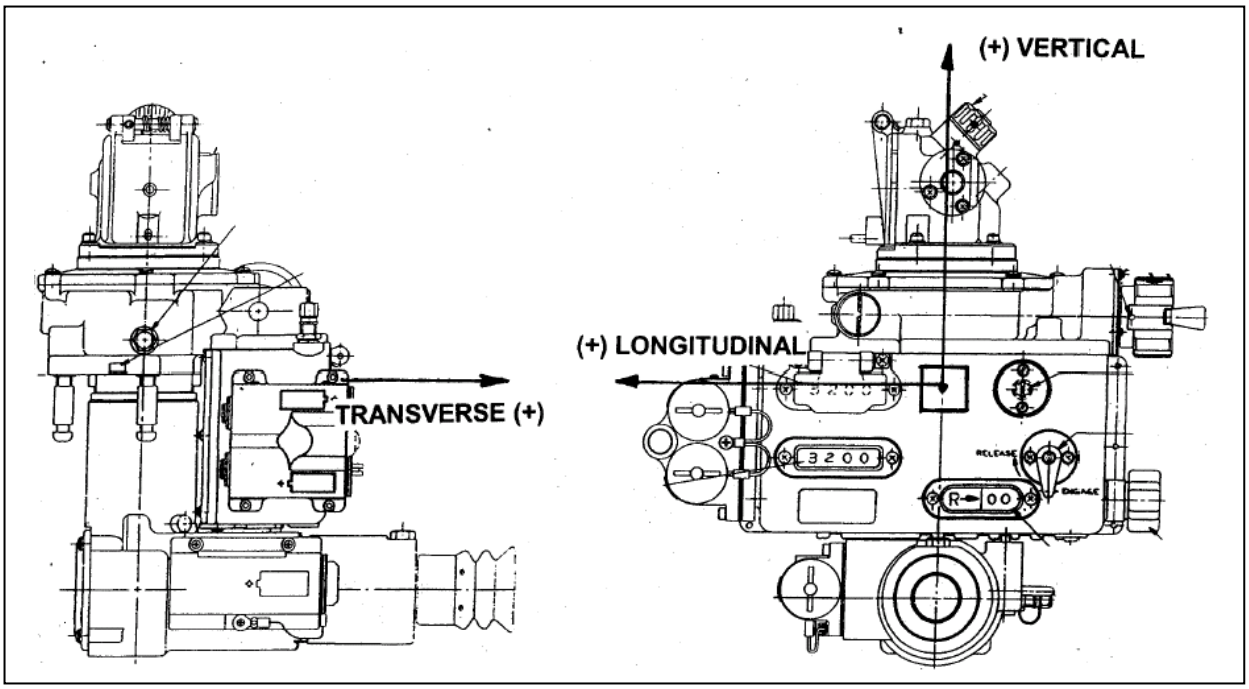


FIGURE 1. Orientation of shock loads.

3.3.4 Vibration "A". The telescope shall withstand a total of 270 minutes of sweep-cycle vibration. The vibration shall be applied for 90 minutes along each of the three mutually perpendicular major axes shown in Figure 1. A complete sweep-cycle shall consist of vibration from origin (5 Hz at 1 inch double amplitude) to mid-point (5 ± 0.5 g's at 500 Hz) to origin, and shall have a duration of 15 ± 1 minutes. Double amplitude shall be constant at 1 inch between 5 Hz and 10 Hz, and varied with frequency to maintain a constant 5 ± 0.5 g's acceleration between 10 Hz and 500 Hz. Upon completion of vibration, the telescope shall exhibit no evidence of damage or physical failure and shall meet the requirements of 3.4 through 3.19 inclusive.

3.3.5 Vibration "B". The telescope shall be vibrated in the vertical plane shown in Figure 1 for a total of 15 ± 1 minutes of sweep cycle vibration. A complete sweep-cycle shall consist of vibration from origin (5 Hz at 1 inch double amplitude) to mid-point (5 ± 0.5 g's at 500 Hz) to origin, and shall have a duration of 15 ± 1 minute. Double amplitude shall be constant at 1 inch between 5 Hz and 10 Hz and varied with frequency to maintain a constant 5 ± 0.5 g's acceleration between 10 Hz and 500 Hz. Upon completion of

vibration, the telescope shall exhibit no evidence of damage or physical failure and shall meet the requirements of 3.4 through 3.19 inclusive.

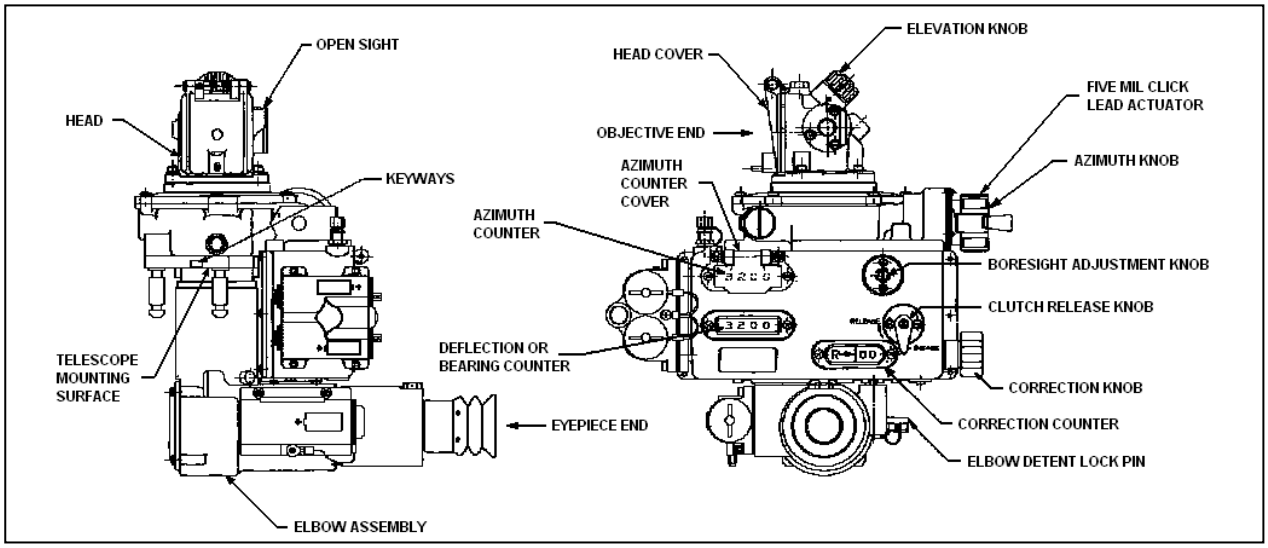


FIGURE 2. Component locations.

3.4 Orientation. The panoramic telescope 12984713 or 12984775 shall be capable of being positioned on a test fixture with mounting surface horizontal and the elbow assembly positioned perpendicular to the plane of the keyways (see Figure 2 for part locations). In this orientation, the azimuth and deflection or bearing counters shall indicate 3200 mils, the correction counter shall indicate zero, and the line of sight shall be horizontal and parallel to the plane of the keyways. The line of sight shall be established by placing the telescope reticle into coincidence with the collimator target reticle 7572447, unless otherwise specified. The five mil click lead actuator shall be set to “Indirect” unless otherwise specified. The requirements of 3.4.1 through 3.17.2 inclusive shall be met with the telescope in this orientation.

3.4.1 Collimation change, post vibration. This requirement shall be met with conditions of 3.4 re-established without readjusting boresight subsequent to vibration. The line of sight established prior to vibration shall not deviate more than .25 mil as read on both the azimuth and deflection or bearing counters due to subjecting the telescope to either Vibration “A” or Vibration “B”.

3.5 Sealing and purging.

3.5.1 Optical assembly. The telescope optical assembly shall be capable of sustaining an internal pressure of 7.0 + 0.1 pounds per square inch gage (psig) for a minimum of one hour with no evidence of leakage.

3.5.2 Counter box. The counter box of the telescope shall be capable of sustaining an internal pressure of 5.0 + 0.1 psig for a minimum of one hour with no evidence of leakage.

3.5.3 Purging. The optical assembly and counter box of the telescope shall be purged with dry nitrogen supplied at a pressure of 8.00 + 0.25 psig until the dew point of the emergent gas is no higher than -25 °F. Purging apparatus shall be removed when relief valve is reseated and maintains a minimum pressure of 5 psig.

3.6 Cleanliness.

3.6.1 Dirt. The maximum length and/or width of any particle appearing on the reticle surface shall not be greater than the width of the reticle line. The maximum number of dirt particles appearing within a central field of view of 50 mils diameter shall be three (3). The maximum number of dirt particles appearing outside this field of view shall be three (3). The minimum separation between dirt particles shall be 15 mils according to the reticle. Dirt particles with widths and/or lengths less than ¼ of the reticle line width shall be ignored regardless of distribution.

3.6.2 Other defects. There shall be no evidence of moisture, grease, fingerprints, condensates, dirt, debris, scratches, fractures and adhesive separations when viewing through the objective end of the instrument or on the surface of the eyepiece lens.

3.7 Optical characteristics.

3.7.1 Eyepiece focus. The best eyepiece focus of the reticle image shall be fixed between the limits of -0.50 and -1.00 diopters. The variation in eyepiece focus between the horizontal and vertical image shall not be greater than 0.25 diopters.

3.7.2 Parallax. Parallax at the center of the field shall not be greater than 0.25 mil when viewing a target at 80 ± 10 meters.

3.7.3 Reticle accuracy. The angular separation between the 40 mil graduations on the horizontal axis shall be 80 ± 0.5 mil.

3.7.4 Resolution. The resolution on the optical axis shall be 15 seconds of arc or less when using an observation telescope of at least 3 power and entrance pupil of at least 0.4 inches. Resolution consists of detectable line structure and proper line count in all four meridians. Total spread in focus shift between meridians shall not be greater than 0.25 diopters as measured at the eyepiece.

3.7.5 Parallelism of reticle and image. The vertical reticle line shall be parallel to the image of a vertical target line and shall not be greater than 30 minutes of arc (8.89 mils) at the position established in paragraph 3.4. This requirement shall also be met with the elbow assembly positioned against the right and left swing stops and at the azimuth settings of 4800 mils, 0000 mils and 1600 mils.

3.7.6 Image tilt. The image of a vertical target line shall be vertical and shall not be greater than one degree of arc (17.78 mils) throughout two (2) revolutions of the head. This requirement shall also be met with the elbow assembly positioned against the right and left swing stops.

3.7.7 Reticle cut-off. All reticle graduations, including the "80" numerals, shall be visible throughout two (2) complete revolutions of the head. This requirement shall be met with the elbow assembly centered and positioned against the right and left swing stops.

3.8 Elevation mechanism.

3.8.1 Excursion range. Rotation of the elevation knob shall cause the line of sight to elevate and depress a minimum of 300 mils in each direction from the position specified in 3.4.

3.8.2 Plumb travel. Starting with the intersection of the panoramic telescope vertical and horizontal reticle lines in coincidence with a vertical target line at zero elevation, the intersection shall track the target line within 1.0 mil total lateral spread throughout the entire excursion when elevated to 300 mils elevation and depressed to 300 mils depression.

3.9 Azimuth mechanism.

3.9.1 800 mil steps. Error at deflection or bearing readings in 800 mil steps throughout two full revolutions of the head in one direction shall not be greater than 1.0 mil without backlash removed. The total spread between the greatest positive error and the greatest negative error shall not be greater than 1.0 mil, without backlash removed. The total error, with backlash removed, between the azimuth counter reading and the deflection or bearing counter reading for any one number shall not be greater than 0.25 mil.

3.9.2 15 mil steps. Rotating the correction knob to indicate 15 mils, followed by rotation of the azimuth knob in the opposite direction with backlash removed, to deflect the line of sight 15 mils, shall cause the deflection or bearing counter to return to within 0.25 mil of the original setting. This requirement shall be met with the 15 mil value set into each direction ("R" and "L") of the correction counter.

3.9.3 Level travel. Starting with the horizontal reticle line of the pantel in coincidence with a horizontal target, the line of sight shall track the target within 1.0 mil (total spread of 2 mils) when the head is rotated through two complete revolutions in azimuth.

3.9.4 Lift. Vertical displacement of the line of sight due to reversing rotation of the head by means of the azimuth knob shall not be greater than 0.5 mil.

3.9.5 Five mil click lead mechanism. With the five mil click lead actuator on the azimuth knob set to “Direct”, a detent action shall be felt and heard when the azimuth knob is rotated to introduce increments of 5.0 mils ± 0.5 mil into the azimuth counter. This input shall also cause a deflection in the line of sight of 5.0 mils ± 0.5 mils. These requirements shall be met at standard ambient temperature and the extreme operating temperatures specified in paragraph 3.3.2.

3.10 Backlash.

3.10.1 Azimuth mechanism. Backlash in the azimuth mechanism shall not be greater than .5 mil as read on the azimuth counter and .75 mil as read on the deflection or bearing counter when checked at 3200 and zero mils.

3.10.2 Elevation mechanism. Backlash in the elevation mechanism shall not be greater than 1.0 mil.

3.11 Counter mechanism.

3.11.1 Rapid boresight retention. With the correction counter indicating zero and subsequent to the azimuth knob being rotated at 140 ± 10 rpm for one full revolution of the head (with backlash removed): the deflection or bearing counter shall follow the azimuth counter within ±0.25 mil, original boresight setting shall remain within ±0.25 mil as read on the azimuth counter, and the correction counter shall remain zero.

3.11.2 Deflection or bearing counter. The deflection or bearing counter shall be settable to any reading from 0 to 6399 within ± 0.25 mil.

3.11.3 Correction counter, excursion range. The correction counter shall have a minimum of 95 mils excursion, but not over 99 mils excursion, for both the “L” and “R” directions.

3.11.4 Correction counter setting affect on deflection or bearing counter. Setting L95 on the correction counter and re-establishing the line of sight on the collimator target reticle within 0.1 mils using the azimuth knob, with the backlash removed, shall increase the deflection or bearing counter reading 95 ± 0.5 mils. Setting R95 on the correction counter and re-establishing the line of sight on the collimator target reticle within 0.1 mils, with the backlash removed, shall decrease the deflection or bearing counter reading 95 ± 0.5 mils.

3.11.5 Correction counter setting. There shall be no change greater than 5 mils in the azimuth counter readings in the applicable direction when the 95 mil values are set into the correction counters. There shall be no change greater than 0.25 mil in the azimuth counter reading when the 95 mil values are set into the correction counter and the line of sight is re-established on the collimator target reticle within 0.1 mils using the azimuth knob, with the backlash removed.

3.12 Open sight. With the telescope positioned as in 3.4, the line of sight of the open sight shall be within 10 mils of the line of sight through the telescope optics in both azimuth and elevation.

3.13 Torque. The running torque required to operate the following knobs shall be within the values specified at the temperatures specified in Table II. The torque values for the azimuth knob shall be met with the five mil click lead actuator set to "Indirect."

TABLE II. Knob torque values.

KNOB	At +60 °F to +90 °F	At -50 °F and +145 °F
Azimuth	3 to 8 in. lbs.	15 in. lbs. max.
Correction Counter	10 to 20 in. ozs.	40 in. ozs. max.
Boresight Adjustment	7 to 80 in. ozs.	10 in. lbs. max.
Elevation	5 to 40 in. ozs.	80 in. ozs. max.
Clutch Release (lever)	7 to 80 in. ozs.	10 in. lbs. max.

3.14 Direct force, elbow assembly. At a standard ambient temperature of +60 °F to +90 °F, a direct force of 1 to 10 pounds, applied horizontally and in the direction of movement adjacent to the eyepiece, shall be required to rotate the elbow assembly in each direction through the full extent of travel with the elbow detent lock pin released. The force required at the extreme operating temperatures of 3.3.2 shall not be greater than 15 pounds.

3.15 Operability. The azimuth counter cover and latch, head cover and latch, azimuth knob folding handle, elbow detent lock pin, and the five mil click lead actuator shall be operable at standard ambient temperature and the extreme operating temperatures specified in paragraph 3.3.2.

3.16 Counter numerals. With the units digit of each counter in coincidence with its respective index line, the remaining numbers shall be in horizontal alignment within one-sixteenth of an inch and more than half of each number must be visible through the shield.

3.17 Illumination.

3.17.1 Reticle. With the battery in place, the reticle markings shall be clearly distinguishable when observed in ambient light conditions, ranging from dusk to darkness.

3.17.2 Counters. The numerals on the azimuth, deflection or bearing and correction counters, when illuminated using the telescope's power and lighting system, shall be clearly distinguishable when observed in ambient light conditions ranging from dusk into darkness with and without the use of a 50% neutral density filter.

3.18 Interchangeability. Telescope interchangeability shall be verified by the insertion, seating and subsequent removal of the maximum interchangeability gage into keyways of the telescope mounting surface without binding.

3.19 Workmanship. The workmanship requirements of MIL-PRF-13830 and MIL-F-13926 shall apply.

4. VERIFICATION

TABLE III. 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 Requirements 1/	Description	Verification Method				Verification Class		Section 4 Verification
		1	2	3	4	A	B	
3.1	First article		X	X	X	X		4.2
3.2	Conformance		X	X	X		X	4.3
3.3.1	Storage temperature				X	X	X	4.19.1.1
3.3.2	Operating temperature				X	X	X	4.19.1.2
3.3.3	Shock				X	X	X	4.19.2
3.3.4	Vibration "A"				X	X		4.19.3
3.3.5	Vibration "B"				X		X	4.19.4
3.4	Orientation				X	X	X	4.4
3.4.1	Collimation change, post vibration			X		X	X	4.5
3.5.1	Optical assembly sealing & purging				X	X	X	4.21.1
3.5.2	Counterbox sealing & purging				X	X	X	4.21.2
3.5.3	Telescope purging				X	X	X	4.21.3
3.6.1	Cleanliness			X		X	X	4.18
3.6.2	Other defects			X		X	X	4.18
3.7.1	Eyepiece focus				X	X	X	4.6.1
3.7.2	Parallax				X	X	X	4.6.2
3.7.3	Reticle accuracy				X	X	X	4.6.3
3.7.4	Resolution				X	X	X	4.6.4
3.7.5	Parallelism of reticle & image				X	X	X	4.6.5
3.7.6	Image tilt				X	X	X	4.6.6
3.7.7	Reticle cutoff			X		X	X	4.6.7
3.8.1	Elevation mechanism excursion range				X	X	X	4.7.1
3.8.2	Elevation mechanism plumb travel				X	X	X	4.7.2

TABLE III. Requirement/verification cross reference matrix. - Continued

Method of Verification 1 - Analysis 2 - Demonstration 3 - Examination 4 - Test						Class of Verification A - First Article B - Conformance		
Section 3 Requirements 1/	Description	Verification Method				Verification Class		Section 4 Verification
		1	2	3	4	A	B	
3.9.1	800 mil steps (azimuth)				X	X	X	4.8.1
3.9.2	15 mil steps (azimuth)				X	X	X	4.8.2
3.9.3	Level travel (azimuth)				X	X	X	4.8.3
3.9.4	Lift (azimuth)				X	X	X	4.8.4
3.9.5	Five mil click lead (azimuth)				X	X	X	4.8.5
3.10.1	Azimuth mechanism backlash				X	X	X	4.9.1
3.10.2	Elevation mechanism backlash				X	X	X	4.9.2
3.11.1	Rapid boresight retention				X	X	X	4.10.1
3.11.2	Deflection or bearing counter				X	X	X	4.10.2
3.11.3	Correction counter excursion				X	X	X	4.10.3
3.11.4	Correction counter affect on deflection or bearing counter				X	X	X	4.10.4
3.11.5	Correction counter setting				X	X	X	4.10.5
3.12	Open sight				X	X	X	4.11
3.13	Torque				X	X	X	4.12
3.14	Direct force, elbow assembly				X	X	X	4.13
3.15	Operability		X			X	X	4.14
3.16	Counter numerals				X	X	X	4.15
3.17.1	Reticle illumination				X	X	X	4.16
3.17.2	Counter illumination				X	X	X	4.17
3.18	Interchangeability				X	X	X	4.20
3.19	Workmanship			X		X	X	4.22
NOTES: 1/ All requirements are classified as major characteristics except 3.19 which is classified as minor. Major and Minor characteristics are as defined in MIL-STD-1916.								

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

a. First article inspection (see 4.2)

b. Conformance inspection (see 4.3)

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

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

4.2.2 First article inspection to be performed. The first article inspection shall be performed in accordance with Table III.

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

4.3 Conformance inspection.

4.3.1 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."

4.3.2 Conformance inspection quantity. Conformance inspection quantities shall be in accordance with MIL-STD-1916, paragraph "Sampling of lots or batches." All major and minor characteristics shall be verification level IV.

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

4.4 Orientation. Test fixture 10558252 shall be used for the inspection of the M137A2 and M137A3 Panoramic Telescopes. Position the test fixture on a vibration free surface in accordance with the set-up instructions on 10558252. Follow the calibration and set-up instructions prior to positioning the telescope to the fixture. Subsequent to completion of all set-up instructions, the telescope shall be able to be oriented on test fixture 10558252 under the conditions specified in paragraph 3.4.

4.5 Collimation change, post vibration. Subsequent to the completion of 4.19.3 Vibration "A" or 4.19.4 Vibration "B", and with the conditions of 3.4 re-established without readjusting boresight or rotating the azimuth knob, the line of sight shall not have deviated from its pre-vibration readings of the azimuth and deflection or bearing counters more than the deflection allowed in 3.4.1.

4.6 Optical characteristics.

4.6.1 Eyepiece focus. A three power dioptometer that has been adjusted to the individual eye shall be used. Individual eye adjustment can be accomplished by sighting through the dioptometer at a white background and adjusting the eyepiece of the dioptometer until the reticle is at the sharpest point obtainable. Sight through the dioptometer and the eyepiece of the telescope. Observe the reticle of the telescope, and

compare it with the reticle of the dioptometer. Adjust the barrel of the dioptometer to make the reticle of the telescope go out of focus; then re-adjust the barrel to bring the telescope reticle into focus at the sharpest point. Read the value on the scale on the barrel of the dioptometer, this number shall not be greater than the limits of 3.7.1. Repeat procedure for horizontal and vertical image individually, the difference between the two shall not be greater than the limits of 3.7.1.

4.6.2 Parallax. With the telescope mounted on the 10558252 test fixture, and the collimator projector set to a range of 80 ± 10 meters, turn the azimuth knob until telescope reticle is coincident with the target reticle. Observe any apparent movement between the telescope and target reticles as the observers head is moved up and down and from side to side within the limits of view imposed by the telescope eyeshield. The apparent motion shall not be greater than the limits of paragraph 3.7.2.

4.6.3 Reticle accuracy. With the telescope oriented as described in paragraph 4.4 adjust the fixture rotary table so that the right 40 mil mark of the telescope is coincident with the target centerline. Read the azimuth counter. Rotate the azimuth knob until the left 40 mil mark is coincident with the target centerline. Reread the azimuth counter. The difference in counter readings is the angular separation between 40 mil graduations and shall be within the limits of paragraph 3.7.3.

4.6.4 Resolution. Place viewing telescope 7680631 in front of the panoramic telescope's eyepiece. The wall target and testing procedures for resolution shall be in accordance with MIL-PRF-13830, paragraph "Resolution test." The telescope shall not be greater than the limits specified in 3.7.4.

4.6.5 Parallelism of reticle and image. When oriented per paragraph 4.4, using collimator reticle 9329535, the azimuth and elevation knobs shall be used to position the intersection of the vertical and horizontal reticle line of the telescope so that it passes through the intersection of the vertical target line and the short horizontal mark on the target reticle (about 20 mils below its center cross). When so positioned, the telescope vertical reticle line shall lie within the 30 minute limit lines of the target reticle to display conformance with paragraph 3.7.5. This test shall also be repeated with the elbow positioned against the right and left swing stops and at azimuth settings of 3200 mils, 4800 mils, 0000 mils and 1600 mils.

4.6.6 Image tilt. The telescope shall be orientated in accordance with 4.4, using collimator reticle 9329535. Use viewing telescope 5549108 and a flat surface to position the viewing telescope at the eyepiece of the telescope under test, adjust the viewing telescope to the height of the telescope eyepiece. Adjust the viewing telescope's position so that the vertical reticle line is in coincidence with the target vertical reticle line at the short horizontal mark (about 20 mils below the center cross). The vertical target line shall be parallel to the vertical line of the viewing telescope within the limits of the 1 degree mark of the target telescope per 3.7.6. This test shall be repeated with the elbow positioned against the right and left swing stops and twice at each of the azimuth settings of 3200 mils,

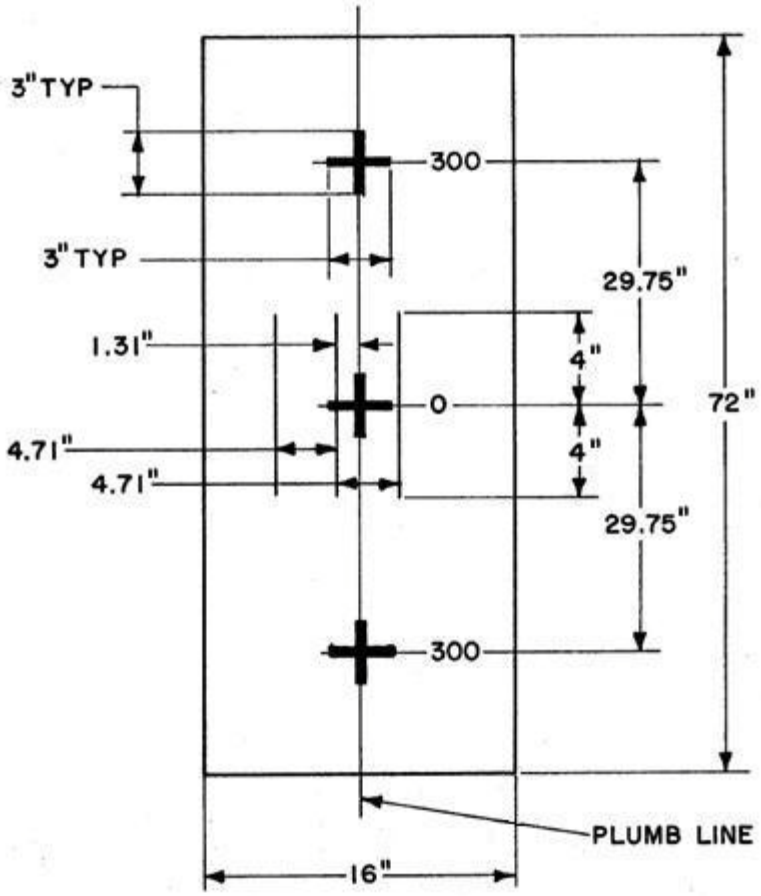
4800 mils, 0000 mils and 1600 mils by performing two full revolutions of the telescope head.

4.6.7 Reticle cut-off. This test shall be performed by viewing through the eyepiece of the telescope while turning the azimuth knob two complete revolutions of the head. The reticle graduations and numerals shall be visible as specified in 3.7.7. This test shall be repeated with the elbow positioned against the right and left swing stops.

4.7 Elevation mechanism.

4.7.1 Elevation mechanism excursion range. With the line of sight established in accordance with 4.4, elevation and depression of the prism in the rotating head by means of the elevation knob shall cause the line of sight to displace the amount specified in 3.8.1 for elevation and depression. This test can be accomplished by using a wall target (see Figure 3) that has an established level line of sight and the excursion limits required.

4.7.2 Elevation mechanism plumb travel. This test can be performed concurrently with 4.7.1. The telescope shall be in a level position with the vertical reticle line brought into coincidence with the vertical target line by rotating the azimuth knob. The horizontal reticle of the telescope shall be in coincidence with the horizontal target line by rotating the elevation knob. Rotate the elevation knob to elevate the line of sight of the telescope 300 mils. Reverse the rotation of the knob to depress the line of sight to 300 mils depression. Reverse the rotation again, returning the line of sight to zero elevation. The vertical reticle line of the telescope must track the target line within the tolerance specified in 3.8.2.



TARGET DISTANCE 8' FROM OBJECTIVE LENS.
0 ELEVATION LINE LEVEL WITH CENTER OF OBJECTIVE LENS.
BLACK LINES ON WHITE BACKGROUND.
TARGET LINE THK - 3/16".

FIGURE 3. Excursion range and plumb travel target.

4.8 Azimuth mechanism.

4.8.1 800 mil steps (azimuth). Position the telescope as specified in 4.4. Rotate the azimuth knob until an additional 800 mils is read on the azimuth counter. Rotate the test fixture 800 mils. Record the difference in movement as read on the target reticle. Repeat readings through two revolutions of the head in one direction. Repeat in the opposite direction without resetting. The error in the readings taken shall not be greater than the tolerance specified in 3.9.1.

4.8.2 15 mil steps (azimuth). Position the telescope as specified in 4.4. Rotate the correction knob to indicate “R-15”. Rotate the azimuth knob, with backlash removed, to deflect the line of sight 15 mils in the opposite direction as read on the collimator target reticle. The deflection counter reading shall return to the original setting within the requirements of 3.9.2. This test shall be repeated with the correction counter indicating “L-15”.

4.8.3 Level travel (azimuth). This test shall be accomplished with the test procedure of 4.8.1. During the azimuth reading for each 800 mil increment, the position of the horizontal reticle line of the telescope shall be observed with respect to the zero elevation line on the target. The telescope reticle shall track the zero elevation line on the target within the tolerance specified in 3.9.3 for two revolutions of the head.

4.8.4 Lift (azimuth). Position the telescope as specified in 4.4. The azimuth knob shall be rotated, first in one direction and then in the opposite direction. Lift is indicated if the line of sight is vertically displaced from the original zero elevation setting upon direction change of the azimuth knob, and it shall not be greater than the tolerance specified in 3.9.4 at any azimuth setting.

4.8.5 Five mil click lead mechanism (azimuth). Set the lead actuator knob to "Direct" and rotate the azimuth knob through one full revolution of the azimuth knob. During rotation, a tactile examination shall be made to feel the detent action required in 5 mil increments. An audible examination shall be simultaneously performed to listen for a distinct click resulting from positive detent seating. At no fewer than five readings throughout the range of operation, the displacement from one increment setting to the next shall represent a 5 mil angular change within the tolerance specified in 3.9.5. All the above examinations shall be performed at standard ambient temperature (+60 °F to +90 °F) and the extreme operating temperatures of 3.3.2 to determine compliance with 3.9.5.

4.9 Backlash.

4.9.1 Azimuth mechanism backlash. The azimuth knob shall first be rotated in one direction to bring the vertical line of the telescope reticle in coincidence with the azimuth zero point on the target. Record the reading of the azimuth counter and deflection or bearing counter. Continue the rotation of the azimuth knob in the same direction, one complete turn, and then reverse the direction of the knob while sighting through the telescope and reposition the vertical reticle line of the telescope in coincidence with the azimuth zero point on the target, without overtravel. Take readings from the azimuth counter and the deflection or bearing counter then compare them with the original set of readings; this difference is the amount of backlash in the azimuth mechanism. The backlash shall not be greater than the tolerances specified in 3.10.1 when checked at 3200 and zero mils.

4.9.2 Elevation mechanism backlash. The test for backlash in the elevation mechanism may be accomplished concurrently with the tests indicated in 4.7.1 and 4.7.2. Position the telescope as specified in 4.4. The horizontal reticle line of the telescope shall be brought into coincidence with the horizontal target line, at zero elevation without overtravel, when the elevation knob is rotated in a clockwise direction. Scribe a continuous vertical reference line on the head and elevation knob. Rotate the elevation knob clockwise to +300 mils, then reverse direction of the knob and align the reference line on the knob with the reference line on the head without overtravel. Observe, through the telescope, the position of the telescope reticle on the target. The telescope reticle shall be within the

tolerance specified in 3.10.2 of the zero level line on the target. This test shall also be conducted in the counterclockwise direction.

4.10 Counter mechanism.

4.10.1 Rapid boresight retention. Position the telescope as specified in 4.4. Turn the azimuth knob at the speed specified in 3.11.1 until the head has made one revolution. Caution should be taken to avoid overtravel in the line of sight coincidence previously obtained. The boresight setting shall read 3200 mils within the specified limit of 3.11.1 as read on the azimuth counter and the deflection or bearing counter shall follow the azimuth counter within the limit specified in 3.11.1. Backlash shall be removed prior to traversing the azimuth knob for this test. This test shall be repeated in the opposite direction.

4.10.2 Deflection or bearing counter. Position the telescope as specified in 4.4. Rotate the azimuth knob to bring the deflection or bearing counter to zero. Place the deflection counter lever in the "Release" position. Rotate the azimuth knob in the same direction used to bring the deflection or bearing counter to zero to bring the telescope reticle into coincidence with the target reticle. Place the deflection counter lever in the "Engage" position. Rotate the azimuth knob in the opposite direction a minimum of two turns. Reverse direction and realign the telescope reticle with the target reticle without overtravel. The value as read on the deflection or bearing counter shall be within the accuracy specified in 3.11.2. This test shall be repeated at 800, 1600, 2400, 3200, 4000, 4800 and 5600.

4.10.3 Correction counter excursion. The correction counter knob shall be manually rotated until the counter has traveled to its full excursion. The counter shall read between the limits specified in 3.11.3. This test shall be performed in both the "L" and "R" directions.

4.10.4 Correction counter affect on deflection or bearing counter. The panoramic telescope shall be positioned as specified in 4.4. Turn the correction knob to 95 mils, "L" direction. With backlash removed, re-establish the line of sight by placing the telescope reticle into coincidence with the collimator target reticle within the applicable limits specified in paragraph 3.11.4. The deflection or bearing counter reading shall have changed by the applicable amount specified in paragraph 3.11.4. This test shall be repeated in the "R" direction.

4.10.5 Correction counter setting. The panoramic telescope shall be positioned as specified in 4.4. Turn the correction knob to 95 mils, "L" direction. The azimuth counter shall not have changed more than the applicable specified limit in 3.11.5. With backlash removed, re-establish the line of sight by placing the telescope reticle into coincidence with the collimator target reticle within the applicable limits specified in paragraph 3.11.5. The azimuth counter shall not have changed more than the applicable specified limit in 3.11.5. This test shall be repeated in the "R" direction.

4.11 Open sight. The line of sight shall be set at zero elevation. Excursion range and plumb travel target (see Figure 3) shall be positioned approximately 8 feet from the objective head window. The wall target shall be plumbed by a plumb line placed in front of the wall target. Sight the target line through open sight. Record azimuth counter reading. Look through telescope and bring reticle line in coincidence with the centerline of the target. Take reading off azimuth counter; this reading shall be 13.25 mils greater than the original azimuth reading (to compensate for the offset between the open sight and the center of the objective window) plus or minus the tolerance limits specified in 3.12.

4.12 Torque. The running torque required to rotate the knobs and lever specified in 3.13, at standard ambient and extreme operating temperatures, shall be determined with a calibrated torque measuring device. The torque measuring device shall be equipped with the adapters shown in Table IV to fit the respective knobs and lever being tested. The measured torque values shall be within the limits specified in 3.13.

TABLE IV. Knob adapters.

Knob	Adapter
Azimuth	11747952
Correction Counter	11747953
Boresight Adjustment	Screw Driver Tip (std)
Elevation	11747954
Clutch Release (Lever)	11747955

4.13 Direct force, elbow assembly. A standard force measuring device shall be used for this test. Release the elbow detent lock pin and apply the force horizontally and in the direction of movement adjacent to the eyepiece through the full extent of travel. This test shall be performed in each direction. The force required to rotate the elbow assembly in both directions shall not be greater than the values specified in 3.14.

4.14 Operability. The azimuth counter cover and latch, head cover and latch, azimuth knob folding handle, the elbow detent lock pin, and the five mil click lead actuator shall be operable as specified in 3.15 at room temperature and the extreme operating temperatures specified in 3.3.2.

4.15 Counter numerals. A standard measuring scale shall be used to determine numeral (digit) alignment to the respective index line within the linear value specified in 3.9.

4.16 Reticle illumination. The reticle illumination test shall be performed under simulated conditions specified in 3.17.1. Place the instrument in a dark room having a controlled light source. The observer must become dark adapted. Prior to performing the test, place a white matted surface approximately 2 feet from the telescope window with the objective cover open. Perform the test by observing the reticle pattern and determine that this pattern is clearly discernible by means of the internal illumination source. Gradually

raise the level of illumination in the room to where the pattern becomes indiscernible. Close the objective cover and observe that the reticle pattern is again discernible by means of the internal illumination source.

4.17 Counter illumination. Follow 4.16 to acquire proper dark adaptation. Place a 50% neutral density filter in front of the counters. In the darkened area, visually inspect for conformance with the requirements of 3.17.2. Remove the filter and repeat the visual inspection to verify conformance with 3.17.2.

4.18 Cleanliness. Inspection for dirt and foreign particles (classed as dirt) shall be made from the eyepiece end only. The unit under test shall be subjected to the test procedures outlined in MIL-PRF-13830 for conformance to requirements outlined in 3.6.1 and 3.6.2.

4.19 Environmental conditions. Unless otherwise specified, requirements 3.5.1 through 3.19 inclusive may be verified after all environmental test procedures of 4.19 have been completed.

4.19.1 Storage and operating temperatures. The temperature tests of 4.19.1.1 and 4.19.1.2 can be combined into one test procedure and performed as such. All required inspections are to be performed at the specified temperature ranges. The rate of temperature change shall not be greater than 6°F per minute to prevent thermal shock.

4.19.1.1 Storage temperature. The telescope, with fresh batteries installed and stabilized at ambient temperature, shall be placed in a test chamber also stabilized at the same temperature. The temperature shall then be raised to +160°F ± 5°F and allowed to soak for a period of not less than 4 hours. While thermally stabilized, the telescope shall be inspected and will not exhibit any signs of physical damage. Upon meeting this requirement, the telescope will be returned to the ambient temperature environment of +60°F to +90°F and subjected to all the required tests of 3.4 through 3.19. Upon meeting all of the above requirements, the telescope shall be placed in the chamber at -60°F ± 5°F and soaked for a period of not less than 4 hours. While thermally stabilized, the telescope shall be inspected and exhibit no signs of physical damage. Upon meeting this requirement, the telescope shall be returned to the ambient temperature environment of +60°F to +90°F and shall be subjected to all the required tests of 3.4 through 3.19. All requirements shall be met.

4.19.1.2 Operating temperature. The telescope, with fresh batteries installed and stabilized at ambient temperature, shall be placed in a test chamber also stabilized at the same temperature. The temperature shall then be raised to +145°F ± 5°F and the telescope shall be allowed to soak for a period of not less than 4 hours. While thermally stabilized, the telescope shall be subjected to the tests required by 3.13 through 3.15. Upon meeting the operating requirements, the temperature in the chamber will be lowered to -50°F ± 5°F and the telescope will be soaked for a period of not less than 4 hours. While thermally stabilized, the telescope shall be subjected to the tests required by 3.13 through 3.15. All operating requirements shall be met.

4.19.2 Shock. The telescope shall be mounted by the telescope mounting surface and subjected to a shock test in accordance with 3.3.3. Adapter, Vibration and/or Shock, 10549198, may be used for this test. Upon completion of the shock test, the telescope shall be inspected to and meet all the requirements of 3.4 through 3.19.

4.19.3 Vibration "A". The telescope shall be mounted by the telescope mounting surface and subjected to a vibration test in accordance with 3.3.4 of this specification. Adapter, Vibration and/or Shock, 10549198, may be used for this test. Upon completion of the vibration test, the telescope shall be examined and inspected to the requirements of 3.4 through 3.19. All requirements shall be met.

4.19.4 Vibration "B". The telescope shall be mounted by the telescope mounting surface and subjected to a vibration test in accordance with 3.3.5 of this specification. Adapter, Vibration and/or Shock, 10549198, may be used for this test. Upon completion of the vibration test, the telescope shall be examined and inspected to the requirements of 3.4 through 3.19. All requirements shall be met.

4.20 Interchangeability. The maximum interchangeability gage, 11747975, shall be applied to the mounting surface (keyway) of the panoramic telescope to assure maximum fit conditions. The gage shall be firmly seated in the keyway and the bolts seated against their respective stops. Any telescope which does not accept the interchangeability gage, without using force, shall be rejected.

4.21 Sealing and purging.

4.21.1 Optical assembly. Prior to the start of the test, secure the poppet valves in a closed position. Pressurize the telescope with dry nitrogen as specified in paragraph 3.5.1. The accuracy of the test equipment used shall be equal to or be greater than the accuracies depicted on 8565556.

4.21.2 Counterbox assembly. Prior to the start of the test, secure the poppet valve in the closed position. Pressurize the telescope's counterbox assembly with dry nitrogen as specified in paragraph 3.5.2. The accuracy of the test equipment used shall be equal to or be greater than the accuracies depicted on 8565556.

4.21.3 Purging assembled telescope. Connect the test equipment to the purging valves of the telescope. Adjust the dry nitrogen pressure to the pressure specified in 3.5.3. A dew point tester (standard type shop equipment) shall be used to measure the nitrogen dew point for conformance with 3.5.3. Purging is to be performed at standard ambient temperature and prior to performing any temperature test. Disconnect the purging apparatus when the relief valve has reseated to maintain the internal pressure specified in 3.5.3.

4.22 Workmanship. A visual and tactile examination shall be performed to ensure compliance with the workmanship requirements specified in 3.19.

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 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 Panoramic Telescope, M137A2 and M137A3 when mounted on their respective telescope mounts are primarily intended to lay the howitzer in azimuth for indirect fire.

6.2 Acquisition requirements. Procurement data 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.

c. Packaging Data Sheet SPI12984713 or SPI12984775 as applicable (See 6.6).

d. Applicable stock number.

e. Provisions for First Article Testing.

f. Contract data requirements for submission of inspection equipment designs conforming to Data Item Description DI-QCIC-81006. (See 6.3.1)

6.3 Inspection equipment design.

6.3.1 Submission of 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. Unless otherwise specified, data item DI-CMAN-80786 will apply. 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) 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 Hazardous material.

6.5.1 Lithium batteries. The M137A2 and M137A3 utilize Lithium batteries. Prospective Bidders must be cognizant of the need to handle and/or dispose of these batteries in accordance with all Local, State and Federal Laws.

6.6 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.

SPI12984713	-	Packaging of Telescope, Panoramic: M137A2
SPI12984775	-	Packaging of Telescope, Panoramic: M137A3

6.7 Subject term (key word) listing.

Fire Control
Towed Artillery
Howitzer
M119
M777
M198

6.8 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.

Custodian:
Army-AR

Preparing activity:
Army-AR
(Project 1240-2011-001)

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at https://assist.daps.dla.mil.