

CONTRACT REQUIREMENTS	CONTRACT ITEM	MODEL	CONTRACT NO.
Exhibit E, Para. 5.15.2	Function 170	LM	NAS9-1100

Type II

Primary Code 716

CR 115294

REPORT

NO. LTR 490-214

DATE: 8 July 1971

LM-12 ACTUAL WEIGHT REPORT

CODE 26512

OPEN PA 23



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REVISIONS

DATE	REV. BY	REVISIONS & ADDED PAGES	REMARKS

N72-13859 (NASA-CR-115294) LM-12 ACTUAL WEIGHT (THRU)
 REPORT J. Bruno (Grumman Aerospace Corp.)
 8 Jul. 1971 38 p CACL 22B

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G3/31

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DISCUSSION

This report is submitted as partial fulfillment of paragraph 5.15.2 of Exhibit E of Contract No. NAS 9-1100 and is written in accordance with ASPO-PS5-13-10, dated August 1965. The actual measurement by stage of LM-12 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 June 8, 1971, in accordance with OCP-GF-32012-LM-12. The ascent stage measurements were made on June 3, 1971, in accordance with OCP-GF-32001-LM-12. 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 -60.5 pounds under the calculated weight and the actual descent hardware weight is -36.8 pounds under the calculated. These and other mass property differences are derived in this report in accordance with the monthly mass properties report, dated June 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	3561.2	0.85	4.80
Non-Flight and Non-Hardware Items	-87.1	-2.5	15.5
Flight Hardware Missing	671.6	0.1	-12.2
TOTAL ASCENT FLIGHT HARDWARE	4145.7	0.7	1.8
Descent Stage As Weighed	3433.4	6.02	- 3.46
Non-Flight and Non-Hardware Items	-71.2	13.9	- 7.9
Flight Hardware Missing	968.4	8.9	-60.1
TOTAL DESCENT FLIGHT HARDWARE	4330.6	6.5	-16.1
TOTAL VEHICLE FLIGHT HARDWARE	8476.3	3.7	- 7.3

LM-12WEIGHT SUMMARY STATEMENT BY STAGES AT EARTH LAUNCH

	<u>Weight</u>
A. Ascent Stage Inert Weight at E.L.	(4726.8)
1.0 Structure	1385.2
2.0 Stabilization and Control	79.2
3.0 Navigation and Guidance	78.1
4.0 Crew Provisions	146.4
5.0 Environmental Control	296.7
7.0 Instrumentation	131.5
8.0 Electrical Power Supply	736.8
9.0 Propulsion	469.4
10.0 Reaction Control	242.1
11.0 Communications	114.0
12.0 Controls and Displays	231.9
13.0 Explosive Devices	28.7
22.0 Manufacturing Variation	-60.5
Hardware-Sub-Total	(3879.5)
14.0 Government Furnished Equipment - Bethpage Installed	266.2
- KSC Installed	404.8
15.0 Liquids and Gases - (Excludes Propellant)	135.7
17.0 Propellants _ (Non-Tanked)	(40.6)
Main	14.1
Reaction Control	26.5
B. Descent Stage Inert Weight at E.L.	(6173.8)
1.0 Structure	1469.9
2.0 Stabilization and Control	13.3
3.0 Navigation and Guidance	43.5
4.0 Crew Provisions	234.2
5.0 Environmental Control	206.2
6.0 Landing Gear	486.4
7.0 Instrumentation	7.7
8.0 Electrical Power Supply	787.3
9.0 Propulsion	1089.3
11.0 Communications	0.0
12.0 Controls and Displays	3.3
13.0 Explosive Devices	26.1
22.0 Manufacturing Variation	-36.8
Hardware - Sub-Total	(4330.4)
14.0 Government Furnished Equipment - Bethpage Installed	0.2
- KSC Installed	1211.4
15.0 Liquids and Gases - (Excludes Propellant)	555.0
17.0 Propellants - (Non-Tanked)	76.8

LM-12WEIGHT SUMMARY STATEMENT BY STAGES AT EARTH LAUNCH (CONT.)

	<u>Weight</u>
Total Inert Weight at Earth Launch	10900.6
APS-Propellant-Tanked	<u>5229.7</u>
-Trapped and residual	31.0
RCS-Propellant-Tanked	<u>605.4</u>
-Trapped and Residual	12.2
DPS-Propellant-Tanked	<u>19506.9</u>
-Trapped and Residual	56.1
Total Weight at Earth Launch	36242.6

TABLE I

GOVERNMENT FURNISHED EQUIPMENT *

	<u>Weight</u>
1. <u>Ascent Stage Items at Earth Launch</u>	<u>781.0</u>
A. Bethpage Installed Items	(266.2)
Inertial Measurement Unit	41.0
Alignment Optical Telescope, Heater Cover, Bellow Assy., Radiation Shield and Filter Assy.	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	(404.8)
Docking Drogue	21.4
EV Gloves - 2 pair	5.4
Geological Equipment Harness	3.0
Lunar Over Shoes - 2 pair	9.0
EMU Maintenance Kit	0.5
PLSS - Cabin Floor	89.2
PLSS Control Box (2)	10.2
PLSS LIOH Cartridge	4.9
Water Dispenser	1.2
Food	7.3
Pilots Preference Kit (2)	2.7

*Compiled from MSC Apollo Stowage List, see Reference 8

TABLE 1GOVERNMENT FURNISHED EQUIPMENT - Cont.

	<u>Weight</u>
B. KSC Installed Items - Continued	
Crew Optical Alignment Sight	1.6
COAS Light Bulb	0.1
EVA Retract Tether	0.9
Tissue Dispenser (2)	2.8
Adapter UTCA Transfer Assy.	0.2
Liquid Cool Garments (2)	8.6
Wedge Bracket	1.3
LGC Constant Wear Adapter	0.4
COAS Snap on Filter	0.1
IM Medical Package	0.5
IM Utility Towel Assembly (2)	0.9
Defecation - Collection Device (2)	1.2
Emergency Wrench	0.8
IM/SIA Pyro Plug	0.2
Fire Extinguisher Assembly	0.7
Pliers	0.1
LM/CM Docking Receptacle	0.1
Bungee Cord	0.3
Oxygen Purge System (2)	71.8
Helmet Stowage Bag (2)	2.8
EV Visor Assembly (2)	11.2
Flight Data File Assembly	9.3
16 MM Acquisition Camera	1.7
10 MM Lens	0.6
Handle & Trigger, Lunar Surface Camera	0.7
Lunar Surface Hasselblad Camera	3.1
PGA Neck Ring Cover	0.4
Bracket Camera Mount	0.6
Reseau Protective Cover	0.2
Data Card Kit	0.8
Book Clamp (3)	0.6
Clips (2)	0.4
Contingency Lunar SRC	0.8
LM/CM Umbilical	1.1
Purge Valve Assy (2)	1.2
LEC - Waist Tether Kit	3.2
Tape	0.4
Bracket - Right Angle 16 MM	0.2
In-Suit Drink Device	0.6
Utility Towel (4), Red & Blue	0.4
Buddy Umbilical	7.7

TABLE 1GOVERNMENT FURNISHED EQUIPMENT - Continued

B. KSC Installed Items - Continued	<u>Weight</u>
Checklist Cuff (2)	0.6
Sample Scale	0.5
Jettisoned Bag (3)	2.7
60 MM Lens, Lunar Surface Hasselblad	1.7
ICC Assembly (2)	8.8
Sleep Restraints (2)	5.2
Standard Flag Kit	0.8
II. <u>Descent Stage Items on at Earth Launch</u>	<u>1211.6</u>
A. Bethpage Installed Items	(0.2)
T.V. Camera Bulkhead Receptacle	0.2
B. KSC Installed Items	(1211.4)
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)	131.6
Pallet Assembly No. 2 (ALSEP)	92.6
RTG Fuel Cask	55.4
Sample Return Container No. 1	26.0
Sample Return Container No. 2	28.4
Color T.V. Control unit	11.5
Trenching Tool	2.9
Lens Brush (2)	0.2
Extension Tool	1.8
Tongs (2)	2.0
Lunar Dust Brush	1.3
Food	8.0
Flag Kit, Lunar Surface	2.5
Lunar Rover Vehicle	507.3
Hand Tool Carrier	17.4
Collection Bag (4)	4.8
Safety Line	1.3
Bag, Safety Lines	0.1
Sample Collection Bag	3.6
T.V. Lens Filter	0.3
Color T.V. Mount	2.1

TABLE 1

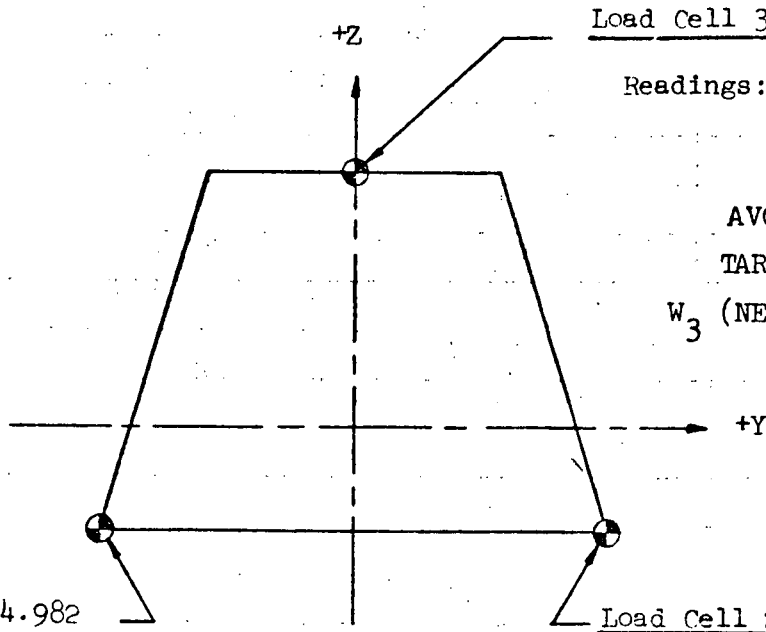
GOVERNMENT FURNISHED EQUIPMENT - Continued

	<u>Weight</u>
B. KSC Installed Items - continued	
Gnomon	0.6
Heat Flow Drill	26.5
Seismic Profiling Experiment	38.0
16 MM Lunar Surface Camera	18.9
Lunar Surface Elect. Hasselblad Camera	3.1
60 MM Lens	1.7
Polarizing Filter	0.2
Reseau Protective Cover	0.2
Trigger and Handle	0.7
16 MM Camera Staff	1.5
Camera Mount Bracket	0.6
Traverse Gravimeter	27.0
Surface Electric Properties Experiment	28.3

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-10 A/S - DATA SHEET



Load Cell 3 y= +0.061
z= +65.982

Readings:
1. 1419 . 8
2. 1419 . 5
3. 1419 . 9
AVG. 1419 . 7
TARE - 204 . 4
W₃ (NET) 1215 . 3

Load Cell 1 y= -64.982
z= -26.886

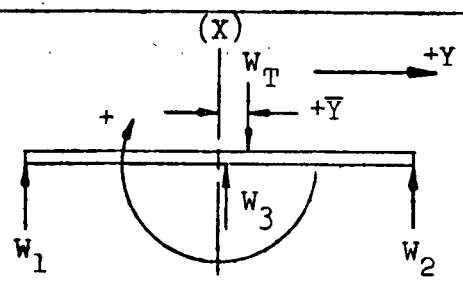
Readings:
1. 1261 . 9
2. 1261 . 8
3. 1261 . 1
AVG. 1261 . 6
TARE - 111 . 3
W₁ (NET) 1150 . 3

Load Cell 2 y= +64.991
z= -26.919

Readings:
1. 1306 . 5
2. 1306 . 5
3. 1306 . 9
AVG. 1306 . 6
TARE - 111 . 0
W₂ (NET) 1195 . 6

SUMMARY

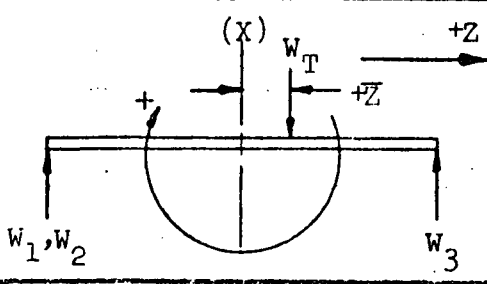
W ₁	1150.3
W ₂	1195.6
W ₃	1215.3
W _T (A/S)	3561.2



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

$$Y = \frac{1215.3(0.061) + 1195.6(64.991) - 1150.3(64.982)}{3561.2}$$

$$Y = +0.85$$



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

$$Z = \frac{1215.3(65.982) - 1150.3(26.886) - 1195.6(26.919)}{3561.2}$$

$$Z = +4.795$$

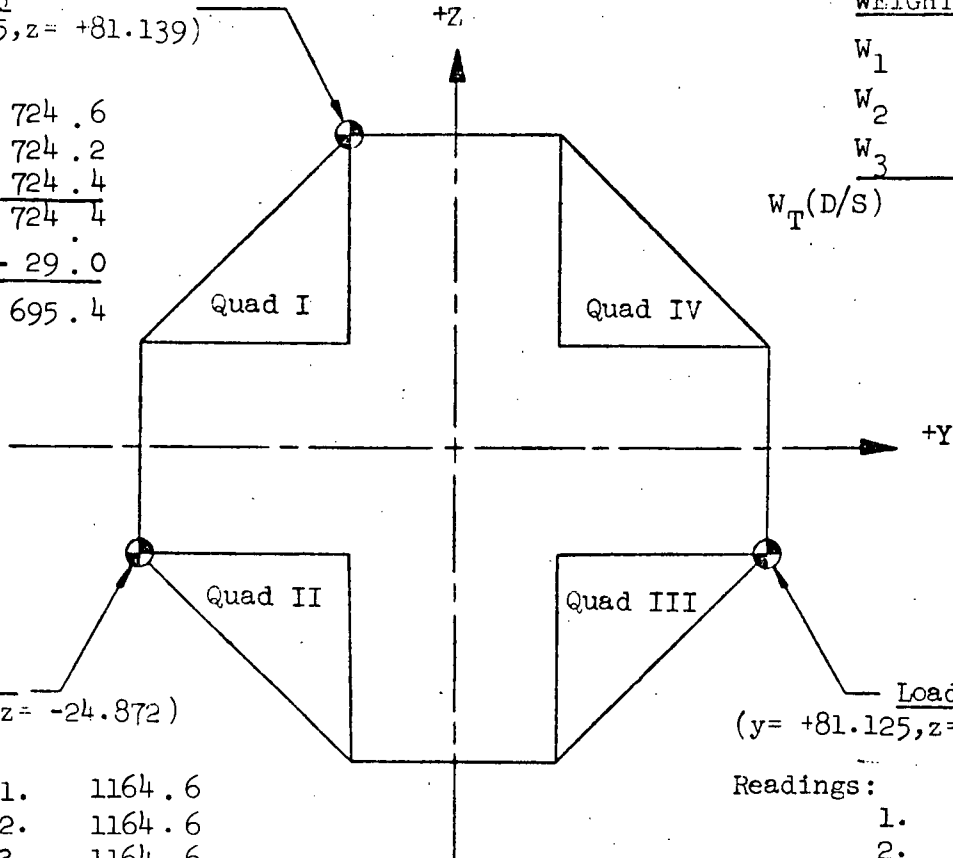
LM-12 (D/S) - DATE SHEET

Load Cell 3
(y = -24.875, z = +81.139)

Readings:
 1. 724.6
 2. 724.2
 3. 724.4
 AVG. 724.4
 TARE - 29.0
 W₃ (Net) 695.4

WEIGHT SUMMARY

W ₁	1134.9
W ₂	1603.1
W ₃	695.4
W _T (D/S)	3433.4

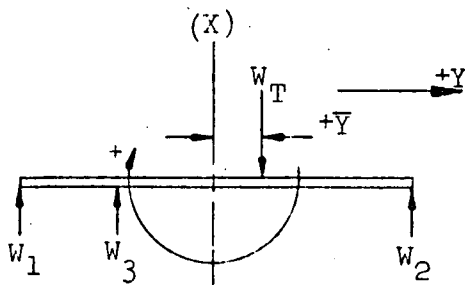


Load Cell 1
(y = -81.151, z = -24.872)

Readings:
 1. 1164.6
 2. 1164.6
 3. 1164.6
 AVG. 1164.6
 TARE - 29.7
 W₁ (Net) 1134.9

Load Cell 2
(y = +81.125, z = -25.003)

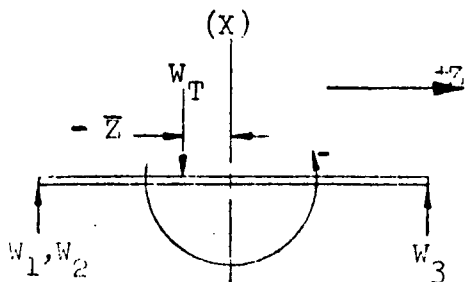
Readings:
 1. 1631.8
 2. 1631.8
 3. 1632.0
 AVG. 1631.9
 TARE - 28.8
 W₂ (Net) 1603.1



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

$$Y = \frac{1603.1(81.125) - 1134.9(81.151) - 695.4(24.875)}{3433.4}$$

$$Y = +6.016$$



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

$$Z = \frac{695.4(81.139) - 1134.9(24.872) - 1603.1(25.003)}{3433.4}$$

$$Z = -3.46$$

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 29. 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-12 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	4145.7	0.7	2759	1.8	7533
Ascent Stage - Calculated	4206.2	0.6	2417	1.6	6541
A/S Manuf. Variation	-60.5		342		992
Descent Stage - Actual	4330.6	6.5	28247	-16.1	-69552
Descent Stage - Calculated	4367.4	6.3	27642	-15.5	-67856
D/S Manuf. Variation	-36.8		605		-1696

Center of Gravity

The Ascent Stage's actual center of gravity is 0.2 inches forward of the calculated location in the Z direction and 0.1 inches outboard of the calculated in 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 0.2 inches outboard of 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 1 June 1971 IBM record.

1 JUNE 1971 IBM RECORD LM-12 ASCENT STAGE HARDWARE INCLUDING BETHPAGE INSTALLED GFE

<u>ITEM</u>	<u>WEIGHT</u>	<u>X</u>	<u>WX</u>	<u>Y</u>	<u>WY</u>	<u>Z</u>	<u>WZ</u>
1.0 Structure	1385.2	255.3	353676	- 2.4	-3296	13.2	18246
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	146.4	250.0	36600	- 8.2	-1205	39.5	5777
5.0 Environmental Control	296.7	266.3	79014	14.3	4234	- 0.6	-187
7.0 Instrumentation	131.5	251.7	33098	-16.3	-2146	-57.7	-7583
8.0 Electrical Power Supply	736.8	259.3	191022	1.7	1283	-17.4	-12787
9.0 Propulsion	469.4	233.7	109676	- 4.0	-1856	-14.1	-6617
10.0 Reaction Control	242.1	264.7	64088	0.1	20	- 3.5	- 858
11.0 Communications	114.0	271.7	30973	37.6	4284	-46.1	-5256
12.0 Controls & Displays	231.9	264.5	61348	5.0	1166	60.9	14123
13.0 Explosive Devices	28.7	230.6	6618	4.3	123	10.9	312
(CFE Hardware Total)	(3940.0)	(256.3)	(1009890)	(0.7)	(2718)	(1.1)	(4196)
14.0 Government Furnished Equipment (Bethpage Installed GFE Only)	266.2	273.6	72831	- 1.1	- 301	8.8	2345
Total IBM LM-12 Ascent Stage Hardware (Including Bethpage Installed GFE)	4206.2	257.4	1082721	0.6	2417	1.6	6541

Contract No. NAS 9-1100
Primary No. 716

RELEASE DATE
8 July 1971

1 JUNE 1971 IBM RECORD LM-12 DESCENT STAGE HARDWARE INCLUDING BETHPAGE INSTALLED GFE

<u>ITEM</u>	<u>WEIGHT</u>	<u>X</u>	<u>WX</u>	<u>Y</u>	<u>WY</u>	<u>Z</u>	<u>WZ</u>
1.0 Structure	1469.9	159.5	234438	0.4	548	- 3.8	- 5605
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	-47.1	-2048	-56.5	- 2456
4.0 Crew Provisions	234.2	161.3	37774	61.1	14298	35.2	8242
5.0 Environmental Control	206.2	174.4	35961	34.5	7115	4.6	945
6.0 Landing Gear	486.4	118.3	57544	0.0	17	1.5	706
7.0 Instrumentation	7.7	156.1	1202	- 5.2	- 40	- 7.2	- 56
8.0 Electrical Power Supply	787.3	172.4	135745	1.6	1274	-78.9	-62134
9.0 Propulsion	1089.3		168492		5463		- 7168
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	26.1	177.8	4641	28.9	754	18.4	479
(CFE Hardware Total)	(4367.2)	(156.7)	(684408)	(6.3)	(27634)	(-15.5)	(-67856)
14.0 Government Furnished Equipment (Bethpage Installed GFE Only)	0.2	152.9	31	38.6	+ 8	+52.1	+ 10
Total IBM LM-12 Descent Stage Hardware (Including Bethpage Installed GFE)	4367.4	156.7	684439	6.3	27642	-15.5	-67856

CONTRACT NO. NAS 9-1100
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 LTR 490-214
 GFLUMMAN

TABLE II

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

LM-12 ASCENT STAGE AS WEIGHED	FROM ACTUAL WEIGHING						
	WEIGHT	X	WX	Y	WY	Z	WZ
	3561.2	257.1	915714	0.85	3028	4.80	17077
<u>NON-FLIGHT ITEMS AND LIQUIDS ON AT WEIGHING</u>	<u>(-87.1)</u>	<u>277.4</u>	<u>(-24161)</u>	<u>-2.5</u>	<u>(-219)</u>	<u>15.5</u>	<u>(-134.5)</u>
LDW 420-13361-3 Nav Base Gage	-18.0	320.0	-5760	0.0	0	55.1	-992
LDW 420-83281-1-1 Sim. Battery Studs (2)	-1.3	252.6	-38	0.0	0	-64.6	84
LDW 420-51009-11 ASA Cold Plate Supt.	-2.8	307.0	-860	4.5	-13	63.0	-176
LDW 420-63119-1 RCS Engine Covers (16)	-12.0	254.0	-3048	0.0	0	0.0	0
LDW 420-11282-5-1 CDR Window Cover -outer	-1.8	274.0	-493	-24.5	44	62.0	-112
LDW 420-11282-6-1 LMP Window Cover -outer	-1.8	274.0	-493	24.5	-44	62.0	-112
LDW 420-11282-7-1 Dkg Window Cover -outer	-1.6	292.0	-467	-22.0	35	42.7	-68
LDW 420-32001-1 LMP ACA Protection	-0.2	251.1	-50	-10.1	2	57.5	-12
LDW 420-32001-1 CDR ACA Protection	-0.1	251.1	-25	34.1	-3	57.5	-6
LDW 420-11251-3 DSKY Cover	-0.2	254.0	-51	0.0	0	58.6	-12
LDW 420-61059-1 Dessicator -Fuel	-0.9	277.0	-249	-44.6	40	-28.0	25
LDW 420-61059-1 Dessicator - Oxid	-0.9	277.0	-249	44.6	-40	-28.0	25
LDW 420-61049-19 Dessicator -RCS (4)	-1.4	279.6	-391	0.0	0	0.0	0
LDW 420-42301-7 Docking Light Covers (5)	-3.2	254.7	-815	-5.0	16	19.1	-61
LDW 430-52232-5-4 H2O Boiler Cover	-3.3	312.7	-1032	26.5	-87	-29.8	98
LDW 430-52233-3-4 H2O Boiler Cover	-6.0	311.1	-1867	9.8	-59	-31.0	186
LDW 420-13690-8 CDR Window Cover -Inner	-1.0	274.5	-274	-22.0	22	62.0	-62
LDW 420-13690-7 LMP Window Cover- Inner	-1.0	274.5	-274	22.0	-22	62.0	-62
LDW 420-13690-9 Dkg Window Cover - Inner	-0.4	292.0	-117	-22.0	9	42.7	-17
NASA 6014322 AOT Protective Cover	-0.3	293.0	-88	0.0	0	57.4	-17
LSK 560-1065-1 Tracking Light Cover	-1.2	268.0	-322	0.0	0	80.0	-96
LDW 430-54391-3 Steam Duct Cover	-0.2	288.0	-58	33.0	-7	-42.0	8
LDW 430-54727-3 Glycol Lines (2)	-1.6	210.4	-337	57.2	-92	-28.7	46
LDW 430-54727-4 O2 Line	-1.0	210.4	-210	57.2	-57	-28.7	29
LDW 430-54727-4 O2 Line	-1.0	218.7	-219	-33.7	34	68.0	-68
LDW 815-10046-11 Transducer	-3.7	282.0	-1043	7.2	-27	-5.0	18
LDW 270M10039-11 Dummy Squib Valves (9)	-0.7	258.5	-181	0.0	0	-31.1	22
Blanket Pressure in Main Tanks	-5.0	224.7	-1124	-13.3	66	1.0	-5
Strut Covers - AFT VHF Antenna	-0.4	303.0	-121	22.3	-9	44.0	-18
Protective Cover -A/S Engine Cover	-8.1	254.0	-2057	0.0	0	0.0	0
Misc Temp. Instl. (caps, tape, bags, flags etc)	-4.0	257.0	-1028	0.0	0	0.0	0
Tygon Tubing -Cabin ECS Lines	-1.9	266.3	-506	14.3	-27	-6.0	11
LDW 340-53264-1 Water Holster Cover	-0.1	237.6	-24	-0.8	0	21.5	-2

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TABLE II

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

	<u>WEIGHT</u>	<u>X</u>	<u>WX</u>	<u>Y</u>	<u>WY</u>	<u>Z</u>	<u>WZ</u>
<u>FLIGHT ITEMS MISSING AT WEIGHING</u>	(671.6)	261.9	(475924)	0.1	(-50)	-12.2	(-8198)
<u>1.0 SHIELDING -CABIN</u>							
LDW 280-10610-25	Stiffener	0.1	252.4	25	0.0	0	76.4 8
LDW 280-10610-27	Stiffener	0.2	252.4	50	0.0	0	76.4 15
LDW 280-10610-31	Bracket	Neg	252.4	-	0.0	-	76.4 -
LDW 280-10610-47	Shield Center Canted	Neg	252.4	-	0.0	-	76.4 -
LDW 280-10610-51	Shield Center Canted	0.3	252.4	76	0.0	0	76.4 23
LDW 280-10612-27	Shield Center Canted	0.1	252.4	25	0.0	0	76.4 8
LDW 280-10612-28	Shield Center Canted	0.1	252.4	25	0.0	0	76.4 8
LDW 280-11862-21	Shield IMU Beam	0.1	302.8	30	0.0	0	58.5 6
LDW 280P11863-11	Shield -IMU Beam	Neg	302.8	-	0.0	-	58.5 -
LDW 280P11863-13	Shield-IMU Beam	Neg	302.8	-	0.0	-	58.5 -
LDW 280-11864-11	Shield - IMU Beam	Neg	302.8	-	0.0	-	58.5 -
LDW 280-11965-11	Washer (18)	0.1	248.5	25	-1.7	0	62.3 6
LDW 280-28175-13	Hatch Shield Instl	3.1	234.0	725	0.0	0	66.6 206
LDW 280-54186-9	Cabin Shield	1.3	232.5	302	48.6	63	48.8 63
LDW 280-54279-9-1	Shield-Center Step	2.0	212.5	425	0.0	0	70.0 140
LDW 280-56186-1	IMU Shield	3.0	312.5	938	0.0	0	51.0 153
LDW 280-56241-23	Shield	0.2	234.4	47	32.9	7	66.6 13
LDW 280-56241-25	Shield	0.6	234.4	141	-31.9	-19	67.6 41
LDW 280-56495-1	Shield-Fwd RCS L.H.	1.5	254.0	381	-66.5	-100	66.5 100
LDW 280-59173-7	Hood Assy's (9)	0.1	248.5	25	- 1.7	0	62.3 6
LDW 280-59173-61	Hand Grip Insul	Neg	234.0	-	15.0	-	80.0 -
LDW 280-59173-67	Cabin Insul	0.2	231.1	46	0.0	0	67.1 13
LDW 280-59173-73	Handgrip Insul	Neg	234.0	-	-15.0	-	80.0 -
LDW 280-59173-75	Lwr Beam Insul	0.2	230.0	46	-20.0	-4	72.0 14
LDW 280-59173-77	Lwr Beam Insul	0.2	230.0	46	-20.0	-4	72.0 14
LDW 280-59173-31-1	Hatch Cover	0.9	234.0	211	0.0	0	67.1 60
LDW 280-59173-33-1	Dump Valve Cover	0.1	234.0	23	-14.0	-1	67.1 7
LDW 280-59173-35	Hatch Latch Cover	0.1	240.2	24	13.0	1	67.1 7
LDW 280-59173-39	Hatch Latch Cover	0.1	240.2	24	13.0	1	67.1 7

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

<u>MID SECTION</u>	<u>WEIGHT</u>	<u>X</u>	<u>WX</u>	<u>Y</u>	<u>WY</u>	<u>Z</u>	<u>WZ</u>
LDW 280-12017-29 Dog House Shield	0.5	305.6	153	0.0	0	-35.7	-18
LDW 280-28884-41-1 Fairing-IM/SIA Umb.	2.0	202.7	405	57.0	114	-27.0	-54
LDW 280-28895-35-1 Shield- VHF Ant.	2.5	304.8	762	-11.6	-29	- 7.6	-19
LDW 280-54851-11 Shield-Blkhd.	2.1	219.4	461	42.5	89	-32.2	-68
LDW 280-54851-13 Shield -Blkhd.	1.0	214.2	214	43.2	43	31.5	32
LDW 280-54851-15 Shield Blkhd.	2.4	222.8	535	-53.6	-129	-32.2	-77
LDW 280-54852-1 Shield Blkhd.	0.9	222.8	201	-53.6	-48	-32.2	-29
LDW 280-54885-1-2 Shield S-Band Ant.	3.5	306.7	1073	48.2	169	7.1	25
LDW 280-54955-33 Shield	0.2	208.0	42	-78.0	-16	-25.0	-5
LDW 280-59896-45 Shield	0.1	209.5	21	-15.0	- 2	0.1	0
LDW 280-60102-17-1 Shield-Tunnel	4.8	302.5	1452	0.0	0	0.0	0
LDW 280-60102-19 Shield-Tunnel	0.6	303.0	182	0.0	0	0.0	0
LDW 280-59282-1 Shield - Dock, Hatch	3.8	298.0	1132	0.0	0	-1.0	- 4
LDW 280-59282-3 Shield Dock. Hatch	0.1	298.0	30	0.0	0	-1.0	0
<u>AFT - EQUIPMENT BAY</u>							
LDW 280-54445-19 Blanket Assy	0.5	250.1	125	-48.7	-24	-49.5	-25
LDW 280-54445-21 Blanket Assy	0.5	250.1	125	48.7	24	-49.5	-25
LDW 280-54470-5 Shield	0.4	276.0	110	-13.7	- 5	-70.8	-28
LDW 280-56463-1 Shield	0.5	248.3	124	-67.5	-34	-69.0	-35
LDW 280-56463-2-1 Shield	0.5	248.3	124	67.5	34	-69.0	-35
LDW 280-56464-1 Shield	0.5	270.8	135	-51.2	-26	-55.0	-28
LDW 280-56464-2 Shield	0.6	270.8	162	51.2	31	-55.0	-33
LDW 280-56465-1 Shield	0.5	259.6	130	-56.4	-28	-44.2	-22
LDW 280-56465-2 Shield	0.5	259.6	130	56.4	28	-44.2	-22
LDW 280-56465-3 Shield	0.4	241.0	96	-47.7	-19	-44.0	-18
LDW 280-56465-4 Shield	0.4	241.0	96	47.7	19	-44.0	-18
LDW 280-56466-5 Shield	0.7	231.6	162	-35.8	-25	-54.0	-38
LDW 280-56466-6 Shield	0.8	231.6	185	35.8	29	-54.0	-43
GP15A-42-24-25 Blanket -Patch	1.3	256.3	333	0.0	0	-50.0	-65
GP15A-42-24-5 Blanket -Patch	0.1	256.3	26	0.0	0	-50.0	- 5
GP15A-42-24-6 Blanket Patch	0.1	256.3	26	0.0	0	-50.0	- 5

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TABLE II

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FROM ACTUAL WEIGHING

		<u>WEIGHT</u>	<u>X</u>	<u>WX</u>	<u>Y</u>	<u>WY</u>	<u>Z</u>	<u>WZ</u>
<u>1.0 STRUCTURE</u>								
LDW 280-23068-11	Hatch Instl-Upr	10.9	294.1	3205	0.0	0	1.8	20
LDW 280-H54060-13	Floor Instl	23.6	213.7	5043	0.1	2	45.3	1069
LDW 280 54093-7-1	Hatch Instl-Fwd	13.0	231.1	3004	-2.9	-38	64.2	835
LDW 340-21245-1	Supt Instl-Floor	1.1	217.4	239	0.0	0	47.4	52
LDW 340-52111-17	Glareshield	0.6	274.0	164	-15.0	-9	65.2	39
LDW 340-52111-16	Glareshield	0.6	274.0	164	15.0	9	65.2	39
LDW 340-54275-1-1	Window Shade -Dkg	0.4	292.0	117	-22.0	-9	42.0	17
LDW 340-54276-1-3	Window Shade	0.6	274.0	164	-24.5	-15	62.0	37
LDW 340-54276-2-3	Window Shade	0.6	274.0	164	24.5	15	62.0	37
LDW 340-58464-3	Container-Buddy umb.	3.8	224.3	852	- 1.5	- 6	29.3	111
LDW 340 60347	Netting	4.1	265.0	1087	0.0	0	- 6.0	-25
LDW 340-60348	Netting	1.3	280.0	364	0.0	0	47.0	61
<u>2.0 STABILIZATION AND CONTROL</u>								
LSC 300-110	RGA	2.0	300.1	600	- 7.3	-15	57.8	116
LSC 300-370-5-10	ASA	20.5	307.0	6294	0.0	0	62.8	1287
LSC 300-330-3-10	AEA	32.8	259.8	8521	24.8	813	-65.5	-2148
Instl Hardware		0.1	259.8	26	24.8	2	-65.5	-7
<u>3.0 NAVIGATION AND GUIDANCE</u>								
LSC 370-200-5-18	RR Ant. Assy	43.0	310.8	13364	0.0	0	83.5	3590
LSC 370-100-7-18	RR Elect Assy	34.7	247.8	8599	-32.0	-1110	-65.5	- 2273
LDW 300-53016-3-4	Instl Hdwr RREA	0.1	247.8	25	-32.0	- 3	-65.5	- 7

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FROM ACTUAL WEIGHING

		<u>Weight</u>	<u>X</u>	<u>WX</u>	<u>Y</u>	<u>WY</u>	<u>Z</u>	<u>WZ</u>
<u>4.0 CREW PROVISIONS</u>								
LDW	340-11102	Velcro Instl - Flr.	0.6	215.0	129	0.0	0	45.5 27
LDW	340-11366-7	Strap Assy. Hammock	0.2	225.7	45	0.0	0	44.7 9
LDW	340-21374-3-7	Cam. Supt. Instl.	0.6	286.0	172	20.0	12	68.0 41
LDW	340-51298-5	Docking Target	2.1	304.1	639	-46.0	-97	0.0 0
LDW	340-52261-27	Strap, ECS LIOH	0.1	250.0	25	8.8	9	-11.8 - 1
LDW	340-53053-3-6	Utility Lights	2.3	270.3	622	0.0	0	52.8 121
LDW	340-53444-1-2	Temp. Stow Bag.	0.9	257.0	231	0.0	0	13.6 12
LDW	340-56272-1-2	Hammock Instl	4.1	228.0	935	-40.2	-165	43.2 177
LDW	340-56272-3-1	Hammock Instl	3.9	228.0	889	-40.2	-157	43.2 168
LDW	340-57303-1-3	ISA	6.4	270.3	1730	0.0	0	52.8 338
LDW	340-57303-39	Conting. Webbing	0.4	231.5	93	35.4	14	41.7 17.
LDW	340-60175-1-2	Coverall Container	5.9	240.5	1419	-16.7	-99	13.3 78
LDW	340-60189-1	Container Assy	0.5	243.7	122	-5.5	- 3	-14.8 -7
LDW	340-60189-3	Container Assy	1.3	235.4	306	-5.5	- 7	-14.8 -19
LDW	340-60190-1	Container Assy	6.0	238.6	1432	-5.5	-33	-14.8 -89
LDW	340-60632-1	Equip. Xfer Bag	1.2	221.8	266	-1.0	-1	29.5 35
LSC	340-100-019	Urine Recep.	0.6	242.5	146	-35.6	-21	38.6 23
LSC	340-201-529	Urine Coll. Bag.	0.3	235.5	71	-37.6	-11	46.6 14
LSC	340-406-5	Lum. Discs	0.2	273.2	55	-17.3	-3	75.4 15
	Emesis Bags (6)		1.2	235.5	283	-37.6	- 45	46.6 56
	Tape Cabin Floor		0.7	215.0	151	0.0	0	50.0 35
<u>5.0 ENVIRONMENTAL CONTROL</u>								
LSC	330-130	O2 Umb. Hose Cdr.	5.6	250.0	1400	0.0	0	31.0 174.
LSC	330-130	O2 Umb. Hose LMP	3.5	250.0	875	23.0	81	31.0 109
LSC	330-430	H2O Umb. Hose LMP	2.2	250.0	550	23.0	51	31.0 68
LSC	330-430	H2O Umb Hose CDR.	2.8	250.0	700	0.0	0	31.0 87
LDW	330-60027	Umb. Hose Instl Hwdr IMP	3.0	250.0	750	23.0	69.	31.0 93
LDW	330-60027	Umb. Hose Instl Hwdr CDR	3.7	250.0	925	0.0	0	31.0 115

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FROM ACTUAL WEIGHING

		<u>Weight</u>	<u>X</u>	<u>WX</u>	<u>Y</u>	<u>WY</u>	<u>Z</u>	<u>WZ</u>
5.0	<u>ENVIRONMENTAL CONTROL (continued)</u>							
LSC 330-505	I/S Disconn. (3)	1.8	202.0	364	60.7	109	-28.7	-52
LSC 330-507	I/S Disc. Flex Line (3)	0.8	210.4	168	57.2	46	-28.7	-23
LDW 330-54013	I/S Disc. Instl.	0.5	210.0	105	57.0	29	-28.0	-14
LSC 330-505	I/S Disconn (Q1)	0.6	209.2	126	-27.5	-17	70.6	42
LSC 330-507	I/S Disc. Flex Line (Q1)	0.3	218.7	66	-33.7	-10	68.0	20
LDW 330-60020	I/S Disc Instl (Q1)	0.5	209.8	105	-27.5	-14	70.6	35
LSC 330-307	CBN Dump Valve-Fwd	2.0	234.7	469	10.5	21	63.2	126
LDW 330-54011	CBN Dump Valve-Hwdr	0.3	234.7	70	10.5	3	63.2	19
LSC 330-307	CBN Dump Valve-Upr	1.9	291.2	553	7.1	13	-7.1	-13
LDW 330-54011	CBN Dump Valve-Hwdr	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
LSC 330-122-3	LIOH Cartridge	9.1	250.0	2275	8.8	80	-11.8	-107
LSC 330-154-1	Lunar Dust Filter	2.3	246.5	567	16.3	37	-1.0	-2
LDW 330-57025-1	Lunar Dust Filter Hwdr	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
LDW 330-28070-1	Water Duct Assy	0.3	314.0	94	26.0	8	-29.8	-9
LDW 330-28071-1	Boil Duct Assy	0.4	312.2	125	9.8	4	-35.6	-14
LDW 280P16202-1	Emerg. Steam Vent Port	0.5	282.6	141	29.9	15	-36.9	-18
LSC 330-210	Accumulator	3.4	301.4	1025	-8.5	-29	-30.0	-102
LSC 330-210	Accumulator	3.5	300.4	1051	-2.8	-10	-30.0	-105
7.0	<u>INSTRUMENTATION</u>							
LSC 360-12-5	Data Storage Unit	2.3	260.0	598	-37.0	-85	28.0	64
LDW 360-54287-5	Xducer Instl-Upr. Hatch	0.3	291.2	87	1.5	0	7.8	2
LDW 360-54287-7	Xducer Instl Fwd Hatch	0.3	242.8	73	10.5	3	63.6	19

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TABLE II

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

FROM ACTUAL WEIGHING

		<u>Weight</u>	<u>X</u>	<u>WX</u>	<u>Y</u>	<u>WY</u>	<u>Z</u>	<u>WZ</u>	
8.0	<u>ELECTRICAL POWER SUPPLY</u>								
	LSC 390-21000-09	Battery No. 5	123.5	252.6	31196	3.6	445	-64.6	-7978
	LSC 390-21000-09	Battery No. 6	123.8	252.6	31272	-3.6	-446	-64.6	-7997
	LDW 390-10032-1	Shield Assy	Neg	255.0	-	-42.5	-	-13.0	-
	LDW 390-10336-	Dust Caps (2)	0.1	265.7	27	0.1	0	-13.1	-1
	LDW 390-21309-5	ACA Shorting Plug	0.1	270.3	27	0.0	0	52.8	5
	LDW 390-52582-3	Coil Cord (2)	0.6	253.0	152	0.0	0	37.0	22
	LDW 390-59430	A/S Cable on D/S	2.8	212.6	595	37.2	104	38.4	108
	LDW 390-59431	A/S Cable on D/S	2.6	212.6	553	37.2	97	38.4	100
	LDW 390-59959-3	Suit Umb Cable-CDR	1.9	250.0	475	0.0	0	31.0	59
	LDW 390-59960-3	Suit Umb Cable-LMP	1.5	250.0	375	23.0	34	31.0	47
	A/S Portion of ED Harness on D/S		1.3	220.0	286	38.5	50	44.9	58
	Battery Instl. Hdwr.		0.1	263.6	26	0.0	0	-53.6	-5
9.0	<u>PROPULSION</u>								
	LDW 270-28013-1	Engine Plug	0.2	227.0	45	0.0	0	0.0	0
10.0	<u>REACTION CONTROL</u>								
	LDW 310-54002-3	Cover Instl	0.2	279.6	56	0.0	0	0.0	0

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FROM ACTUAL WEIGHING

		<u>Weight</u>	<u>X</u>	<u>WX</u>	<u>Y</u>	<u>WY</u>	<u>Z</u>	<u>WZ</u>
<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	RCS Cartridge (4)	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 Assy (2)	0.2	220.5	+ 44	+39.6	+8	+48.7	+10
LSC 320-319-1	RCS Cartridge Assy (2)	0.2	220.5	+ 44	+39.6	+8	+42.4	+ 8
LSC 320-30400-23	Intrstg. Nut Cart.	0.1	203.7	+ 20	-65.0	-6	-27.0	- 3
LSC 320-30400-23	Intrstg. Nut Cart.	0.1	203.7	+ 20	+65.0	+6	-27.0	- 3
LSC 320-30400-23	Intrstg. Nut Cart.	0.1	209.2	+ 21	-23.4	-2	+65.9	+ 6
LSC 320-30400-23	Intrstg. Nut Cart.	0.1	209.2	+ 21	+23.4	+2	+65.9	+ 6
LSC 320-30400-27	Nut Assy	0.4	203.7	+ 81	-65.0	-26	-27.0	-11
LSC 320-30400-27	Nut Assy	0.4	203.7	+ 81	+65.0	+26	-27.0	-11
LSC 320-30400-27	Nut Assy	0.4	209.2	+ 84	-23.4	-9	+65.9	+26
LSC 320-30400-27	Nut Assy	0.4	209.2	+ 84	+23.4	+9	+65.9	+26
LDW 320-23412-3	Cover Assy -Fwd. Int.	0.3	211.7	+ 64	+3.1	+1	+ 4.2	+ 1
LDW 320-23412-4	Cover Assy - Fwd. Int.	0.3	211.7	+ 64	+3.1	+1	+ 4.2	+ 1
LDW 320-23413-1-1	Cover Assy. Aft. Int.	0.3	211.7	+ 64	+3.1	+1	+ 4.2	+ 1
LDW 320 23413-3-1	Cover Assy - Aft.	0.3	211.7	+ 64	+3.1	+1	+ 4.2	+ 1
JSF	Electrical Circuit Inst	0.1	220.5	22	39.6	4	45.5	4
JSF	Interstage Bracket	1.3	211.7	275	3.1	4	4.2	5

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TABLE II

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

		<u>Weight</u>	<u>X</u>	<u>WX</u>	<u>Y</u>	<u>WY</u>	<u>Z</u>	<u>WZ</u>
14.0	<u>GOVERNMENT FURNISHED EQUIPMENT</u>							
6011834	Aot Eyeguard Assy	0.3	309.0	93	0.0	0	57.4	17
6011856A	Aot Hd Filter	0.1	238.4	24	38.6	4	46.0	5
201860-241	IMU	41.0	307.0	12587	0.0	0	49.9	2046
6007000-041	PTA	14.5	304.2	4411	0.0	0	29.5	428
	Harness B	4.4	305.0	1342	4.8	21	37.5	165
	Total Actual LM 12 Ascent Stage Hardware including Bethpage installed GFE	4145.7	257.4	1067103	0.7	2759	1.8	7533
	Total Calculated LM 12 Ascent Stage Hardware including Bethpage installed GFE	4206.2	257.4	1082721	0.6	2417	1.6	6541
	Manufacturing Variation	-60.5	-	-15618	-	342	-	992

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

	<u>WEIGHT</u>	<u>X</u>	<u>WX</u>	<u>Y</u>	<u>WY</u>	<u>Z</u>	<u>WZ</u>
LM-12 DESCENT STAGE AS WEIGHED	3433.4	153.6	527565	6.02	20655	-3.46	-11885
<u>NON-FLIGHT ITEMS AND LIQUIDS ON AT WEIGHING</u>	-71.2	161.6	(-11508)	13.9	(-988)	-7.9	(565)
LSK 340-1658-1-1 Mass Rep. - Ladder	-6.8	143.8	-978	0.0	0	-138.0	-938
LSC 270-714-113 Dummy Pyro Squibs	-1.8	196.0	-353	0.0	0	0.0	0
LDW 270-52307-1 SHe Tank Cover	-17.5	148.3	-2595	+44.8	-784	-47.2	826
LSC 420-61059-1 Dessicator (2)	-1.3	198.0	-257	0.0	0	0.0	0
LDW 420-11006-3 Dummy Guillotine	-3.7	196.0	-725	+35.9	-133	+31.3	-116
LDW 420-13123-3 RTG Support Cover	-3.0	145.0	-435	-92.0	+276	-41.0	+123
LDW 430-54727-1 GSE Glycol Loop (Q. III)	-1.0	180.0	-180	+69.0	-69	-30.0	+30
LDW 430-54727-3 GSE Glycol Loop (Q III)	-3.0	180.0	-540	+69.0	-207	-30.0	+90
LDW 430-54727-6 GSE GOX Loop (Q. III)	-1.0	180.0	-180	+69.0	-69	-30.0	+30
LDW 430-54727-6 GSE GOX Loop (Q. I)	-1.0	180.0	-180	-30.0	+30	+68.0	-68
LSW 815-10042-1 Accelerometer (3) Quad III	-1.2	130.0	-156	+27.0	-32	-81.0	+97
LSW 815-10042-1 Accelerometer (3) Batt. Rk.	-1.3	170.5	-222	0.0	0	-87.0	113
LDW 420-83281-5-1 Dummy Battery Studs (5)	-5.0	170.5	-852	0.0	0	-87.0	435
Blanket Pressure in Main Tanks	-18.5	157.1	-2906	0.0	0	0.0	0
Hoist Lugs (4)	-3.0	204.3	-613	0.0	0	19.0	-57
Temporary Installations (dust caps, red tags, plastic bags, etc.)	-2.1	160.0	-336	0.0	0	0.0	0

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DERIVATION OF DESCENT 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>
FLIGHT ITEMS MISSING AT WEIGHING	(968.4)	167.9	(162548)	8.9	(8580)	-60.1	(-58232)
<u>1.0 STRUCTURE</u>							
LDW 280-18728-11 (4) Shield	1.3	123.7	161	0.0	0	0.0	0
LDW 280-18728-13 (2) Shield	0.6	123.7	74	0.0	0	0.0	0
LDW 280-18728-19 (4) Shield	0.2	123.7	25	0.0	0	0.0	0
LDW 280-18944-11 Vent-Shield	0.1	166.8	17	32.5	3	-76.5	-8
LDW 280-52574-1 LRAA Reflector Shield	3.0	106.3	319	-28.0	-84	-34.3	-103
LDW 280-53644-23 Fwd. I/S Shield	0.8	198.2	159	0.0	0	65.9	53
LDW 280-53646-31 R.H. Aft I/S Shield	0.8	196.5	159	71.0	57	-27.0	-22
LDW 280-53649-21 L.H. Aft I/G Shield	0.2	196.5	39	-71.0	-14	-27.0	-5
LDW 280-54739-3-2 QII Side Plume Shield	0.8	168.0	134	40.5	32	-67.5	-54
LDW 280-56767-1 Shield Alsep Door	0.6	144.4	87	-61.8	-37	-61.8	-37
LDW 280-56767-9 Shield Alsep Door	0.5	144.4	72	-61.8	-31	-61.8	-31
LDW 280-60505-19-1 Shield	0.8	163.6	131	54.0	43	54.0	43
LDW 280-60505-39 Shield	0.8	163.6	131	54.0	43	54.0	43
LDW 280-60505-41 Shield	0.8	163.6	131	54.0	43	54.0	43
LDW 280-60511-19 (4) Shield-Catenary	3.8	123.7	470	0.0	0	0.0	0
LDW 280-60511-45 (4) Shield-Catenary	0.6	123.7	74	0.0	0	0.0	0
LDW 280-60511-47 (2) Shield-Catenary	1.1	123.7	136	0.0	0	0.0	0
LDW 280-60511-48 (2) Shield-Catenary	0.9	123.7	111	0.0	0	0.0	0
LDW 280-60511-53 (2) Shield-Catenary	0.5	123.7	62	0.0	0	0.0	0
LDW 280-60511-54 (2) Shield-Catenary	0.5	123.7	62	0.0	0	0.0	0
LDW 280-60511-103 Shield-Catenary	3.0	123.7	371	0.0	0	0.0	0
LDW 280-60551-1 Shld. Inst. QIII Payload	15.3	151.0	2310	65.4	1001	-65.4	-1001
LDW 280-60601-1 Rtg Shield Door	0.4	146.4	59	-81.0	-32	-41.0	-16
LDW 280-60605-19 Shield	1.6	163.0	261	0.0	0	-81.0	-130
LDW 280-60605-20 Shield	1.6	163.0	261	0.0	0	-81.0	-130
LDW 280-60648-53 Shield	0.1	144.4	14	-61.8	-6	-61.8	-6
LDW 280-60665-9 Shield	0.2	163.0	33	-54.0	-11	-54.0	-11
LDW 280-60665-93 Shield	0.1	163.0	16	-54.0	-5	-54.0	-5
LDW 280-66532-1 QIII Plume Deflect.	10.6	217.0	2300	61.5	652	-61.5	-652
LDW 280-66532-2 QII Plume Deflect.	10.6	217.0	2300	-61.5	-652	-61.5	-652
LDW 280-66552-1 QI Plume Deflect.	10.7	217.0	2322	-61.5	-658	61.5	658
LDW 280-66552-2 QIV Plume Deflect.	10.6	217.0	2300	61.5	652	61.5	652

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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>1.0 STRUCTURE-CONT.</u>							
LDW 280-54626-4-1 Mechan. Instl-Alsep	0.3	157.1	47	-61.0	-18	-31.0	-9
LDW 280-60512-1-1 Mesa Actuator Assy	1.0	197.0	197	41.0	41	62.0	63
<u>2.0 STABILIZATION & CONTROL</u>							
<u>COMPLETE</u>							
<u>3.0 NAVIGATION AND GUIDANCE</u>							
LSC 370-400 LR Antenna Assy	29.4	117.4	3452	-54.0	-1588	-51.0	-1499
LDW 370-54018 LRAA Instl Hdwr	0.1	117.4	12	-54.0	-5	-51.0	-5
LSC 370-300 LR Electronics Assy	14.0	161.4	2260	-32.5	-455	-68.0	-952
<u>4.0 CREW PROVISIONS</u>							
LDW 340-11246-35 ECS LIOH Strap (2)	0.2	147.4	29	64.9	13	67.1	13
LDW 340-11976-1 Foam Side	0.8	168.0	134	47.1	38	80.5	64
LDW 340-11977-1 Strap Assy	0.1	168.0	17	47.1	5	80.5	8
LDW 340-55500-1-1 T.V. Camera Tripod	1.3	192.0	250	65.0	84	68.0	88
LDW 340-58630-3 Sample Bag #Z27	3.2	168.0	538	47.1	151	80.5	258
LDW 340-60015-1 Quad 3 Strap Assy	0.9	132.1	119	71.2	64	-53.4	-48
LDW 340-60607-3-1 S-Band Ant. Supt.	2.2	137.0	301	88.3	194	38.9	86
LDW 340-60609-1-1 Hand Tools Supt.	6.8	155.2	1055	38.5	262	84.8	577
LDW 340-60610-1 Color T.V. Cam. Supt.	5.5	182.3	1003	42.3	233	87.4	481
LDW 340-60611-1-4 EVA Pallet #1	15.3	171.2	2619	59.8	915	62.5	956
LDW 340-60612-1-3 EVA Pallet #2	15.1	158.6	2395	59.8	903	62.5	944
LDW 340-60613-1-2 EVA Pallet #3	6.0	145.9	875	59.8	359	62.5	375
LDW 340-60614-3-4 EVA Pallet #4	8.1	183.7	1488	59.8	484	62.5	506
LDW 340-60640-1 Sample Cont. Instl.	0.8	168.0	134	47.1	38	80.5	64
LDW 340-60777-1 70 MM Camera Supt.	3.6	192.0	691	46.9	169	79.4	286
LDW 340-60779- LRV Pallet Quad 3	34.6	155.5	5380	63.0	2180	-62.9	-2176
LDW 340-60782- Equip Pallet Quad 3	22.1	155.5	3437	78.0	1724	-43.7	-966
LDW 340-60784-5 Vise Assy	0.3	159.3	48	70.5	21	-57.5	-17

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TABLE III
DERIVATION OF DESCENT 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>4.0 CREW PROVISIONS - CONT.</u>							
LDW 340-60791-1 Sample Cont. Bags-6	3.0	186.7	560	69.0	207	47.0	141
LDW 340-60792-1 Sample Cont. Bag	0.2	186.7	37	69.0	14	47.0	9
LDW 340-10324-31 Decal Flag (2)	0.4	157.6	63	66.5	27	45.0	18
LDW 340-10324-33 Decal U.S. (2)	0.5	157.6	79	66.5	33	45.9	23
<u>5.0 ENVIRONMENTAL CONTROL</u>							
LSC 330-122 LioH Cartridge	9.3	139.1	1294	84.5	786	41.5	386
LSC 330-122 LioH Cartridge	9.3	143.7	1336	45.4	422	81.8	761
LSC 330-505 I/S Disconn. Quad 3	1.5	196.0	294	60.7	91	-30.3	-45
LSC 330-507 Flex Lines (3) Quad 3	0.8	191.6	153	60.4	48	-30.7	-25
LSC 330-54013 I/S Disconn. Instl.	0.6	201.0	121	60.7	36	-28.7	-17
LSC 330-505 I/S Disconn. Quad 1	0.5	207.3	104	-27.5	-14	70.6	35
LSC 330-507 Flex Lines Quad 1	0.3	199.9	60	-27.5	-8	74.0	22
LSC 330-60020 I/S Disconn. Instl	0.7	206.6	145	-27.5	-19	70.6	49
<u>6.0 LANDING GEAR</u>							
LDW 320M10918-1 Bolt (3)	0.6	128.1	77	0.0	0	0.0	0
LDW 340-60647 Ladder Instl.	7.1	143.8	1021	0.0	0	138.0	980
<u>7.0 INSTRUMENTATION</u>							
COMPLETE							
<u>8.0 ELECTRICAL POWER SUPPLY</u>							
LSC 390-22000 Battery	134.1	170.5	22864	-11.0	-1475	-87.0	-11667
LSC 390-22000 Battery	134.1	170.5	22864	11.0	1475	-87.0	-11667
LSC 390-22000 Battery	134.1	170.5	22864	0.0	0	-87.0	-11667
LSC 390-22000 Battery	134.0	170.5	22864	22.0	2950	-87.0	-11667
LSC 390-22000 Battery	134.0	170.5	22864	-22.0	-2950	-87.0	-11667
LDW 390-59430 A/S Cable Weighed w. D/S	-2.8	198.0	-554	27.0	-76	32.0	-90
LDW 390-59431 A/S Cable Weighed w. D/S	-2.6	198.0	-515	27.0	-70	32.0	-83
A/S Portion of Ed Harness on D/S	-1.3	198.0	-257	27.0	-35	34.0	-44

TABLE III
DERIVATION OF DESCENT 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>							
LDW 270-23101-15 Eng. Thermal Plug	0.7	132.7	93	0.0	0	0.0	0
<u>11.0 COMMUNICATIONS</u>							
COMPLETE							
<u>12.0 CONTROLS AND DISPLAYS</u>							
COMPLETE							
<u>13.0 EXPLOSIVE DEVICES</u>							
LSC 270-714-113 He. Xpl Bstr Cart	1.2	181.6	218	-10.6	-13	-28.6	-34
LSC 320-301 Pyro Battery	3.6	189.9	684	62.1	224	34.5	124
LSC 320-307 L.G. Uplock Mech (4)	2.2	127.7	281	0.0	0	0.0	0
LSC 320-309 Umbilical Cutter Assy	3.2	195.3	625	35.9	115	31.9	102
LSC 320-315-15 Cartridge Assy (2)	0.1	195.3	20	35.9	4	31.9	3
LSC 320-315-15 Cartridge Assy (8)	0.4	127.7	51	0.0	0	0.0	0
LSC 320-30400-13 Bolt Assy-Aft. LH.	0.7	201.3	141	-65.0	-46	-27.0	-19
LSC 320-30400-13 Bolt Assy-Aft. RH.	0.7	201.3	141	55.0	46	-27.0	-19
LSC 320-30400-13 Bolt Assy-FWD LH.	0.7	207.3	145	-23.4	-16	65.9	46
LSC 320-30400-13 Bolt Assy-FWD RH.	0.7	207.3	145	23.4	16	65.9	46
LSC 320-30400-21 Cartridge Assy	0.1	207.3	20	-65.0	-7	-27.0	-3
LSC 320-30400-21 Cartridge Assy	0.1	207.3	20	65.0	7	-27.0	-3
LSC 320-30400-21 Cartridge Assy	0.1	207.3	21	-23.4	-2	65.9	7
LSC 320-30400-21 Cartridge Assy	0.1	207.3	21	23.4	2	65.9	7
<u>14.0 GOVERNMENT FURNISHED EQUIPMENT</u>							
COMPLETE							

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TABLE III

DERIVATION OF DESCENT 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>
Total Actual LM-10 Descent Stage Hardware including Bethpage Installed GFE only.	4330.6	156.7	678605	6.5	28247	-16.1	-69552
Total Calculated LM-10 Descent Stage Hardware including Bethpage Installed GFE only.	4367.4	156.7	684439	6.3	27642	-15.5	-67856
Manufacturing Variation	-36.8		-5834	-	605	-	-1696

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LM-12 VEHICLE DIAGRAM

* - Landing Gear Retracted
** - Landing Gear Extended

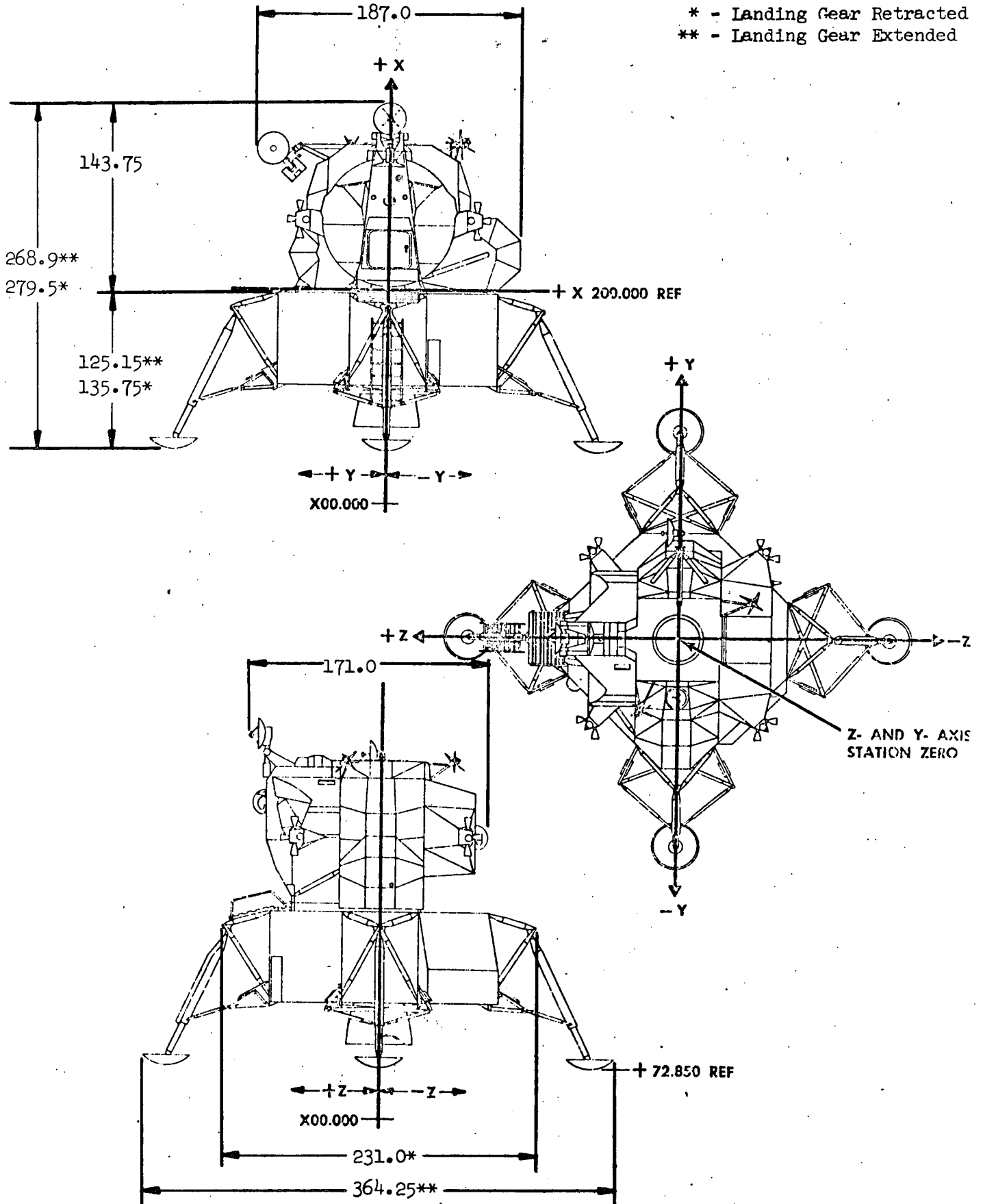


FIGURE 1Ascent Stage Center of Gravity/Thrust Vector Offset
vs. Control Boundary

Information to follow under separate cover. This data will now be supplied in the IM Mass Properties Data Book (Reference 4) as directed by CCA 2864 (Reference 3).

FIGURE IIDescent 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 4) as directed by CCA 2864 (Reference 3).

Derivation of the Dry IM-12 Mass Properties at Earth
Launch

Information to follow under separate cover. This data will now be supplied in the IM Mass Properties Data Book (Reference 4) as directed by CCA 2864 (Reference 3).

The Mass Properties of the LM-12 Vehicle at Pertinent Points
in the Mission as Obtained from the LM-12 Mass Properties
Data Book, LDP 490-12 to be Released

Information to follow under separate cover. In accordance with the direction of CCA 2864 (Reference 3) this information will no longer be supplied in this document; the mass properties are shown in the referenced data book.

LIST OF REFERENCES

1. OCP-GF-32001-LM-12 Ascent Stage - Weight and Center of Gravity Check,
dated 12 February 1971
2. OCP-GF-32012-LM-12 Descent Stage - Weight and Center of Gravity Check,
dated 1 March 1971
3. EDP Status K10707, LM-12 Configuration Combined Extract, dated 30 May
1971
4. DD 250. LM-12 Ascent Stage Acceptance Summary Report, dated 14 June 1971
5. DD 250. LM-12 Descent Stage Acceptance Summary Report, dated 14 June 1971
6. CCA 2864, Revised Mass Property Reporting and Weight Requirements, dated
20 July 1970.
7. LDP-490-12 LM-12 Mass Properties Data Book, to be released.
8. MSC Report No. V19-02-911-B. Apollo Stowage List, Mission J-3, CML14
LM-12 (Apollo 17), dated 18 May 1971
9. Vehicle No. 42. LM-12 Ascent Stage Temporary Installation Record.
10. Vehicle No. 42. LM-12 Descent Stage Temporary Installation Record.
11. Vehicle No. 42. LM-12 Ascent Stage Replacement Record.
12. Vehicle No. 42. LM-12 Descent Stage Replacement Record.
13. Vehicle No. 42. LM-12 Ascent Stage Part Installation and Removal Record.
14. Vehicle No. 42. LM-12 Descent Stage Part Installation and Removal Record.

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