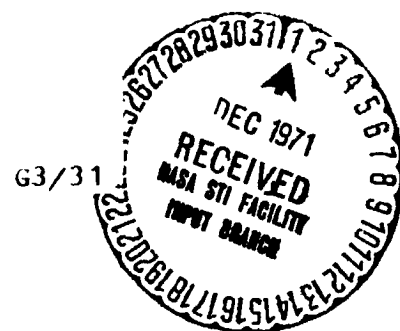


CONTRACT REQUIREMENTS	CONTRACT ITEM	MODEL	CONTRACT NO
Exhibit E, Para. 5.15.2	Function 170	LM	NAS9-1100
Type II		Primary Code 716	
REPORT			
NO <u>LTR 490-213</u>		DATE <u>1 June 1971</u>	
<u>LM-11 ACTUAL WEIGHT REPORT</u>			

N72-12872 (NASA-CR-115224) LM-11 ACTUAL WEIGHT
 REPORT D. Cunnius (Grumman Aerospace
 Corp.) 1 Jun. 1971 44 p CSCL 22B

Unclas
 09156



PREPARED BY: D. Cunnius
 CHECKED BY: B. Catterson
 DEPARTMENT: LM Mass Property Control
 SECTION:

TECHNICAL APPROVAL: F. Hyatt
 APPROVED BY: W. Bischoff
 APPROVED BY: J. D. Marino
 APPROVED BY:

REVISIONS			
DATE	REV. BY	REVISIONS & ADDED PAGES	REMARKS

ii TABLE OF CONTENTS

	<u>Page</u>
Discussion	1
Weight Summary Statement By Stages at Earth Launch	3
Government Furnished Equipment	5
Actual Data Record - LM-11	9
- Ascent Stage Data Sheet	10
- Descent Stage Data Sheet	11
Discussion of Differences Between Actual and Calculated Mass Properties	12
IBM Record LM-11 Ascent Stage Hardware Including Bethpage Installed GFE	13
IBM Record LM-11 Descent Stage Hardware Including Bethpage Installed GFE	14
Derivation of Ascent Stage Flight Hardware Weight Including GFE Installed At Bethpage From Actual Weighing	15
Derivation of Descent Stage Flight Hardware Weight Including GFE Installed at Bethpage From Actual Weighing	29
Vehicle Diagram	35
<u>Figure I</u> A/S C.G./Thrust Vector Offset vs Control Boundary	36
<u>Figure II</u> Descent Stage C.G. Offset vs Control Boundary	37
Derivation of the Dry LM-11 Mass Properties At Earth Launch	38
The Mass Properties of the LM-11 Vehicle at Pertinent Points in the Mission as Obtained from the LM-11 Mass Properties Data Book, LDP-490-11, to be released.	39
List of References	40
External Distribution	41
Internal Distribution	42

DISCUSSION

This report is submitted as partial fulfillment of paragraph 5.15.2 of Exhibit E of Contract No. NAS9-1100 and is written in accordance with ASPO-PS5-13-10, dated August 1965. The actual measurement by stage of LM-11 weight and center of gravity in the Y and Z plane are documented herein.

The stages were weighed separately on the LM Weight and Balance Fixture (LDW 420-13460). The descent stage measurements were made on April 22, 1971, in accordance with OCP-GF-32012-LM-11. The ascent stage measurements were made on May 1, 1971, in accordance with OCP-GF-32001-LM-11. These two documents define the procedure for obtaining the weight and center of gravity check and provide for the official recording of the measurements. Official witnesses of the procedure signed off a copy of the document attesting to the method and the data obtained.

The data sheets on Pages 10 and 11 provide a pictorial and tabulated description of the weighing points for each stage. The load cell readings and the calculations of resultant stage weight and Y and Z center of gravity are also indicated on these pages.

The Government Furnished Equipment section of this report lists that equipment aboard at Earth Launch. The equipment is listed by stages and by site at which the installation in the vehicle is accomplished. It should be noted that there was no KSC installed Government Furnished Equipment on at weighing.

The actual ascent hardware weight is 72.2 pounds under the calculated weight and the actual descent hardware weight is 21.0 pounds under the calculated. These and other mass property differences are derived in this report in accordance with the monthly mass properties report, dated May 1, 1971, and are noted as Manufacturing Variations. The derivation establishes the Earth Launch hardware weight for each stage by removing non-flight and non-hardware items aboard at weighing, and adding flight hardware missing at weighing. These derivations include only the Government Furnished Equipment installed at Bethpage.

DISCUSSION - Cont.

ACTUAL MEASUREMENT SUMMARY TABLE

ITEM	WEIGHT	$\bar{Y}$	$\bar{Z}$
Ascent Stage as Weighed	3632.6	+1.2	+3.9
Non-Flight and Non-Hardware Items	-108.6	5.3	+8.3
Flight Hardware Missing	599.3	-1.6	-10.3
TOTAL ASCENT FLIGHT HARDWARE	4123.3	+0.7	+1.7
Descent Stage as Weighed	3362.6	+2.7	-7.3
Non-Flight and Non-Hardware Items	-74.5	+9.6	-34.2
Flight Hardware Missing	1050.4	+18.1	-45.6
TOTAL DESCENT FLIGHT HARDWARE	4338.5	+6.3	-16.1
TOTAL VEHICLE FLIGHT HARDWARE	8461.8	+3.6	-7.4

LM-11WEIGHT SUMMARY STATEMENT BY STAGES AT EARTH LAUNCH

	<u>Weight</u>
A. Ascent Stage Inert Weight at E. L.	(4707.3)
1.0 Structure	1385.3
2.0 Stabilization and Control	79.2
3.0 Navigation and Guidance	78.1
4.0 Crew Provisions	137.1
5.0 Environmental Control	296.8
7.0 Instrumentation	129.5
8.0 Electrical Power Supply	736.8
9.0 Propulsion	468.8
10.0 Reaction Control	242.3
11.0 Communications	113.9
12.0 Controls and Displays	232.8
13.0 Explosive Devices	28.7
22.0 Manufacturing Variation	-72.2
Hardware-Sub-Total	(3857.1)
14.0 Government Furnished Equipment - Bethpage Installed	266.2
- KSC Installed	408.3
15.0 Liquids and Gases - (Excludes Propellant)	135.7
17.0 Propellants - (Non-Tanked)	(40.0)
Main	14.2
Reaction Control	25.8
 B. Descent Stage Inert Weight at E. L.	 (6176.7)
1.0 Structure	1458.1
2.0 Stabilization and Control	13.3
3.0 Navigation and Guidance	43.5
4.0 Crew Provisions	232.1
5.0 Environmental Control	205.3
6.0 Landing Gear	486.4
7.0 Instrumentation	6.7
8.0 Electrical Power Supply	787.3
9.0 Propulsion	1096.6
11.0 Communication	0.0
12.0 Controls and Displays	3.3
13.0 Explosive Devices	24.6
22.0 Manufacturing Variation	-21.0
Hardware-Sub-Total	(4336.2)
14.0 Government Furnished Equipment - Bethpage Installed	2.3
- KSC Installed	1219.7
15.0 Liquids and Gases - (Excludes Propellant)	542.2
17.0 Propellants - (Non-Tanked)	76.3

LM-11

WEIGHT SUMMARY STATEMENT BY STAGES AT EARTH LAUNCH (Cont.)

	<u>Weight</u>
Total Inert Weight at Earth Launch	10884.0
APS-Propellant-Tanked	<u>5229.7</u>
-Trapped and residual	31.0
-Outage	11.9
-Required ¹ for ΔV	4991.3
-3 σ Dispersions	68.4
-Engine Malfunctions	21.3
-Performance Allowance	
-Contingencies ²	50.3
-Abort	-
-.99999 Probability	27.8
-Margin	27.7
RCS-Propellant-Tanked	<u>605.4</u>
-Trapped and Residual	12.2
-Required for ΔV	22.4
-Required for attitude	256.5
-Checkout	10.0
-Dispersions	83.7
-Margin	220.6
DPS-Propellant-Tanked	<u>19506.9</u>
-Trapped and Residual	56.1
-Outage	37.0
-Required ¹ for ΔV	18829.3
-3 σ Dispersion	327.6
-Malfunction Allowance	48.9
-Abort Reserve	194.4
-Margin	13.6
Total Weight at Earth Launch	36226.0

1. Includes Start/Stop Losses (6.7 lbs. APS, 5.4 lbs. DPS).
2. Includes PGCS/AGS Switchover with Balanced Couples on.

TABLE IGOVERNMENT FURNISHED EQUIPMENT*

	<u>Weight</u>
I. <u>Ascent Stage Items at Earth Launch</u>	<u>674.5</u>
A. Bethpage Installed Items	(266.2)
Inertial Measurement Unit	41.0
Alignment Optical Telescope, Heater Cover, Bellow Assembly, Radiation Shield and Filter Assembly	24.3
LM Guidance Computer	58.9
LGC Ropes	12.0
LGC Kit	0.4
Coupler and Data Unit	37.9
Power and Servo Assembly	17.8
Signal Conditioner Assembly	5.6
Display and Keyboard and Glass Cover	18.4
Navigational Base	5.3
Harness "A" Cabling	15.8
Harness "B" Cabling	4.4
Computer Control and Reticle Dimmer Assembly	1.6
Pulse Torque Assembly	14.5
ORDEAL	6.9
Signal Conditioner Installation Kit	0.1
Vehicle PGA Connector Mounting Plate	0.5
Vehicle Waste Connector	0.2
Vehicle Water Recharge Connector	0.1
Vehicle Oxygen Recharge Connector	0.1
Shear and Bearing Plate	0.2
PLSS Condensate Container	0.2
B. KSC Installed Items	(408.3)
Docking Drogue	21.4
EV Gloves - 2 pair	5.4
Straps - Helmet Tie	0.2
Lunar Over Shoes - 2 pair	9.0
EMU Maintenance Kit	0.5
PLSS-Cabin Floor	89.2
PLSS-Recharge Station	89.1
PLSS Control Box (2)	10.2
PLSS LiOH Cartridge	4.9
Geological Equipment Harness	3.0
Food	7.3
Pilots Preference Kit (2)	2.7

*Compiled from MSC Apollo Stowage List, see Reference 8

TABLE I

GOVERNMENT FURNISHED EQUIPMENT (Cont'd)

	<u>Weight</u>
B. KSC Installed Items (Cont'd)	
Checklist Cuff (2)	0.6
Sample Scale	0.5
Jettisoned Bag (3)	2.7
60 MM Lens, Lunar Surface Hasselblad	1.7
ICG Assembly (2)	8.8
Lens - Brush	0.1
Standard Flag Kit	0.8
	1222.0
II. <u>Descent Stage Items on at Earth Launch</u>	
A Bethpage Installed Items	(2.3)
T. V. Camera Bulkhead Receptacle	0.2
T. V. Camera Mount	2.1
B. KSC Installed Items	(1219.7)
Communications Relay System	93.7
PLSS Batteries (4)	38.0
PLSS LiOH Cartridge (4)	27.6
T. V. Color Camera	11.3
T. V. Cable (100 ft.)	2.4
Pallet Assembly No. 1 (ALSEP)	140.5
Pallet Assembly No. 2 (ALSEP)	76.4
RTG Fuel Cask	54.4
Sample Return Container No. 1	26.0
Sample Return Container No. 2	23.8
Sample Return Container No. 3	22.8
Trenching Tool	2.9
Cosmic Ray Detector	20.0
Extension Handle	1.8
Tongs (2)	2.0
Dust Brush	1.3
Food	8.0
Flag Kit, Lunar Surface	2.5
Lunar Rover Vehicle	507.3
Hand Tool Carrier	17.4
Collection Bags (3)	3.6
Safety Line	1.3
Bag, Safety Lines	0.1
Magnetometer	10.4
Penetrometer	5.8

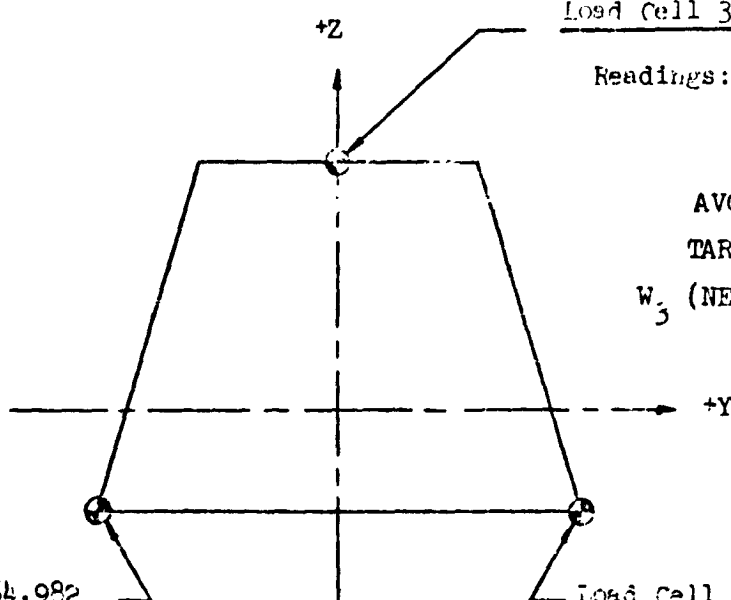
TABLE IGOVERNMENT FURNISHED EQUIPMENT (Cont'd)

	<u>Weight</u>
B. KSC Installed Items (Cont'd)	
T. V. Control Unit	11.5
LCRU - CTV Cable	1.4
T. V. Lens Filter	0.3
Gnomon	0.6
Heat Flow Drill	26.5
ASE Cable Anchor	0.5
16 MM Lunar Surface Camera	8.9
Lunar Surface Elect. Hasselblad Camera	3.6
60 MM Lens	1.7
Polarizing Filter	0.2
Reseau Protective Cover	0.2
Trigger and Handle	0.7
Bracket - Camera Mount	0.6
16 MM Camera Staff	1.5
Lens Brush (2)	0.2
FAR UV Camera/Spectroscope	58.0
Magazine - FAR UV Camera/Spectroscope	2.0

DATA SHEETS

The following two pages show the data obtained from the Ascent Stage and Descent Stage OCP's and the calculation of the total stage weight and center of gravity. The original data is on the Grumman Q.C. hard copy in the Q.C. permanent files.

LM-11 A/E - DATE: NET



Load Cell 3 y = +0.061
z = +65.982

Readings:

1.	1408.1
2.	1408.2
3.	1408.4
AVG.	1408.2
TARE	-204.4
W ₃ (NET)	1203.8

Load Cell 1 y = -64.982
z = -26.886

Readings:

1.	1291.8
2.	1292.0
3.	1292.1
AVG.	1292.0
TARE	-111.3
W ₁ (NET)	1180.7

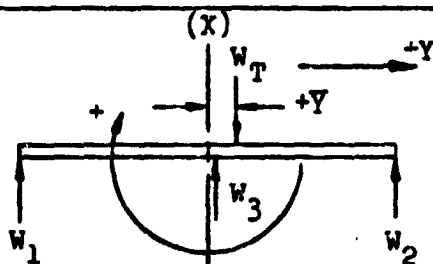
Load Cell 2 y = +64.991
z = -26.919

Readings:

1.	1359.0
2.	1359.1
3.	1359.1
AVG.	1359.1
TARE	-111.0
W ₂ (NET)	1248.1

SUMMARY

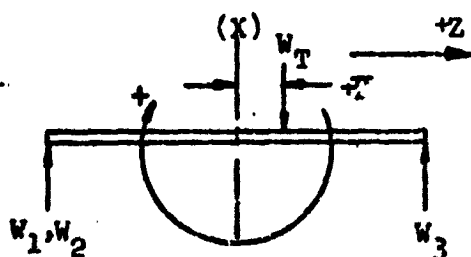
W ₁	1180.7
W ₂	1248.1
W ₃	1203.8
W _T (A/S)	3632.6



$$Y = \frac{W_3 (0.061) + W_2 (64.991) - W_1 (64.982)}{W_T}$$

$$Y = \frac{1203.8 (0.061) + 1248.1 (64.991) - 1180.7 (64.982)}{3632.6}$$

$$Y = +1.2$$



$$Z = \frac{W_3 (65.982) - W_1 (26.886) - W_2 (26.919)}{W_T}$$

$$Z = \frac{1203.8 (65.982) - 1180.7 (26.886) - 1248.1 (26.919)}{3632.6}$$

$$Z = +3.9$$

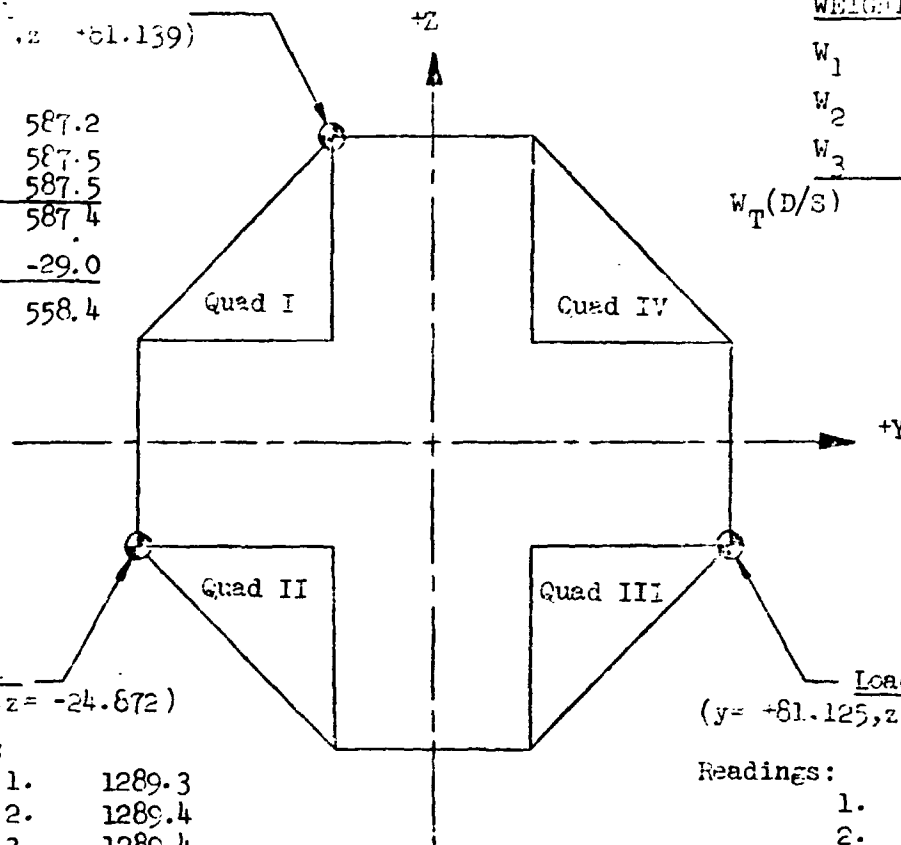
REPRODUCIBILITY OF THE ORIGINAL PAGE IS POOR.

11

11-11 (1/2) - Data Sheet

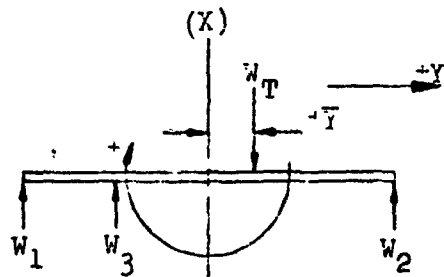
Load Cell 1
(y = -81.139, z = -24.872)
Readings:
1. 587.2
2. 587.5
3. 587.5
AVG. 587.4
TARE -29.0
W₃ (Net) 558.4

WEIGHT SUMMARY
W₁ 1259.7
W₂ 1544.5
W₃ 558.4
W_T (D/S) 3362.6



Load Cell 1
(y = -81.151, z = -24.872)
Readings:
1. 1289.3
2. 1289.4
3. 1289.4
AVG. 1289.4
TARE -29.7
W₁ (Net) 1259.7

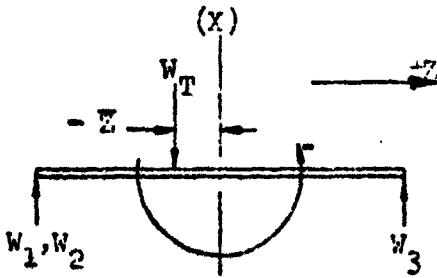
Load Cell 2
(y = +81.125, z = -25.003)
Readings:
1. 1573.3
2. 1573.3
3. 1573.4
AVG. 1573.3
TARE -28.8
W₂ (Net) 1544.5



$$\bar{Y} = \frac{W_2 (81.125) - W_1 (81.151) - W_3 (24.875)}{W_T}$$

$$\bar{Y} = \frac{1544.5(81.125) - 1259.7(81.151) - 558.4(24.875)}{3362.6}$$

$$\bar{Y} = +2.7$$



$$\bar{Z} = \frac{W_3 (81.139) - W_1 (24.872) - W_2 (25.003)}{W_T}$$

$$\bar{Z} = \frac{558.4(81.139) - 1259.7(24.872) - 1544.5(25.003)}{3362.6}$$

$$\bar{Z} = -7.3$$

Discussion of Differences Between
Actual and Calculated Mass Properties

The comparison between actual values and calculated values is made separately for each stage. The comparison condition of each stage is for Earth Launch with the Government Furnished Equipment not installed at Bethpage excluded and without any liquids and gases. The mass properties for this condition are readily derived from the actual measured values as noted on page 15 thru page 34. The calculated mass properties for this condition as taken from the IBM record is stated by subsystem on page 13 and page 14.

The difference between the derived actual values and the calculated mass properties is termed the manufacturing variation. The manufacturing variation is attributed to material tolerances, differences in application techniques, time lag in updating records, possible errors, etc.

The following table summarizes the comparison of the LM-11 mass properties and presents the manufacturing variations by stages.

FLIGHT HARDWARE	WEIGHT (W) (LBS.)	$\bar{Y}$ (INCH.)	$\bar{WY}$ (IN.-LB.)	$\bar{Z}$ (INCH.)	$\bar{WZ}$ (IN.-LB.)
Ascent Stage - Actual	4123.3	+0.7	+ 2945	+ 1.7	+ 7014
Ascent Stage - Calculated	4195.5	+0.6	+ 2563	+ 1.6	+ 6749
A/S Manufacturing Variation	-72.2		+ 382		+ 265
Descent Stage - Actual	4338.5	+6.3	+27432	-16.1	-69996
Descent Stage - Calculated	4359.5	+6.3	+27401	-15.5	-67741
D/S Manufacturing Variation	- 21.0		+ 31		- 2255

Center of Gravity

The Ascent Stage's actual center of gravity is 0.1 inches forward of the calculated location in the Z direction and 0.1 inches outboard of the calculated location in the Y direction. Figure I reflects the relationship of this actual center of gravity and various related flight uncertainties to the single jet failure control boundary. The Descent Stage's actual center of gravity is 0.6 aft of the calculated location in the Z direction and is equivalent to the calculated location in the Y direction. Figure II reflects the relationship of the unstaged vehicles actual center of gravity with various related flight uncertainties to the control boundary. The above calculated stage weights are taken from the May 1, 1971 IBM record.

1 MAY 1971 IEM RECORD IM-11 ASCENT STAGE HARDWARE INCLUDING BETHPAGE INSTALLED GFE

ITEM	WEIGHT	X	WX	Y	WY	Z	WZ
1.0 Structure	1385.3	255.3	353703	- 2.4	-3292	+13.2	+18236
2.0 Stabilization Control	79.2	273.9	21696	+15.5	+1225	-29.2	- 2311
3.0 Navigation and Guidance	78.1	282.7	22081	-14.3	-1114	+17.1	+ 1337
4.0 Crew Provisions	137.1	250.8	34330	- 8.4	-1147	+42.7	+ 5860
5.0 Environmental Control	296.8	266.3	79841	+14.3	+4232	- 0.6	- 192
7.0 Instrumentation	129.5	250.9	32487	-15.9	-2065	-57.8	- 7484
8.0 Electrical Power Supply	735.8	259.3	191057	+ 1.7	+1285	-17.4	-12819
9.0 Propulsion	468.8	233.7	109552	- 4.0	-1863	-14.1	- 6609
10.0 Reaction Control	242.3	264.7	64141	+ 0.1	+ 20	- 3.5	- 858
11.0 Communications	113.9	271.7	30949	+37.6	+4282	-46.1	- 5249
12.0 Controls & Displays	232.8	264.6	61596	+ 5.1	+1178	+60.9	+14181
13.0 Explosive Devices	28.7	230.6	6618	+ 4.3	+ 123	+10.9	+ 312
(CFE Hardware Total)	(3929.3)	256.3	(1007301)	+ 0.7	(+2864)	+ 1.2	(+ 4404)
14.0 Government Furnished Equipment (Bethpage Installed GFE Only)	266.2	273.6	72831	- 1.1	- 301	+ 8.8	+ 2345
Total IEM IM-11 Ascent Stage Hardware (Including Bethpage Installed GFE)	4195.5	257.5	1080132	+0.6	+2563	+ 1.6	+ 6749

1 MAY 1971 IBM RECORD IM-11 DESCENT STAGE HARDWARE INCLUDING BETHPAGE INSTALLED GFE

ITEM	WEIGHT	X	WX	Y	WY	Z	WZ
1.0 Structure	1458.1	159.5	232529	+ 0.2	+ 330	- 3.8	- 5553
2.0 Stabilization and Control	13.3	178.3	2372	+11.6	+ 154	-43.9	- 584
3.0 Navigation and Guidance	43.5	131.6	5723	-17.1	- 2048	-56.5	- 2456
4.0 Crew Provisions	232.1	160.9	37341	+60.9	+14133	+34.7	+ 8055
5.0 Environmental Control	205.3	174.3	35793	+34.4	+ 7071	+ 4.6	+ 954
6.0 Landing Gear	486.4	118.3	57544	0	+ 17	+ 1.5	+ 706
7.0 Instrumentation	6.7	157.1	1053	- 1.0	- 7	+ 3.8	+ 25
8.0 Electrical Power Supply	787.3	172.4	135745	+ 1.6	+ 1274	-78.9	-62134
9.0 Propulsion	1096.6	154.7	169615	+ 5.0	+ 5528	- 6.6	- 7192
11.0 Communications	0.0	--	0	--	0	--	0
12.0 Controls and Displays	3.3	156.4	516	+30.0	+ 99	-71.1	- 235
13.0 Explosive Devices	24.6	176.0	4329	+30.7	+ 754	+19.5	+ 479
(GFE Hardware Total)	(4357.2)	156.7	(682560)	+ 6.3	(+27305)	-15.6	(-67935)
14.0 Government Furnished Equipment (Bethpage Installed GFE Only)	2.3	179.7	413	+42.0	+ 96	+84.3	+ 194
Total IBM IM-11 Descent Stage Hardware (Including Bethpage Installed GFE)	4359.5	156.7	682973	+ 6.3	+27401	-15.5	-67741

TABLE II
DERIVATION OF ASCENT STAGE FLIGHT HARDWARE WEIGHT (INCLUDING GFE INSTALLED AT BETHPAGE) FROM

	ACTUAL WEIGHING						
	WEIGHT	X	WX	Y	WY	Z	WZ
LM-11 ASCENT STAGE AS WEIGHED	3632.6	257.0	933433	+1.2	+4464	+3.9	+14087
NON-FLIGHT ITEMS AND LIQUIDS ON AT WEIGHING	(-108.6)	272.7	(-29610)	+5.3	(-571)	+8.3	(-900)
LMW 420-42301-7 Docking Light Cover (2)	-1.3	269.4	-350	0.0	0	+87.0	-113
LMW 420-42301-7 Docking Light Cover (2)	-1.3	233.0	-303	-12.3	+16	- 8.3	+ 11
LMW 270M10039-11 He Mod. XPL Vlv. Plug (10)	-1.8	252.0	-454	0.0	0	-31.0	+56
GSE Memory Modules	-10.6	266.0	-2820	+10.9	-116	-20.9	+222
LMW 420-51009-7-1 RGA Cold Plate	-0.6	300.1	-180	-7.3	+4	+57.8	-35
AOT Protective Cover (For Prism)	Neg	293.0	-	0.0	0	+57.4	-
LMW 420-13361-3 Nav. Base Gauge	-18.0	320.0	-5760	0.0	0	+55.1	-992
LMW 420-11251-3 DSKY Cover	-0.2	254.0	-51	0.0	0	+58.6	-12
AOT Protective Cover (6014322)	-0.3	293.0	-88	0.0	0	+57.4	-17
LMW 420-11282 CDR. Window Cover - Outer	-1.8	274.0	-493	-24.5	+44	+62.0	-112
LMW 420-11282-6-1 IMP Window Cover - Outer	-1.8	274.0	-493	+24.5	-44	+62.0	-112
LMW 420-11282-7-1 Docking Window Cover - Outer	-1.6	292.0	-467	-22.0	+35	+42.7	-68
LMW 420-2476-1 ASA Cold Plate Support	-2.8	307.0	-860	+4.5	-13	+63.0	-176
LMW 420-83281-1-1 Simulated Battery Studs (2)	-1.3	252.6	-328	0.0	0	-64.6	+84
LMW 420-32002-1 IMP ACA Protective Assembly	-0.2	251.1	-50	-10.1	+2	+57.5	-12
LMW 420-32002-1 CDR ACA Protective Assembly	-0.1	251.1	-25	+34.1	-3	+57.5	-6

TABLE II
DEVIATION OF ASCENT STAGE FLIGHT HARDWARE WEIGHT (INCLUDING GFE INSTALLED AT BETHPAGE) FROM
ACTUAL WEIGHING (Cont.)

ITEM-FLIGHT ITEMS AND LIQUIDS ON AT WEIGHING - Cont.	WEIGHT	X	WX	Y	WY	Z	WZ
LW 430-52232-5-4 GSE Water Boiler Cover W/Gage	-3.3	312.7	-1032	+26.5	-87	-29.8	+98
LW 430-52233-3-4 GSE Water Boiler Cover	-6.0	311.1	-1867	+9.8	-59	-31.0	+186
LSC 420-61059-1 Dessicator - Fuel	-0.9	277.0	-249	-44.6	+40	-28.0	+25
LSC 420-61059-1 Dessicator - OX.	-0.9	277.0	-249	+44.6	-40	-28.0	+25
LW 420-63119-11 RCS Engine Covers (16)	-12.0	254.0	-3048	0.0	0	0.0	0
LW 340-11029-15 Safety Locks (2)	Neg	240.0	0	0.0	0	+60.0	0
LW 340-53264-1 Water Holster Cover	-0.1	237.6	-24	-0.8	0	+21.5	-2
LW 420F80022-1 Cover, Abort Sw. (Pnl.1)	Neg.	277.1	0	-4.0	0	+70.3	0
LW 420F80022-1 Cover, Start Switch (Pnl. 5)	Neg.	254.2	0	-18.7	0	+57.5	0
LW 420F80023-1 Cover, Abort Stage (Pnl. 1)	Neg.	277.1	0	-2.0	0	+70.3	0
LW 420F80023-1 Cover, +X Transl. (Pnl. 5)	Neg.	254.2	0	-18.7	0	+57.5	0
LW 420F80024-1 Cover, Master Alarm (Pnl. 1)	Neg.	277.1	0	-12.0	0	+70.3	0
LW 420F80024-1 Cover, Master Alarm (Pnl. 2)	Neg.	277.5	0	+8.2	0	+69.8	0
LW 420F80025-1 Cover, Stop Switch (Pnl. 6)	Neg.	252.6	0	+23.9	0	+58.3	0

TABLE II

DERIVATION OF ASCENT STAGE FLIGHT HARDWARE WEIGHT (INCLUDING GFE INSTALLED AT BETHPAGE) FROM
ACTUAL WEIGHING (Cont.)

NON-FLIGHT ITEMS AND LIQUIDS ON AT WEIGHING - Cont.	WEIGHT	X	WX	Y	WY	Z	WZ
LDW 420F80026-1 Cover, Stop Switch (Pnl. 5)	Neg.	254.2	0	-18.7	0	+57.5	0
LDW 420F80034-1 Cover, Stop Switch (Pnl. 5)	Neg.	254.2	0	-18.7	0	+57.5	0
LDW 420F80035-1 Cover, Stop Switch (Pnl. 6)	Neg.	252.6	0	+23.9	0	+58.3	0
Blanket Pressure In Main Tanks	-5.0	228.0	-1140	-13.3	+66	0.0	0
Primary Coolant On At Weighing	-24.6	251.7	-6191	+10.2	-251	-3.3	+81
Red Tags - Cabin (37)	-0.4	254.0	-102	0.0	0	+60.0	-24
- Mid-Section (12)	-0.1	250.0	-25	+17.0	-2	+16.0	-2
- Exterior (46)	-0.5	254.0	-127	0.0	0	0.0	0
LDW 430-54391-3 Steam Duct Cover	-0.2	288.0	-58	+33.0	-7	-42.0	+8
LDW 420-61049-5 RCS Dessicator (4)	-1.4	279.6	-391	0.0	0	0.0	0
Misc. Temporary Installations (incls. Dust Caps, Plastic Bags, Tape, etc.)	-0.2	257.0	-51	0.0	0	0.0	0
LSW 815-10042-1 Accelerometer (6)	-3.7	282.0	-1043	+7.2	-27	-5.0	+18
LDW 430-54727-2 Glycol Lines (2)	-1.6	210.4	-337	+57.2	-92	-28.7	+46
LDW 430-54727-4 O ₂ Line (1)	-1.0	210.4	-210	+57.2	-57	-28.7	+29
LDW 430-54727-4 O ₂ Line (1)	-1.0	218.7	-219	-33.7	+34	+68.0	-68
GSE Plug for ISC 310-302 Vlv. (4)	-0.9	285.0	-256	0.0	0	0.0	0

TABLE II
DERIVATION OF ASCENT STAGE FLIGHT HARDWARE WEIGHT (INCLUDING GFE INSTALLED AT BETHPAGE) FROM
ACTUAL WEIGHING (Cont.)

NON-FLIGHT ITEMS AND LIQUIDS ON AT WEIGHING - Cont.	WEIGHT	X	WX	Y	WY	Z	WZ
Plastic Cover, Dust Caps, and Tape (IM/SLA Umbilical)	-0.3	202.7	- 61	+57.0	-17	-27.0	+ 8
Protective Pads on Handrail	-0.5	260.0	-130	-17.3	+9	+75.4	-38
Dust Caps (O ₂ Umbilical)	-0.3	260.0	-78	+20.0	-6	+25.0	-8

TABLE II

DERIVATION OF ASCENT STAGE FLIGHT HARDWARE WEIGHT (INCLUDING GFE INSTALLED AT BETHPAGE) FROM

ACTUAL WEIGHING (Cont.)

FLIGHT ITEMS MISSING AT WEIGHING	WEIGHT (599.3)	X 263.2	WX (157717)	Y -1.6	WY (-948)	Z -10.3	WZ (-6173)
1.0 Shielding							
LDW 280-54945-8-2 Shield	0.3	285.6	86	+48.6	+15	0	0
LDW 280-54852-7 Shield	0.9	292.6	263	-39.0	-35	-32.2	-29
LDW 280-54945-7-2 Shield	0.3	285.6	86	-48.6	-15	0	0
LDW 280-60102-17 Tunnel Insul.	4.9	302.5	1482	0	0	0	0
LDW 280-60102-19 Umbilical Support	0.5	303.0	152	0	0	0	0
LDW 280-54174-5 Shield - IMU Beam	4.1	312.5	1281	0	0	+51.0	+209
LDW 280-59173-31-1 Insul. - Fwd. Hatch	0.9	234.0	211	0	0	+67.1	+60
LDW 280-59173-39 Latch Cover - Fwd.	0.2	240.2	48	+13.0	+3	+67.1	+13
LDW 280-59173-33-1 Dump Vlv. Cover	0.1	234.0	23	-14.0	-1	+67.1	+7
LDW 280-28175-13 Shield - Fwd. Hatch	2.7	234.0	632	0	0	+66.6	+180
LDW 280-59282 Shield Upr. Hatch	1.0	298.0	298	0	0	-1.0	-1
LDW 280-59984 Insul. Upr. Hatch	0.7	298.0	209	+0.1	—	-1.0	-1
1.0 Structure							
LDW 280-23068-11 Hatch Inst'l. - Upr..	10.9	294.1	3206	0.0	0	+1.8	+20
LDW 280-59282 Shield Support - Upr.	2.2	298.0	656	0.0	0	-1.0	-2
LDW 280-54093-7-1 Hatch Inst'l. - Fwd.	13.0	231.1	3004	-2.9	-38	+64.2	+835
LDW 280-28175-13 Handgrip - Fwd.	0.4	226.8	91	+3.5	+1	+66.0	+26
LDW 280-54060-13 Floor Inst'l. - Cabin	23.6	213.7	5043	+0.1	+2	+45.3	+1069

TABLE II
DERIVATION OF ASCENT STAGE FLIGHT HARDWARE WEIGHT (INCLUDING GFE INSTALLED AT BETHPAGE) FROM
ACTUAL WEIGHING (Cont.)

	<u>WEIGHT</u>	<u>X</u>	<u>WX</u>	<u>Y</u>	<u>WY</u>	<u>Z</u>	<u>WZ</u>
1.0 Structure - Cont.							
LJW 340-54275 Window Shade - Dkg.	0.4	292.0	117	-22.0	-9	+42.0	+17
LJW 340-54276-1-3 Window Shade - R. H.	0.6	274.0	164	+24.5	+15	+62.0	+37
LJW 340-54276-2-3 Window Shade - L. H.	0.6	274.0	164	-24.5	-15	+62.0	+37
LJW 340-52211 Glareshield - R. H.	0.2	263.0	53	+15.0	+3	+65.2	+13
LJW 340-52211 Glareshield - L. H.	0.2	263.0	53	-15.0	-3	+65.2	+13
LJW 340-21374-3-7 Support - Seq. Camr.	0.3	286.0	86	+20.0	+6	+68.0	+20
LJW 340-58464-3-1 Container - Buddy Umbl.	3.8	221.8	843	-1.0	-4	+29.5	+112
2.0 Stabilization and Control							
LSC 300-110-9-7 Rate Gyro Ass'y	2.0	300.1	600	-7.3	-15	+57.8	+116
LSC 300-370-5-10 Abort Sensor Ass'y	20.5	307.0	6294	0	0	+62.8	+1287
3.0 Guidance and Navigation							
LSC 370-200-5-16 R. R. Antenna Ass'y	43.0	310.8	13364	0	0	+83.5	+3590
LSC 370-100-7-16 R. R. Electronic Ass'y	34.8	247.8	8623	-32.0	-1114	-65.5	-2279

TABLE II

DERIVATION OF ASCENT STAGE FLIGHT HARDWARE WEIGHT (INCLUDING GFE INSTALLED AT BETHPAGE) FROM
ACTUAL WEIGHING (Cont.)

	WEIGHT	X	WX	Y	WY	Z	WZ
4.0 Crew Provisions							
LHW 340-57303-1-3 Interim Storage Contr.	6.4	270.3	1730	0.0	0	+52.8	+338
LHW 340-57303-39 Contr. Tie Down Webbing	0.4	238.0	95	+38.0	+15	+39.2	+16
LHW 340-56013 OPS Pallet Inst'l.	5.1	261.6	1334	-25.6	-131	-6.0	-31
LHW 340-56272-1-2 Hammock Ass'y.	3.9	228.0	889	-40.2	-157	+45.2	+168
LHW 340-56272-3-1 Hammock Ass'y.	3.8	228.0	866	-40.2	-153	+43.2	+164
LHW 340-55013 Hammock Mod - LCD 5412	0.3	228.0	68	-40.2	-12	+43.2	+13
LHW 340-60636-1 Equip. Transfer Bag	1.2	221.8	266	-1.0	-1	+29.5	+35
LSC 340-201-529 Urine Bags, Small (2)	0.6	235.5	141	-37.6	-23	+46.6	+28
60-C074-001 Emesis Bag (6)	1.2	235.5	283	-37.6	-45	+46.6	+56
LSC 340-1000-19-1 Urine Receptacle	0.6	242.5	145	-35.6	-21	+38.6	+23
LHW 340-53053-3-7 Utility Lights (2)	2.3	284.0	653	-16.0	-37	+16.1	+37
LHW 340-51298-5 Docking Target Inst'l.	2.1	304.1	639	-46.0	-97	0.0	0
LHW 340-53444-1-2 EVA Storage Bag	0.9	257.0	231	0.0	0	+13.6	+12
LSC 340-406-5 Luminous Discs - Handrail	0.2	273.2	55	-17.3	-3	+75.4	+15
LCD 3300 Tape Edges	0.7	250.0	175	0.0	0	+50.0	+35
LHW 340-52261-27 Strap Ass'y. - LIQH Cann.	0.1	250.0	25	+8.8	+1	-11.8	-1
LCD 3966 Tape Docking Tunnel	0.3	302.0	51	0.0	0	0.0	0
Velcro - Floor Inst'l.	0.6	215.0	129	0.0	0	+45.5	+27

TABLE II

DERIVATION OF ASCENT STAGE FLIGHT HARDWARE WEIGHT (INCLUDING GFE INSTALLED AT BETHPAGE) FROM

ACTUAL WEIGHING (Cont.)

	WEIGHT	X	WX	Y	WY	Z	WZ
<u>3.0 Environmental Control</u>							
LSC 330-130 Ox Umbl. Hose - Cmdr.	5.6	250.0	+1400	0.0	0	+31.0	+174
LSC 330-130 Ox Umbl. Hose - Pilot	3.5	250.0	+875	+23.0	+80	+31.0	+108
LSC 330-430 H ₂ O Umbl. Hose - Pilot	2.2	250.0	+550	+23.0	+51	+13.1	+29
LSC 330-430 H ₂ O Umbl. Hose - Cmdr.	2.8	250.0	+700	0.0	0	+31.0	+87
LHW 330-60027 O ₂ & H ₂ O Hdwr. - Pilot	3.0	250.0	+750	+23.0	+69	+31.0	+93
LHW 330-60027 O ₂ & H ₂ O Hdwr. - Cmdr.	3.7	250.0	+925	0.0	0	+31.0	+115
LSC 330-505 Instrtg. Disconnects (3)	1.8	202.0	+364	+60.7	+109	-28.7	-52
LSC 330-507 Instrtg. Disc. Flex Lines (3)	0.8	210.4	+168	+57.2	+46	-28.7	-23
LHW 330-54013 Instrtg. Disconnect Inst'l.	0.5	210.0	+105	+57.0	+28	-28.0	-14
LSC 330-505 Instrtg. Disc. (Quad 1)	0.6	209.2	+126	-27.5	-16	+70.6	+42
LSC 330-507 Instrtg. Disc. Flex Line (Q. I)	0.3	218.7	+66	-33.7	-10	+68.0	+20
LHW 330-60020 Instrtg. Disc. Inst'l (Q. I)	0.5	209.8	+105	-27.5	-14	+70.6	+35
LSC 330-307 Cbn Dump Vlv. - Fwd. Hatch	2.0	234.7	+469	+10.5	+21	+63.2	+126
LHW 330-54011 Cbn Dump Vlv. Hdwr.	0.3	234.7	+70	+10.5		+63.2	+19
LSC 330-307 Cbn Dump Vlv. - Up'r. Hatch	1.9	291.2	+553	+7.1	+13	+7.1	+13
LHW 330-54011 Cbn Dump Vlv. Hdwr.	0.2	291.2	+58	+7.1	+1	+7.1	+1
LSC 330-122-3 LiOH Cartridge	9.1	261.2	+2377	+20.7	+188	+5.9	+54

Contract No. NAS 9-1100
Primary No. 716

LR-490-213
1 June 1971

TABLE II

DERIVATION OF ASCENT STAGE FLIGHT HARDWARE WEIGHT (INCLUDING GFE INSTALLED AT BETHPAGE) FROM

ACTUAL WEIGHING (Cont.)

	<u>WEIGHT</u>	<u>X</u>	<u>WX</u>	<u>Y</u>	<u>WY</u>	<u>Z</u>	<u>WZ</u>
5.0 Environmental Control - Cont.							
LSC 330-122-3 LiOH Cartridge	9.1	250.0	+2275	+8.8	+80	-11.8	-107
LSC 330-154-1 Lunar Dust Filters	2.2	246.5	+542	+16.3	+36	-1.0	-2
LDM 330-57025-1 Lunar Dust Filter Hdwr.	0.2	241.4	+48	+13.5	+3	+9.5	+2
LSC 330-423-9 Water Bacteria Filter	0.5	245.2	+123	+3.2	+2	+16.5	+8
LSC 330-28070-1 Water Duct Ass'y.	0.3	314.0	+94	+26.0	+8	-29.8	-9
LSC 330-28071-1 Boil Duct Ass'y.	0.4	312.2	+125	+9.8	+4	-35.6	-14
LDM 280P16202-1 Emerg. Steam Vent Duct	0.5	282.6	+141	+29.9	+15	-36.9	-18

Contract No. NAS 9-1100
Primary No. 716LTR-490-213
1 June 1971

TABLE II

DERIVATION OF ASCENT STAGE FLIGHT HARDWARE WEIGHT (INCLUDING GFE INSTALLED AT BETHPAGE) FROM
ACTUAL WEIGHING (Cont.)

	WEIGHT	X	WX	Y	WY	Z	WZ
7.0 Instrumentation							
LSC 360-12-5 Data Storage Unit (DSEA)	2.3	260.0	+598	-37.0	-85	+28.0	+64
LW 360-54287-5 Xducer Inst'l - Upr. Hatch	0.3	291.2	+87	+1.5	0	+7.8	+2
LW 360-54287-7 Xducer Instl. - Fwd. Hatch	0.3	242.8	+73	+10.5	+3	+63.2	+19
8.0 Electrical Power							
LSC 390-21000-13 Battery No. 5	123.5	252.6	+31196	+3.6	+445	-64.6	-7978
LSC 390-21000-13 Battery No. 6	123.8	252.6	+31272	-3.6	-446	-64.6	-7997
LW 390-10032-1 Shield Ass'y.	Neg.	255.0	0	-42.5	0	-13.0	0
LW 390-10336 Dust Caps (2)	0.1	265.7	+26	+0.1	0	-13.1	-1
LW 390-21309-5 ACA Circuit Jumper	0.1	270.3	+27	0.0	0	+52.8	+5
LW 390-52582-3 Coil Cord (2) - Util. Its.	0.6	253.0	+152	0.0	0	+37.0	+22
LW 390-59430 A/S Cbl. Weighed with D/S	2.8	212.6	+595	+37.2	+104	+38.4	+108
LW 390-59431 A/S Cbl. Weighed with D/S	2.6	212.6	+553	+37.2	+97	+38.4	+100
LW 390-59959-3 Suit Umbl. Cbl. - Cmdr.	1.9	250.0	+475	0.0	0	+31.0	+59
LW 390-59960-3 Suit Umbl. Cbl. - IM Pilot	1.5	250.0	+375	+23.0	+34	+31.0	+46
A/S Portion of E.D. Harness on Board D/S	1.3	220.0	+286	+38.5	+56	+44.9	+58

TABLE II
 DERIVATION OF ASCENT STAGE FLIGHT HARDWARE WEIGHT (INCLUDING GFE INSTALLED AT BETHPAGE) FROM
 ACTUAL WEIGHING (Cont.)

	<u>WEIGHT</u>	<u>X</u>	<u>WX</u>	<u>Y</u>	<u>WY</u>	<u>Z</u>	<u>WZ</u>
<u>9.0 Propulsion</u>							
LM 270-28013-1 Engine Plug	0.2	227.0	+45	0.0	0	0.0	0
<u>10.0 Reaction Control</u>							
LM 310-54002-3 Cover Inst'l.	0.2	279.6	+56	0.0	0	0.0	0

Contract No. NAS 9-1100
 Primary No. 716

LTR-490-213
 1 June 1971

TABLE II
DERIVATION OF ASCENT STAGE FLIGHT HARDWARE WEIGHT (INCLUDING GFE INSTALLED AT BETHPAGE) FROM
ACTUAL WEIGHING (Cont.)

	WEIGHT	X	WX	Y	WY	Z	WZ
<u>11.0 Communications</u>							
Complete							
<u>12.0 Controls and Displays</u>							
Complete							
<u>13.0 Explosives Devices</u>							
LSC 270-714-113 Prop. He Cartridge (10)	1.0	260.1	+260	0.0	0	-30.2	-30
LSC 320-301-3 Pyro Battery	3.6	255.0	+918	-42.5	-153	-13.0	-47
LSC 320-318-1 RCS Cartridge (4)	0.4	285.0	+114	0.0	0	0.0	0
LSC 320-319-1 RCS Cartridge Ass'y (2)	0.2	220.5	+44	+39.6	+8	+48.7	+10
LSC 320-319-1 RCS Cartridge Ass'y (2)	0.2	220.5	+44	+39.6	+8	+42.4	+8
LSC 320-30400-23 Instrstg. Nut Cart.	0.1	203.7	+20	-65.0	-6	-27.0	-3
LSC 320-30400-23 Instrstg. Nut Cart.	0.1	203.7	+20	+65.0	+6	-27.0	-3
LSC 320-30400-23 Instrstg. Nut Cart.	0.1	209.2	+21	-23.4	-2	+65.9	+6
LSC 320-30400-23 Instrstg. Nut Cart.	0.1	209.2	+21	+23.4	+2	+65.9	+6
LSC 320-30400-27 Nut Ass'y	0.4	203.7	+81	-65.0	-26	-27.0	-11
LSC 320-30400-27 Nut Ass'y	0.4	203.7	+81	+65.0	+26	-27.0	-11
LSC 320-30400-27 Nut Ass'y	0.4	209.2	+84	-23.4	-9	+65.9	+26

TABLE II
DERIVATION OF ASCENT STAGE FLIGHT HARDWARE WEIGHT (INCLUDING GFE INSTALLED AT BETHPAGE) FROM
ACTUAL WEIGHING (Cont.)

	WEIGHT	X	WX	Y	WY	Z	WZ
<u>13.0 Explosives Devices - Cont.</u>							
LSC 320-30400-27 Nut Ass'y	0.4	209.2	+84	+23.4	+9	+65.9	+26
LW 320-23412-3 Cover Ass'y - Fwd. Int.	0.3	211.7	+64	+3.1	+1	+4.2	+1
LW 320-23412-4 Cover Ass'y - Fwd. Int.	0.3	211.7	+64	+3.1	+1	+4.2	+1
LW 320-23413-1-1 Cover Ass'y - Aft. Int.	0.3	211.7	+64	+3.1	+1	+4.2	+1
LW 320-23413-3-1 Cover Ass'y - Aft. Int.	0.3	211.7	+64	+3.1	+1	+4.2	+1
<u>14.0 Government Furnished Equipment</u>							
2018601-241 Inertial Measurement Unit	41.0	307.0	12587	0.0	0	+49.9	+2046
6007000-041 Pulse Torque Ass'y.	14.5	304.2	4411	0.0	0	+29.5	+428
6010678 Harness 'B'	4.4	305.0	1342	+4.8	+21	+37.5	+165
6011834-011 AOT Eye Guard	0.1	309.0	31	0	0	+57.4	+6
6011856A AOT HD Filter Ass'y.	0.1	238.4	24	+38.6	+4	+46.0	+5
Flight Ropes	12.0	266.0	3192	+10.0	+120	-20.9	-251

TABLE III
DERIVATION OF DESCENT STAGE FLIGHT HARDWARE WEIGHT (INCLUDING GFE INSTALLED AT BETHPAGE)
FROM ACTUAL WEIGHING

	WEIGHT	X	WX	Y	WY	Z	WZ
IM-11 DESCENT STAGE AS WEIGHED	3362.6	152.8	513652	+2.7	+9181	-7.3	-24640
NON-FLIGHT ITEMS AND LIQUIDS ON AT WEIGHING	(-74.5)	156.1	(-11628)	+9.6	(-712)	-34.2	(+2551)
LSC410-31210-11 LRAA Hat Coupler	-11.8	117.4	-1385	-30.0	+354	-73.6	+868
LSC270-714-113 Dummy Pyro Squibs	-1.8	196.0	-353	0.0	0	0.0	0
LDW270-52307-1 SHE Tank Cover	-17.3	148.3	-2566	+44.8	-775	-47.2	+817
LSC420-61059-1 Dessicator (2)	-1.3	198.0	-257	0.0	0	0.0	0
LDW420-11006-3 Dummy Guillotine	-3.7	196.0	-725	+35.9	-133	+31.3	-116
LDW420-13123-3 RTG Support Cover	-3.0	145.0	-435	-92.0	+276	-41.0	+123
LDW430-54727-1 GSE Glycol Loop (Q. III)	-1.0	180.0	-180	+69.0	-69	-30.0	+30
LDW430-54727-3 GSE Glycol Loop (Q. III)	-3.0	180.0	-540	+69.0	-207	-30.0	+90
LDW430-54727-6 GSE GOX Loop (Q. III)	-1.0	180.0	-180	+69.0	-69	-30.0	+30
LDW430-54727-6 GSE GOX Loop (Q. I.)	-1.0	180.0	-180	-30.0	+30	+68.0	-68
LSW815-10042-1 Accelerometer (3) (Q. III)	-1.2	130.0	-156	+27.0	-32	-81.0	+97
LSW815-10042-1 Accelerometer (3) Batt. Rk.	-1.3	170.5	-222	0.0	0	-87.0	+113
LDW420-83281-13 Dummy Battery Studs (5)	-5.0	170.5	-852	0.0	0	-87.0	+435
Blanket Pressure in Main Tanks	-18.5	160.8	-2975	0.0	0	0.0	0
Primary Coolant	-2.6	177.8	-462	+33.5	-87	-50.7	+132
Temporary Installations (dust caps, red tags, plastic bags, etc.)	-1.0	160.0	-160	0.0	0	0.0	0

TABLE III

**DERIVATION OF DESCENT STAGE FLIGHT HARDWARE WEIGHT (INCLUDING GFE INSTALLED AT BETHPAGE)
FROM ACTUAL WEIGHING**

<u>FLIGHT ITEMS MISSING AT WEIGHING</u>	<u>WEIGHT</u>	<u>X</u>	<u>WX</u>	<u>Y</u>	<u>WY</u>	<u>Z</u>	<u>WZ</u>
(1050.4)		169.1	(177658)	+18.1	(+18963)	-45.6	(-47907)
1.0 Shielding							
LDW280-60584-21	1.0	190.5	190	+96.8	+97	+13.5	+14
Ass'y.							
LDW280-60584-1	1.8	190.5	343	0.0	0	0.0	0
Ass'y. (2)							
LDW280-60584-2	0.9	190.5	171	-96.8	-87	-13.5	-12
Ass'y.							
LDW280-60584-1	0.9	190.5	171	+13.5	+12	+96.8	+87
Ass'y.							
LDW280-60584-2	0.9	190.5	171	-13.5	-12	+96.8	+87
Ass'y.							
LDW280-53644-23	0.8	198.2	159	0.0	0	+65.9	+53
LDW280-53646-31	0.8	196.5	157	+71.0	+57	-27.0	-22
LDW280-53649-21	0.2	196.5	39	-71.0	-14	-27.0	-5
LDW280-52574-1	3.0	106.3	319	-28.0	-84	-34.3	-103
LDW280-66552	10.7	217.0	2322	-61.5	-658	+61.5	+658
LDW280-66552	10.6	217.0	2300	+61.5	+652	+61.5	+652
LDW280-66532	10.6	217.0	2300	-61.5	-652	-61.5	-652
LDW280-66532	10.6	217.0	2300	+61.5	+652	-61.5	-652
LDW280-60551-1	15.3	151.0	2310	+65.4	+1061	-65.4	-1001
QIII Payload							
LDW280-60667-1	38.3	163.5	6262	+60.0	+2298	+60.0	+2298
LDW280-60511-91	0.3	123.7	37	0.0	0	0.0	0
LDW280-60511-45	0.2	123.7	25	0.0	0	0.0	0
LDW280-60511-47	0.1	123.7	12	0.0	0	0.0	0
LDW280-60511-48	0.1	123.7	12	0.0	0	0.0	0
LDW280-18728-11	1.3	123.7	161	0.0	0	0.0	0
LDW280-18728-13	0.6	123.7	74	0.0	0	0.0	0
LDW280-18728-19	0.2	123.7	25	0.0	0	0.0	0

TABLE III
DERIVATION OF DESCENT STAGE FLIGHT HARDWARE WEIGHT (INCLUDING GFE INSTALLED AT BETHPAGE)
FROM ACTUAL WEIGHING

	WEIGHT	X	WX	Y	WY	Z	WZ
1.0 Shielding - Cont.							
LDW280-60511-51 Blanket	Neg.	131.0	--	0.0	0	0.0	0
LDW280-60511-53 Shield (2)	0.3	123.7	37	0.0	0	0.0	0
LDW280-60511-19 Shield	0.9	123.7	111	0.0	0	0.0	0
LDW280-60511-59 Shield	0.6	123.7	74	0.0	0	0.0	0
LDW280-60511-54 Shield (2)	0.5	123.7	62	0.0	0	0.0	0
LDW280-60511-93 Shield (4)	Neg.	123.7	--	0.0	0	0.0	0
LDW280-58656-49 Blanket	Neg.	163.6	--	0.0	0	+81.0	--
LDW280-58656-51 Blanket	Neg.	163.6	--	0.0	0	+81.0	--
LDW280-60507 Deployment Mechanism	2.8	190.0	532	+67.0	+188	+41.0	+115
LDW280-60512-1-1 Actuator Inst'l.	1.0	197.0	197	+41.5	+42	+63.0	+63

2.0 Stabilization and Control
 Complete

3.0 Navigation and Guidance
 Complete

TABLE III

DERIVATION OF DESCENT STAGE FLIGHT HARDWARE WEIGHT (INCLUDING GFE INSTALLED AT BETHPAGE)
FROM ACTUAL WEIGHING - Cont.

	WEIGHT	X	WX	Y	WY	Z	WZ
4.0 Crew Provisions							
LDW340-55500-1-1 T.V. Tripod Ass'y	1.3	192.0	250	+65.0	+84	+68.0	+88
LDW340-58630-3 Bag, Sample Return	3.2	168.0	538	+47.1	+151	+80.5	+258
LDW340-11976-1, -15 Foam Side	0.8	168.0	134	+47.1	+38	+80.5	+64
LDW340-11977-1 Strap Assembly	0.1	168.0	17	+47.1	+5	+80.5	+8
LDW340-60611-1-4 EVA Pallet No. 1	15.3	171.2	2619	+59.8	+915	+62.5	+956
LDW340-60612-1-3 EVA Pallet No. 2	15.1	158.6	2395	+59.8	+903	+62.5	+944
LDW340-60613-1-2 EVA Pallet No. 3	6.7	145.9	978	+59.8	+401	+62.5	+419
LDW340-60614-3-3 EVA Pallet No. 4	8.1	183.7	1488	+59.8	+484	+62.5	+506
LDW340-60769-5 Basic Mesa Pallet	115.8	161.5	18702	+59.2	+6855	+66.3	+7678
LDW340-10324-31 Decal - Flag	0.2	157.6	32	+66.5	+13	+45.0	+9
LDW340-10324-33 Decal - U. S.	0.2	157.6	32	+66.5	+13	+45.0	+9
LDW340-60781-1 LRV Pallet - Q. III	35.6	155.5	5536	+63.0	+2243	-62.9	-2239
LDW340-60780-1 Payload Pallet -	21.8	155.5	3390	+78.0	+1700	-43.7	-953
(Q. III)							
LDW340-60015 Strap Ass'y. -	0.8	132.1	106	+71.2	+57	-53.4	-43
(Q. III)							
LDW340-60784 Vise Ass'y. -	0.5	159.3	80	+70.5	+35	-57.5	-29
(Q. III)							
5.0 Environmental Control							
LSC330-122-3-12 LiOH Cartridge	9.3	139.1	1294	+84.5	+786	+41.5	+386
LSC330-122-3-12 LiOH Cartridge	9.3	143.7	1336	+45.4	+422	+81.8	+761
LSC 330-505 Instrtg. Disc. (3)	1.5	196.0	294	+60.7	+91	-30.3	-45
(Q. III)							
LSC 330-507 Flex Lines (3)	0.8	191.6	153	+60.4	+48	-30.7	-25
(Q. III)							
LSC 330-54013 Instrtg. Disc.	0.6	201.0	121	+60.7	+36	-28.7	-17
LSC 330-505 Instrtg. Disc. Q. I	0.5	207.3	104	-27.5	-14	+70.6	+35
LSC 330-507 Flex Hose - Q. I	0.3	199.9	60	-27.5	-8	+74.0	+22
LSC 330-60020 Instrtg. Disc. Inst'l.	0.7	206.6	145	-27.5	-19	+70.6	+49

TABLE III

DERIVATION OF DESCENT STAGE FLIGHT HARDWARE WEIGHT (INCLUDING GFE INSTALLED AT BETHPAGE)
FROM ACTUAL WEIGHING - Cont.

	WEIGHT	X	WX	Y	WY	Z	WZ
<u>6.0 Landing Gear</u>							
LDW320M10918-1 Pin Deploy Truss (3)	0.6	128.1	77	0.0	0	0.0	0
<u>7.0 Instrumentation</u>							
Complete							
<u>8.0 Electrical Power</u>							
LSC390-22000 Battery (5)	670.3	170.5	114286	0.0	0	-87.0	-58316
LCB5716 4.15 Amp. hr. Battery	5.0	170.5	852	0.0	0	-87.0	-435
LDW390-54587 Harness - Ldg. Gear	0.2	124.0	25	0.0	0	-100.0	-20
LDW390-54590 Harness - Ldg. Gear	0.2	124.0	25	100.0	+20	0.0	0
LDW390-54593 Harness - Ldg. Gear	0.2	124.0	25	-100.0	-20	0.0	0
LDW390-59430 A/S cbl. weighed with D/S	-2.8	198.0	-554	+27.0	-76	+32.0	-90
LDW390-59431 A/S cbl. weighed with D/S	-2.6	198.0	-515	+27.0	-70	+32.0	-83
A/S Portion of E.D. Harness on bd D/S	-1.3	198.0	-257	+27.0	-35	+34.0	-44
LCD 5797 Landing Radar Wiring Fix	0.1	161.4	16	-32.5	-3	-68.0	-7
<u>9.0 Propulsion</u>							
LDW270-23101-15 Eng. Thermal Plug	0.7	132.7	93	0.0	0	0.0	0
<u>11.0 Communications</u>							
Complete							

TABLE III

DERIVATION OF DESCENT STAGE FLIGHT HARDWARE WEIGHT (INCLUDING GFE INSTALLED AT BETHPAGE)
FROM ACTUAL WEIGHING - Cont.

	WEIGHT	X	WX	Y	WY	Z	WZ
<u>12.0 Displays and Controls</u> <u>Complete</u>							
<u>13.0 Explosive Devices</u>							
LSC270-714-113 He Xpl. Bstr. Cart. (12)	1.2	181.6	218	-10.6	-13	-28.6	-34
LSC320-301 Pyro Battery	3.5	189.9	665	+62.1	+217	+34.5	+121
LSC320-307 L.G. Uplock Mech. (4)	2.2	127.7	281	0.0	0	+86.2	+190
LSC320-309 Umbilical Cutter Assy & JSF	3.1	195.3	605	+35.9	+111	+31.9	+99
LSC320-315-15 Cartridge Assy (2)	0.1	195.3	20	+35.9	+4	+31.9	+3
LSC320-315-15 Cartridge Assy (8)	0.4	127.7	51	0.0	0	+86.2	+34
LSC320-304OC-13 Bolt Assy - Aft Lt.	0.7	201.3	141	-65.0	-46	-27.0	-19
LSC320-304OC-13 Bolt Assy - Aft Rt.	0.7	201.3	141	+65.0	+46	-27.0	-19
LSC320-304OC-13 Bolt Assy - Fwd Lt.	0.7	207.3	145	-23.4	-16	+65.9	+46
LSC320-304OC-13 Bolt Assy - Fwd Rt.	0.7	207.3	145	+23.4	+16	+65.9	+46
LSC320-304OC-21 Nstg. Bolt Cartridge	0.1	201.3	20	-65.0	-6	-27.0	-3
LSC320-304OC-21 Nstg. Bolt Cartridge	0.1	201.3	20	+65.0	+6	-27.0	-3
LSC320-304OC-21 Nstg. Bolt Cartridge	0.1	207.3	21	-23.4	-2	+65.9	+6
LSC320-304OC-21 Nstg. Bolt Cartridge	0.1	207.3	21	+23.4	+2	+65.9	+6
<u>14.0 Government Furnished Equipment</u>							
T.V. Camera Bulkhead Receptacle	0.2	152.9	31	+38.6	+8	+52.1	+10
Color T.V. Camera Mount	2.1	182.3	383	+42.3	+89	+87.4	+184
Total Actual IM-11 Descent Stage Hardware Including Bethpage Installed GFE only	4338.5	156.7	679682	+6.3	+27432	-16.1	-69996
Total Calculated IM-11 Descent Stage Hardware Including Bethpage Installed GFE only.	4359.5	156.7	682973	+6.3	+27401	-15.5	-67741
Manufacturing Variation	-21.0	156.7	-3291		+31		-2255

LM-11 VEHICLE DIAGRAM

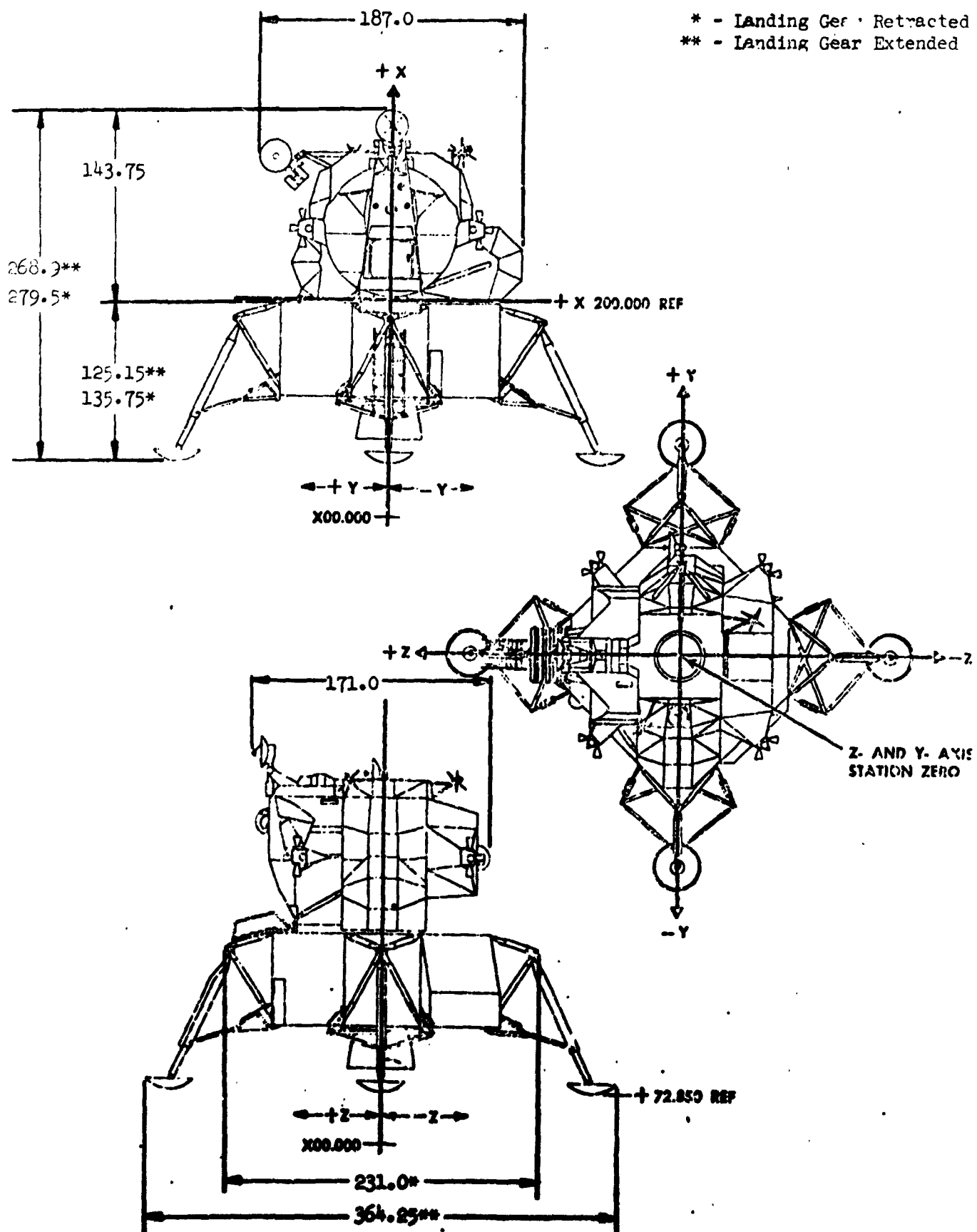


FIGURE I

Ascent Stage Center of Gravity/Thrust Vector Offset
vs. Control Boundary

Information to follow under separate cover. This data will now be supplied in the IM Mass Properties Data Book (Reference 7) as directed by CCA 2864 (Reference 6).

FIGURE II

Descent Stage Center of Gravity Offset
vs. Control Boundary

Information to follow under separate cover. This data will now be supplied in the LM Mass Properties Data Book (Reference 7) as directed by CCA 2864 (Reference 6).

Derivation of the Dry LM-11 Mass Properties at Earth Launch

Information to follow under separate cover. This data will now be supplied in the LM Mass Properties Data Book (Reference 7) as directed by CCA 2864 (Reference 6).

The Mass Properties of the LM-11 Vehicle at Pertinent Points
in the Mission as Obtained from the LM-11 Mass Properties
Data Book, LDP 490-11, to be Released

Information to follow under separate cover. In accordance with the direction of CCA 2864 (Reference 6) this information will no longer be supplied in this document; the mass properties are shown in the referenced data book (Reference 7)

LIST OF REFERENCES

1. OCP-GF-32001-IM-11 Ascent Stage - Weight and Center of Gravity Check, dated 12 February 1971.
2. OCP-GF-32012-IM-11 Descent Stage - Weight and Center of Gravity Check, dated 1 March 1971.
3. EDP Status K10686. LM-11 Configuration Combined Extract, dated April 11, 1971.
4. DD 250. LM-10 Ascent Stage Acceptance Summary Report, dated 7 May 1971.
5. DD 250. LM-10 Descent Stage Acceptance Summary Report, dated 30 April 1971.
6. CCA 2864. Revised Mass Property Reporting and Weight Requirements, dated 20 July 1970.
7. LDP-490-11. LM-11 Mass Properties Data Book, to be released.
8. MSC Report No. V19-02-911-B. Apollo Stowage List, Mission J-2 CM-113 LM-11 (Apollo 16), dated 6 April 1971.
9. Vehicle No. 41. LM-11 Ascent Stage Temporary Installation Record.
10. Vehicle No. 41. LM-11 Descent Stage Temporary Installation Record.
11. Vehicle No. 41. LM-11 Ascent Stage Replacement Record.
12. Vehicle No. 41. LM-11 Descent Stage Replacement Record.
13. Vehicle No. 41. LM-11 Ascent Stage Part Installation and Removal Record.
14. Vehicle No. 41. LM-11 Descent Stage Part Installation and Removal Record.