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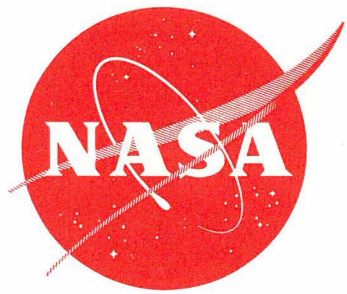

Moffett Field, California

LUNAR PORTABLE MAGNETOMETER

ENVIRONMENTAL TEST SPECIFICATION

D34-105

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1.0 SCOPE

1.1 This specification establishes the Flight Acceptance Testing, Type Approval Testing and Qualification Testing requirements for the Lunar Portable Magnetometer (LPM).

2.0 APPLICABLE DOCUMENTS

2.1 The following documents of the issue noted from a part of this specification to the extent referenced herein. In those cases where the document listed is not dated, the latest issue in effect shall be used.

	Document	Title	Date
2.1.1	D34-101	Lunar Portable Magnetometer Technical Specification	2/6/70
2.1.2	D34-102	Lunar Portable Magnetometer Reliability and Quality Assurance Plan	2/17/70
2.1.3	D34-103	Lunar Portable Magnetometer Fabrication and Inspection Procedure and Record	2/24/70

3.0 TEST PLAN

3.1 GENERAL PHILOSOPHY

The Flight Acceptance Tests (FAT) and Type Approval Tests (TAT) shall consist of identical types of environmental tests in generally the same sequence. The TAT shall, in most cases, be more severe than the FAT. The Flight Unit Lunar Portable Magnetometer shall pass the

Flight Acceptance Tests enumerated in this specification. Failure of the Flight Unit LPM to pass any one of the tests of the FAT shall necessitate, after remedy of the difficulty, resequencing of the testing completely. The Qualification model shall pass Qualification Tests defined as FAT followed by TAT and concluded by an optional FAT. Failure of the qualification model to pass any of the tests enumerated for the FAT shall require complete resequencing of FAT after failure correction. Failure of the Qualification model to pass any of the tests indicated for the TAT shall necessitate complete resequencing of all TAT and may, at the descretion of the LPM Experiment Manager, be required to completely recycle the entire series of Qualification tests. Any modification of the test sequence enumerated herein shall be at the descretion of the Material Review Board as specified in D34-102.

3.2 TEST SEQUENCE

TAT shall consist of the following tests in the sequence enumerated below:

a. Calibration
b. Acoustics Test
c. Functional Test
d. Shock (Non-Operating)
e. Functional Test
f. Launch and Boost Phase Random Vibration (Non-Operating)
g. Functional Test
h. Launch and Boost Phase Sinusoidal Vibration (Non-Operating)
i. Functional Test

j. Thermal Vacuum (Operating)
k. Functional Test
l. Lunar Descent Phase Sinusoidal Vibration
m. Lunar Descent Phase Random Vibration
n. Functional Test
o. Recalibration

The sequence of tests for FAT shall be identical to that for TAT except item b need not be performed.

4.0 FLIGHT ACCEPTANCE TEST DESCRIPTION

Figure 1 shows the LPM mounted on its pallet. The following tests in the sequence shown shall be performed for the Flight Acceptance Test for the Lunar Portable Magnetometer.

4.1 CALIBRATION

Prior to calibration the following tests shall be performed.

a. The unit shall be weighed.
b. The unit shall be given a dimensional check.
c. The unit's center of gravity shall be determined.
d. The tripod shall be exposed to a 5 gauss field and checked to see if residual magnetic fields are present.
e. The unit shall be checked to determine if making connections through the electronics and data display box test connector affects the instrument's performance. If no interference is noted, data readout for the tests to be enumerated below shall be by means of the instrument's taut-band meters as well as DVM output connected to the test connector. Photographs of the taut-band meters shall be taken for each measurement.

	CDR ACTIVITIES		LMP ACTIVITIES
0+30	OPEN SRC	0+30	RECHECK STABILITY & MOBILITY
	STOW SRC EQUIPMENT ON MET- -SESC -2 WEIGH BAGS -35-BAG DISPENSER -3 CORE TUBES -CORE TUBE CAP ASSEMBLY		ASSIST CDR READ & CHECK MET - GNOMON -PENETROMETER -TONGS -EXTENSION HANDLE -2 CORE CAP ASSEMBLIES -SCRIBE/LENS/BRUSH -HAMMER -SCOOP (SMALL) -16MM CAMERA -TRENCHING TOOL -5 CORE TUBES -2 35-BAG DISPENSERS -2 SESC'S -4 WEIGH BAGS -2 16MM MAGS -STEREO CAMERA -70MM CAM + 1 MAG -STEREO CAM MAG -CLOSE-UP CAMERA
	CHECK EQUIP SECURE ON MET		
	POSITION TV TO VIEW QUAD II, IF PRACTICAL		
			PULL MET TO QUAD II
0+40	MOVE TO QUAD II	0+40	OFFLOAD LUNAR PORTABLE MAGNETOMETER (LPM) FROM LM
	OFFLOAD MAG TRIPOD FROM LM		
	RECEIVE MAG SENSOR FROM LMP, MOUNT ON TRIPOD		STOW ELECT/CABLE REEL ON MET, HAND SENSOR TO CDR
	STOW TRIPOD/SENSOR ON MET		
	GEOLOGY TRAVERSE		GEOLOGY TRAVERSE
	POSITION TV TO VIEW PROPOSED DIRECTION OF TRAVERSE-CONFIRM WITH MCC-H		CONFIRM PROPOSED TRAVERSE WITH MCC-H
	MOUNT STEREO CAM ON RCU (OPTIONAL)		MOUNT 70MM CAM ON RCU (OPTIONAL)
			TETHER TONGS (OPTIONAL) START 16MM CAM (OPT) -1 FPS, 1/500, f/___
	START TRAVERSE - CARRY GNOMON (OPTIONAL)		START TRAVERSE - PULL MET
0+50		0+50	

4. 1. 1 LINEARITY CHECK (AMBIENT CONDITIONS)

The sensor head mounted on the tripod shall be placed at the center of a Helmholtz coil system. The cable shall be deployed so as to separate the electronics and data display box from the sensor by a distance of 50 feet. All three axes of the sensor shall be exposed to magnetic fields of from -100 gamma to +100 gamma in 10 gamma increments with the meter range control in the 'High' position. The sensor shall be rotated so as to obtain complete polarity reversal. With the sensor at reverse polarity positions, external fields as enumerated above shall be applied so as to obtain offset measurements. The tests enumerated above shall be repeated over the range of -50 gamma to +50 gamma increments with the meter range control in the 'Low" position.

4. 1. 2 LINEARITY CHECK (THERMAL CONDITIONS)

The sensor head without tripod shall be placed in a temperature chamber in the middle of a Helmholtz coil system. The cable reel shall be deployed and the electronics and data display box shall be kept in a temperature chamber external to the Helmholtz coil system. All three axes of the sensor shall be exposed to magnetic fields of from -100 gamma to +100 gamma in 10 gamma increments with the meter range control in the 'High' position. The sensor shall be rotated so as to obtain complete polarity reversal. With the sensor at reverse polarity positions external fields as enumerated above shall be performed with the electronics box and the sensor held at 0°C and 50°C. The tests enumerated above shall be repeated over the range of -50 gamma to +50 gamma in 10 gamma increments with the

meter range control in the 'Low' position.

4.1.3 FREQUENCY RESPONSE

Instrument frequency response shall be performed as follows:

a. The instrument shall be exposed to a sinusoidally varying magnetic field of 25 gamma peak-to-peak at the following frequencies:

0.005 Hz, 0.008 Hz,
0.01 Hz, 0.02 Hz,
0.05 Hz, 0.1 Hz, 0.2 Hz,
0.5 Hz, and 1 Hz.

b. The instrument shall be exposed to a sinusoidally varying magnetic field of 75 gamma peak-to-peak at the same frequencies enumerated above.

c. The instrument shall be exposed to a 75 gamma step signal and the output from the test connector recorded on a strip chart recorder to determine the instrument's time constant.

d. The magnetic field frequency shall be adjusted until the instrument's 3 db point is located.

4.1.4 ANGULAR RESOLUTION

The alignment of all three sensors with respect to one another and with respect to the tripod shall be measured. The tripod alignment capabilities shall be determined. D34-101 requires a 3° alignment accuracy.

4.1.5 'PERM' CHARACTERISTICS

The sensor and tripod shall be exposed to a 25 gauss field

while in the non-operating condition. Changes in offset shall be noted.

4.1.6 'LATCH UP' DETERMINATION

All sensor axes shall be exposed to a one gauss field while operating. The capability of the unit to return to zero with the removal of this field shall be determined. The unit should return to zero within seven time constants as determined by 4.1.3 c.

4.2 FUNCTIONAL TEST

The functional test shall be performed with the sensor in a fluxtank at ambient temperature and pressure conditions. The electronics and data display box shall be separated from the sensors by the deployed cable reel. All three axes of the sensor shall be exposed to magnetic fields of from -100 gamma to +100 gamma in increments of 20 gamma with the meter range control set at the 'High' position. In addition when the magnetic field is in the range -50 gamma to +50 gamma the meter range control shall be set at the 'Low' position and readings taken. The sensor shall be rotated so as to obtain complete polarity reversal. With the sensor at reverse polarity positions, external fields as enumerated above shall be applied so as to obtain offset measurements. Paragraph 4.1.3 d shall be repeated to determine frequency response.

4.3 SHOCK (NON-OPERATING)

For the Shock Test the instrument shall be on its mounting pallet and while not operating shall be exposed to the following shock conditions.

Axis	Level	Pulse Shape
X	+5.0 g	20m sec linear rise
Y	±5.0 g	100m sec hold
Z	±5.0 g	40m sec linear fall (Ramp Step)

4.4 FUNCTIONAL TEST

Repeat Paragraph 4.2.

4.5 LAUNCH AND BOOST PHASE RANDOM VIBRATION (NON-OPERATING)

For the launch and boost phase random vibration test the instrument shall be mounted on its pallet and, with the instrument in the non-operating condition, the pallet shall be vibrated according to the following:

Axis	Frequency Range (Hz)	Level 2.5 min/axis
X	20-34	0.004 g^2/Hz
	34-200	+6 db/oct
	200-230	0.16 g^2/Hz
	230-350	-12 db/oct
	350-700	0.03 g^2/Hz
	700-2000	-6 db/oct
Y-Z	20-100	0.004 g^2/Hz
	100-160	+3 db/oct
	160-600	0.006 g^2/Hz
	600-800	+9 db/oct
	800-1500	0.016 g^2/Hz
	1500-2000	-6 db/oct

4.6 FUNCTIONAL TEST

Repeat Paragraph 4.2.

4.7 LAUNCH AND BOOST PHASE SINUSOIDAL VIBRATION (NON-OPERATING)

For the Launch and Boost Phase Sinusoidal Vibration the instrument shall be mounted on its pallet and, with the instrument in the non-operating condition, be vibrated according to the following:

Axis	Frequency Range Hz	Level 3 oct/min
X	5-16	0.16" DA
	16-100	2.1 g
Y-Z	5-10	0.16" DA
	10-100	0.77 g

4.8 FUNCTIONAL TEST

Repeat Paragraph 4.2.

4.9 THERMAL VACUUM (OPERATING)

Repeat Paragraph 4.2 except place electronics and data display box in thermal vacuum chamber. Perform all tests at 1×10^{-6} torr. over the following temperature ranges: -10°C, +20°C, +35°C and +50°C.

4.10 FUNCTIONAL TEST

Repeat Paragraph 4.2.

4.11 LUNAR DESCENT PHASE SINUSOIDAL VIBRATION

For this test the instrument shall be mounted on its pallet

and, while in a non-operating condition, be exposed to the following sinusoidal vibration:

Axis	Frequency Range (Hz)	Level 12.5 min/axis
X, Y, Z	5-30	0.02" DA
	30-100	1.1 g

4.12 LUNAR DESCENT PHASE RANDOM VIBRATION

For this test the instrument shall be mounted on its pallet and, while in a non-operating condition, be exposed to the following random vibrations:

Axis	Frequency Range (Hz)	Level
X, Y, Z	10-20	+12 db/oct
	20-100	.008 g^2/Hz
	100-120	-12 db/oct
	120-2000	.004 g^2/Hz

4.13 FUNCTIONAL TEST

Repeat Paragraph 4.2.

4.14 RECALIBRATION

Repeat Paragraph 4.1.

5.0 TYPE APPROVAL TESTS

The following tests in the sequence shown shall be performed for the Type Approval Test of the LPM. Normally only TAT would be performed on proto-typical hardware, however the LPM for Apollo 14 will consist of two identical

Flight units one of which will be required to pass prototype approval tests. Since the unit which will have to pass TAT will also have to be flight qualified the sequence of tests for this qualification model shall be FAT-TAT-FAT. This sequence is defined as the Qualification Test. Calibration and recalibration steps in the TAT description which follows have been omitted because of the fact that the recalibration step in the FAT preceding TAT and the calibration step in the FAT following TAT serve this purpose.

5.1 FUNCTIONAL TEST

Repeat Paragraph 4.2.

5.2 ACOUSTICS TEST

For the Acoustics Test the instrument shall be on its mounting pallet and, while not operating, be exposed to the following acoustics levels.

Octave Band (Hz)	Level db(+5) for 2 min
9 to 18.8	127
18.8 to 37.5	133
37.5 to 75.0	136
75.0 to 150.0	134
150.0 to 300.0	129
300.0 to 600.0	125
600.0 to 1200.0	120
1200.0 to 2400.0	116
2400.0 to 4800.0	112
4800.0 to 9600.0	107
OVERALL	141

5.3 FUNCTIONAL TEST

Repeat Paragraph 4.2.

5.4 SHOCK (NON-OPERATING)

Repeat Paragraph 4.3 except use the following values:

Level (FAT X1.6)	Pulse Shape
+ 8.0 g	20 m sec linear rise
± 8.0 g	100 m sec hold
± 8.0 g	40 m sec linear fall (Ramp Step)

5.5 FUNCTIONAL TEST

Repeat Paragraph 4.2.

5.6 LAUNCH AND BOOST PHASE RANDOM VIBRATION (NON-OPERATING)

Repeat Paragraph 4.5 except use the following values:

Axis	Frequency Range Hz	Level (FAT X1.3) 2.5 min/axis
X	20- 34	0.005 g^2/Hz
	34- 200	+6 db/oct
	200- 230	0.2 g^2/Hz
	230- 350	-12 db/oct
	350- 700	0.04 g^2/Hz
	700-2000	-6 db/oct
Y-Z	20- 100	0.005 g^2/Hz
	100- 160	+3 db/oct

Axis	Frequency Range Hz	Level (FAT Xl. 3) 2. 5 min/axis
	160- 600	0. 008 g^2/Hz
	600- 800	+9 db/oct
	800-1500	0. 02 g^2/Hz
	1500-2000	-6 db/oct

5. 7 FUNCTIONAL TEST

Repeat Paragraph 4. 2.

5. 8 LAUNCH AND BOOST PHASE SINUSOIDAL VIBRATION (NON-OPERATING)

Repeat Paragraph 4. 7 except use the following values:

Axis	Frequency Range Hz	Level (FAT Xl. 3) 3 oct/min
X	5- 16	0. 2" DA
	16-100	2. 7 g
Y-Z	5- 100	0. 2" DA
	10-100	1. 0 g

5. 9 FUNCTIONAL TEST

Repeat Paragraph 4. 2.

5. 10 THERMAL VACUUM (OPERATING)

Repeat Paragraph 4. 9 except perform for the following temperatures: -30°C, 0°C, +30°C, +60°C. In addition the unit shall be operated at ambient temperature in vacuum previously specified continuously for four hours.

The external magnetic field strength shall be held at +50 gamma. Readings shall be taken at least every 10 minutes during this period of time.

5.11 FUNCTIONAL TEST

Repeat Paragraph 4.2.

5.12 LUNAR DESCENT PHASE SINUSOIDAL VIBRATION

Repeat Paragraph 4.11 except use the following values:

Axis	Frequency Range (Hz)	Level (FAT X1.3)
X, Y, Z	5-30	0.03" DA
	30-100	1.4 g

5.13 LUNAR DESCENT PHASE RANDOM VIBRATION

Repeat Paragraph 4.12 except the following values:

Axis	Frequency Range (Hz)	Level (FAT X1.3)
X, Y, Z	10- 20	+12 db/oct
	20- 100	0.01 g^2/Hz
	100- 120	-12 db/oct
	120-2000	0.005 g^2/Hz

5.14 FUNCTIONAL TEST

Repeat Paragraph 4.2.

5.15 FUNCTIONAL TEST

Repeat Paragraph 4.2.

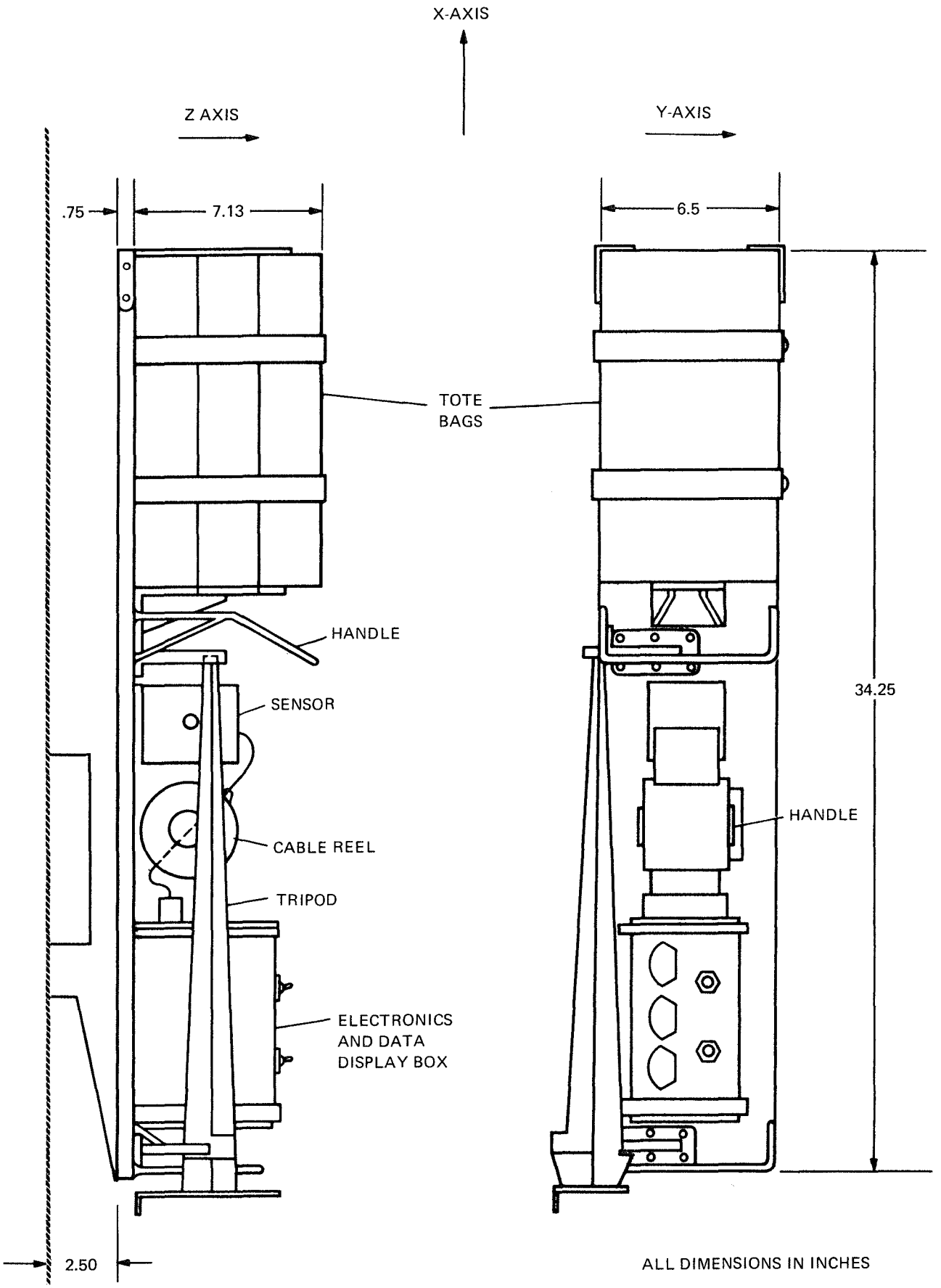

Figure 1. LPM Mounting