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COPY NO. 11

CONTRACT REQUIREMENTS	CONTRACT ITEM	MODEL	CONTRACT NO.	DATE
Exhibit E, Para. 5.2	Line Item 13.0	LEM	NAS 9-1100	1/14/63

Type II

Primary Code 713

REPORT

NO. LED-490-6

DATE: 1 March 1964

LEM MASS PROPERTY REPORT [U]

CODE 26512

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REVISIONS

DATE	REV. BY	REVISIONS & ADDED PAGES	REMARKS

CLASSIFICATION CHANGE
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DOWNGRADED AT 3-YEAR
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INTRODUCTION

This report includes the status of the LEM Mass Properties as of February 15, 1964. The total weight at separation of 27472 is 462 pounds lighter than previously reported in LED-490-5, dated 31 January 1964. At this gross weight the vehicle meets the required performance (ΔV) and is 2375 pounds below the designated control weight of 29,500 pounds at Translunar Injection. Figures I & II illustrate the present relationship of LEM weight and performance capability.

A summary of changes since the last report are:

	Item	Weight
A.	Ascent stage Inert * Weight	-85 Lbs.
B.	Ascent stage Propellant - Reduced Inert Weight	-82
	- Increase in ΔV Budget (+5 fps)	+ 5
C.	Descent stage Inert * Weight	+10
D.	Descent stage Propellant - Reduction in Touchdown Wt.	-180
	- Reduction of ΔV Budget(57 fps)	-130
	Total LEM Weight Change at Separation	-462 Lbs.

Table 3, LEM Stage Weight History has been added in this report in order to simplify the usage of the data contained herein.

It should be noted that current weight status contained herein is based on Mission Time Profile and ΔV Budget, per Table 1 and Reference 4. Since neither of these values have been finalized reported weights will vary somewhat due to changes in the current values of these parameters.

The weight information in this report is predicated on the following pertinent data:

1) The ΔV budget, Ascent = 6683 fps and Descent = 7389 fps, is that recommended in GAEC memo LMO-500-37, Rev. D, dated 8 February 1964.

2) The tankage for consumables are sized by "Mission A" (Day Landing) while the quantity of consumables aboard are determined by "Mission B" (Earthshine Landing). The Total Mission Times are different by 50 hours, as shown on Page 6 of this Report.

* Inert weight includes all non-propulsive expendables

MISSION HISTORY OF WEIGHT AND PERFORMANCE

Condition	January 1964 Weight	January 1964 ΔV	January 1964 Isp	February 1964 Weight	February 1964 ΔV	February 1964 Isp
Earth Launch	27,587			27,126		
Separation	27,934	7446	301	27,472	7389	301
Touchdown	12,823			12,668		
Lunar Lift-off	9,282	6368	306	9,121	6373	306
Transfer Orbit	4,804	310	295	4,718	310	295
Burnout (Docked)	4,546			4,462		

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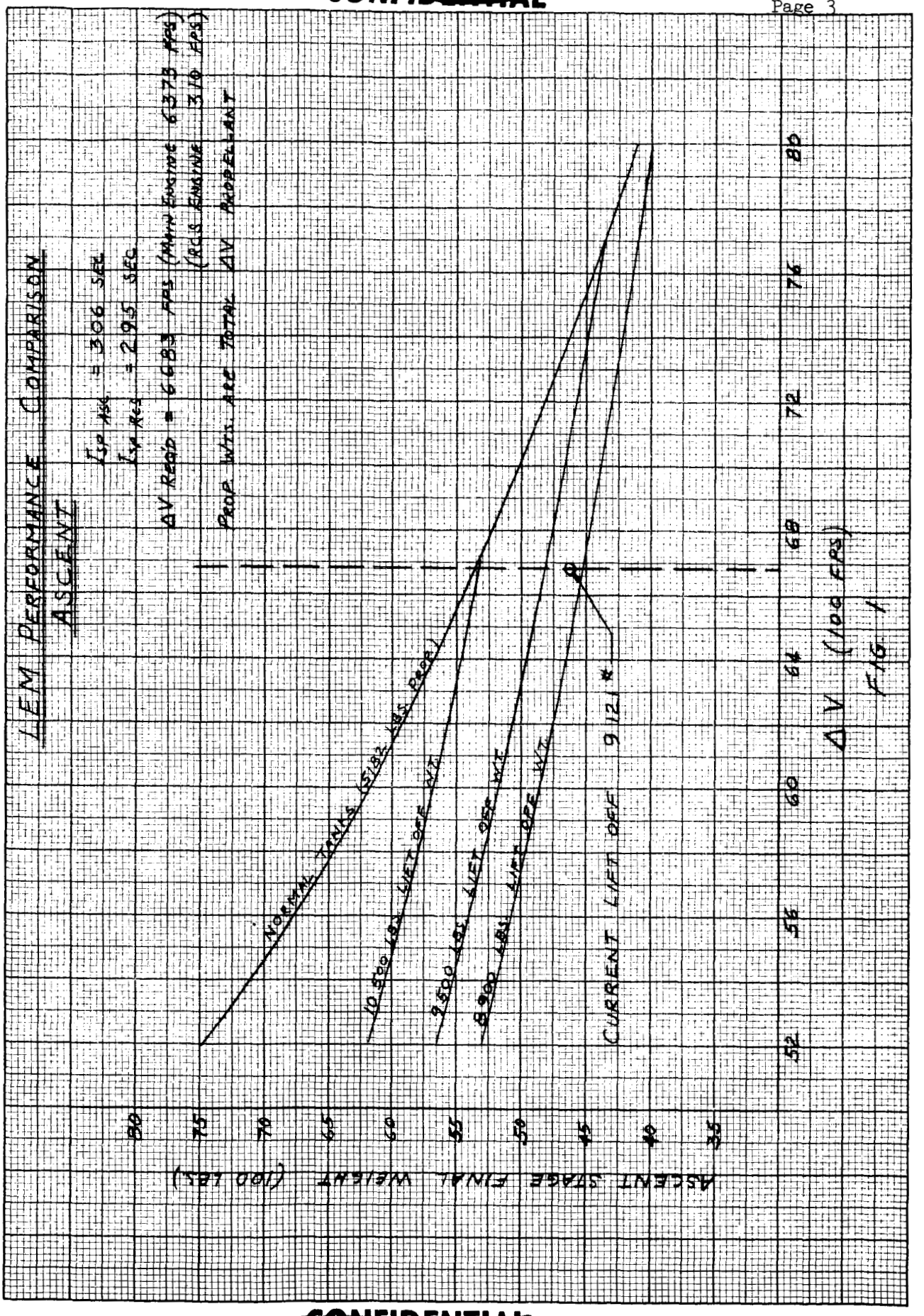

FIG 1

~~CONFIDENTIAL~~

10 X 10 TO THE ½ INCH 359T-11
KEUFFEL & ESSER CO.

K+E 10 X 10 TO THE 1/2 INCH 359T-11
KEUFFEL & ESSER CO. MADE IN U.S.A.
ALBANY, N.Y.

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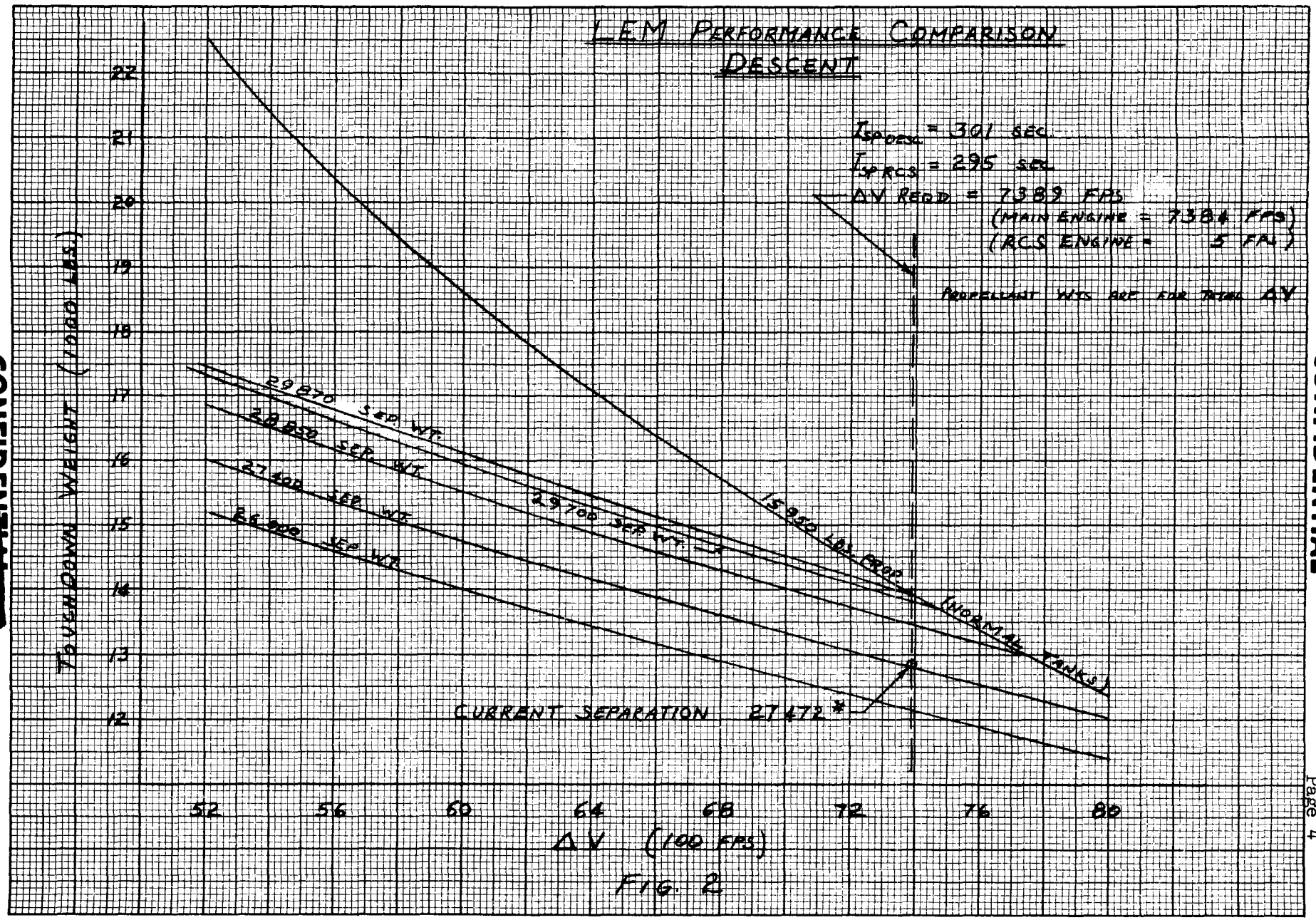

FIG. 2

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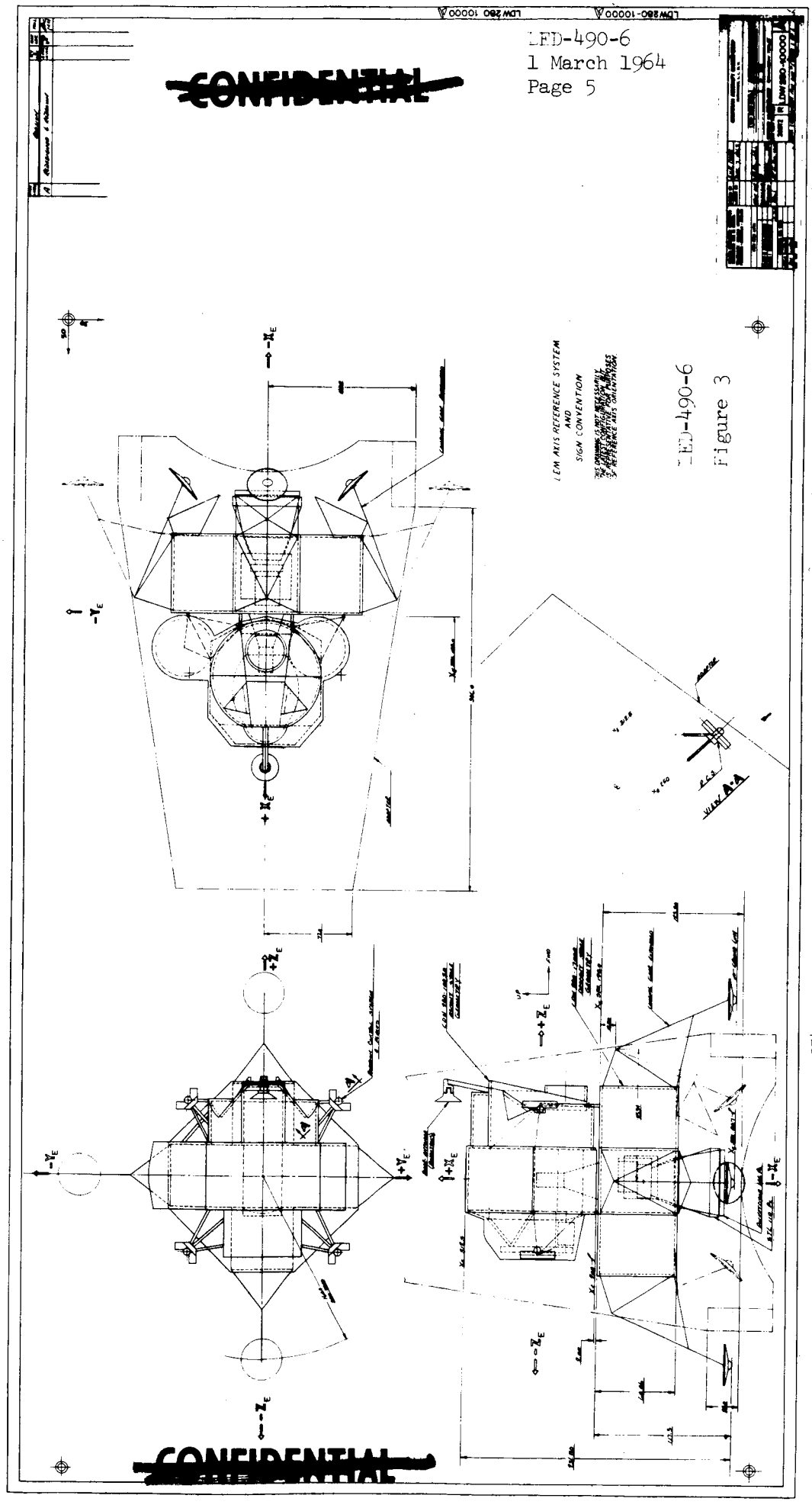

LED-490-6
Figure 3

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Table 1

SUMMARY OF LEM SIZING MISSION & WEIGHT REPORTING MISSION

MISSION PHASE		A SIZING MISSION (Day Landing) Per Ref. 1 & 2		B REPORTING MISSION (Earthshine Landing) For Loading Expendables				REMARKS
Description	Ltr.	Hours	Minutes	Hours	Minutes			
Prelaunch	C	10		10		Dormant Period		
Launch	D,E		12		12			
Earth Parking Orbit	F	4	30	2	48			
Translunar Injection	G		5		5			
Translunar Coast	H							
Prior to Transposition			20	1				
During Transposition			40					
Subsequent to Transposition	I	109		62	12			
Lunar Orbit	J							
Lunar Orbit Insertion			6		5			
Lunar Orbit Coast Prior to Sep.		2	30	2	30			
Lunar Orbit Checkout		1	30	1	30	Active Period		
LEM Separation, Checkout, and Insertion into Desc. Transfer Orbit	K		15		15		Post-Separation Period	Desc. Period- 1 Hr. 23min. to 1 Hr. 21 min.
Coast in Descent Transfer Orbit		1			58			
Powered Descent (& Hover)			8		8			
Lunar Staytime	L	35		34	36			Lunar Stay Period
Powered Ascent	M		8		6			
Parking Orbit Contingency		9*		9				
Coasting Ascent Transfer		1	30		42			Ascent Period - 11 Hr. 37 min. to 10 Hr. 33 min.
Rendezvous			24		10			
Docking			15		15			
Crew Transfer			20		20			
Dormant LEM Time		127	23	78	52			* The 9 hour contingency time in lunar orbit following Lunar lift-off will be provided at the expense of lunar surface stay time.
Active LEM Time		49	30	48	0			
Post-Separation LEM Time		(48)	(0)	(46)	(30)			
Total LEM Period		176	53	126	52			

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Table 2

LEM WEIGHT BY STAGES

AT EARTH LAUNCH

		ASCENT STAGE	DESCENT STAGE	TOTAL
1.0	Structure	924.7	940.5	1865.2
2.0	Stabilization & Control	74.6	7.5	82.1
3.0	Navigation & Guidance	238.0	10.0	248.0
4.0	Crew Provisions *	148.2	5.0	153.2
5.0	ECS	306.8	170.6	477.4
6.0	Landing Gear	--	387.0	387.0
7.0	Instrumentation	283.5	235.0	518.5
8.0	Electrical Power Supply	817.3	284.7	1102.0
9.0	Propulsion Inert	633.9	1578.3	2212.2
10.0	Reaction Control	847.1	---	847.1
11.0	Communication	78.2	20.6	98.8
12.0	Controls & Displays	262.9	---	262.9
	Totals - Inert	4615.2	3639.2	8254.4
	Add Main Propulsion ΔV Propellant	4244.3	14626.8	18871.1
	Total with ΔV Propellant	8859.5	18266.0	27125.5

* Without crew, suits, radiation dosimeter, etc. (426.2#).

Table 3

LEM STAGE WEIGHT HISTORY

MISSION PHASE AND CONSUMABLE DESCRIPTION	ASCENT STAGE		DESCENT STAGE		TOTAL WEIGHT (LBS.)
	DRY WEIGHT (LBS.)	ΔV-PROPELLANT WEIGHT (LBS.)	DRY WEIGHT (LBS.)	ΔV-PROPELLANT WEIGHT (LBS.)	
EARTH LAUNCH AND TRANSLUNAR INJECTION	4323.3	4525.2	3650.2	14626.8	27125.5
Crew and Equipment	+426.2				
Water, Oxygen & Hydrogen			-79.8		
SEPARATION	4749.5	4525.2	3570.4	14626.8	27471.9
Landing Flare			- 5.0		
Water, Oxygen & Hydrogen			-29.3		
Descent ΔV Propellant					
- Main				-14626.8	
- RCS		-27.9			
RCS - Attitude Propellant	-115.2				
LUNAR TOUCHDOWN	4634.3	4497.3	3536.1		12667.7
Scientific Samples & Equip.	+ 40.0		-210.0		
Jettisoned on Lurain	- 51.0		-3326.1		
LUNAR LIFT-OFF	4623.3	4497.3			9120.6
Water, Oxygen & Hydrogen	- 71.4				
Ascent ΔV Propellant					
- Main		-4244.3			
- RCS		- 253.0			
RCS - Attitude Propellant	- 89.9				
BURNOUT (DOCKING)	4462.0				4462.0

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LEM
SUMMARY WEIGHT STATEMENT

CODE	ITEM	1/31/64 WEIGHT AT SEPARATION	CURRENT WEIGHT STATUS: BURN OUT	CONS'D ON ASCENT	JET ON LURAIN	CONS'D ON DESCENT	TOTAL SEPARATION	X-LUNAR EXPEND-ABLES	EARTH LAUNCH TOTAL
1.0	Structure	1865.2	924.7		940.5		1865.2		1865.2
2.0	Stabilization & Control	111.5	74.6		7.5		82.1		82.1
3.0	Navigation & Guidance	290.7	220.0		28.0		248.0		248.0
4.0	Crew Provisions	579.4	568.8		5.6	5.0	579.4	-426.2	153.2
5.0	Environmental Control	(421.1)	(224.8)	(54.6)	(123.4)	(16.3)	(419.1)	(58.3)	(477.4)
	-Inert	232.7	206.2	0	26.0	0	232.2	0	232.2
	-Expendables	188.4	18.6	54.6	97.4	16.3	186.9	58.3	245.2
6.0	Landing Gear	387.0			387.0		387.0		387.0
7.0	Instrumentation	518.5	323.5		195.0		518.5		518.5
8.0	Electrical Power	(1080.5)	(800.5)	(16.8)	(250.2)	(13.0)	(1080.5)	(21.5)	(1102.0)
	-Inert	936.8	800.5	0	136.3	0	936.8	0	936.8
	-Expendables	143.7	0	16.8	113.9	13.0	143.7	21.5	165.2
9.0	Propulsion	(21468.2)	(633.9)	(4244.3)	(1578.3)	(14626.8)	(21083.3)		(21083.3)
	-Inert	2212.2	633.9	0	1578.3	0	2212.2		2212.2
	-Expend.- Δ V Propellant	19256.0	0	4244.3	0	14626.8	18871.1		18871.1
10.0	Reaction Control	(849.2)	(361.1)	(342.9)		(143.1)	(847.1)		(847.1)
	-Inert	361.1	361.1	0		0	361.1		361.1
	-Expendables -Att. Prop.	205.1		89.9		115.2	205.1		205.1
	-ΔV Propellant	283.0		253.0		27.9	280.9		280.9

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LEM
SUMMARY WEIGHT STATEMENT (Cont.)

CODE	ITEM	1/31/64 WEIGHT AT SEPARATION	CURRENT WEIGHT STATUS: BURN OUT	CONS'D ON ASCENT	JET. ON LURAIN	CONS'D ON DESCENT	TOTAL SEPARATION	X-LUNAR EXPEND-ABLES	EARTH LAUNCH TOTAL
11.0	Communications	104.3	67.2		31.6		98.8		98.8
12.0	Controls & Displays	258.0	262.9				262.9		262.9
	Total								
	-Inert	7857.4	4443.4	0	3335.8	0	7779.2	-426.2	7353.0
	-Expend. -W/O V Prop.	537.2	18.6	161.3	211.3	149.5	540.7	79.8	620.5
	-ΔV Prop. Only	19539.0	0	4497.3	0	14654.7	19152.0		19152.0
	Total	27933.6	4462.0	4658.6	3547.1	14804.2	27471.9	-346.4	27125.5
	Burnout Weight	4545.7	4462.0 Lbs.						
	Lift-off Weight	9281.5		9120.6 Lbs.					
	Touchdown Weight	12823.1			12667.7 Lbs.				
	Separation Weight	27933.6					27471.9 Lbs.		
	Earth Launch Weight	27587.2							27125.5 Lbs.

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LEM
WEIGHT STATEMENT

CODE	ITEM	1/31/64 WEIGHT AT SEPARATION	CURRENT WEIGHT STATUS: BURN OUT	CONS'D ON ASCENT	JET. ON LURAIN	CONS'D ON DESCENT	TOTAL SEPARATION	X-LUNAR EXPEND-ABLES	EARTH LAUNCH TOTAL
1.0	Structure	1865.2	924.7		940.5		1865.2		1865.2
1.1	Crew Compartment	(564.0)	(564.0)				(564.0)		(564.0)
1.1.1	Skin	115.7	115.7				115.7		115.7
1.1.2	MM Shielding	0	0				0		0
1.1.3	Thermal Protection	19.0	19.0				19.0		19.0
1.1.4	Bulkheads	4.9	4.9				4.9		4.9
1.1.5	Beams	30.0	30.0				30.0		30.0
1.1.6	Longerons	18.2	18.2				18.2		18.2
1.1.7	Stiffeners	37.8	37.8				37.8		37.8
1.1.8	Frames	12.1	12.1				12.1		12.1
1.1.9	Windows	40.7	40.7				40.7		40.7
1.1.10	Docking Tube	129.6	129.6				129.6		129.6
1.1.11	Hatches	50.0	50.0				50.0		50.0
1.1.12	Equipment Support	34.0	34.0				34.0		34.0
1.1.13	Flooring	51.8	51.8				51.8		51.8
1.1.14	Welds & Fasteners	20.2	20.2				20.2		20.2
1.2	Equipment Compartment	(91.9)	(91.9)				(91.9)		(91.9)
1.2.1	Skin	--	--				--		--
1.2.2	Thermal Protection	11.0	11.0				11.0		11.0
1.2.3	MM Shielding	0	0				0		0
1.2.4	Vertical Supports	7.3	7.3				7.3		7.3
1.2.5	Stiffeners	19.7	19.7				19.7		19.7
1.2.6	Misc. Support Structure	30.0	30.0				30.0		30.0
1.2.7	Cold Plates	18.7	18.7				18.7		18.7
1.2.8	Weld and Fasteners	5.2	5.2				5.2		5.2

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LEM
WEIGHT STATEMENT

CODE	ITEM	1/31/64 WEIGHT AT SEPARATION	CURRENT WEIGHT STATUS: BURN OUT	CONS'D ON ASCENT	JET. ON LURAIN	CONS'D ON DESCENT	TOTAL SEPARATION	X-LUNAR EXPEND-ABLES	EARTH LAUNCH TOTAL
1.3	Engine/Tank Compartment	(222.9)	(222.9)				(222.9)		(222.9)
1.3.1	Skin	--	--				--		--
1.3.2	Thermal Protection	35.7	35.7				35.7		35.7
1.3.3	MM Shielding	0	--				--		--
1.3.4	Bulkheads	111.8	111.8				111.8		111.8
1.3.5	Stiffeners	10.7	10.7				10.7		10.7
1.3.6	Engine Supports	6.0	6.0				6.0		6.0
1.3.7	Tank Supports	16.0	16.0				16.0		16.0
1.3.8	Deck	15.0	15.0				15.0		15.0
1.3.9	Beams	14.5	14.5				14.5		14.5
1.3.10	Weld and Fasteners	13.2	13.2				13.2		13.2
1.4	Bulkhead (Ascent)	(45.9)	(45.9)				(45.9)		(45.9)
1.4.1	Structure	18.7	18.7				18.7		18.7
1.4.11	Insulation	27.2	27.2				27.2		27.2
1.10	Descent Stage Structure	(940.5)			(940.5)		(940.5)		(940.5)
1.10.1	Skin (Closure)	140.8			140.8		140.8		140.8
1.10.2	Beams and Bulkheads	417.7			417.7		417.7		417.7
1.10.3	MM Shielding	0			0		0		0
1.10.4	Thermal Protection	92.0			92.0		92.0		92.0
1.10.5	Supports	140.8			140.8		140.8		140.8
1.10.6	L.G. Support Truss	81.2			81.2		81.2		81.2
1.10.7	Separation System	29.0			29.0		29.0		29.0
1.10.8	S-IV-B Attachment Penalty	24.0			24.0		24.0		24.0
1.10.9	Ladder	15.0			15.0		15.0		15.0

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LEM
WEIGHT STATEMENT

CODE	ITEM	1/31/64 WEIGHT AT SEPARATION	CURRENT WEIGHT STATUS: BURN OUT	CONS'D ON ASCENT	JET. ON LURAIN	CONS'D ON DESCENT	TOTAL SEPARATION	X-LUNAR EXPEND-ABLES	EARTH LAUNCH TOTAL
2.0	Stabilization & Control	111.5	74.6		7.5		82.1		82.1
2.1	Guidance Coupler Assy.	6.0	(1.5)				(1.5)		(1.5)
2.1.1	Engine Logic Box	--	1.0				1.0		1.0
2.1.2	Mode Switch	--	.5				.5		.5
2.2	Att. Translation Control Assy	22.0	22.0				22.0		22.0
2.3	Rate Gyro Assy. (2)	3.0	3.6				3.6		3.6
2.4	Inflight Monitor Assy.	10.0	10.0				10.0		10.0
2.5	Descent Engine Control Syst.	(7.5)			(7.5)		(7.5)		(7.5)
2.5.1	Descent Engine Control Assy	1.5			1.5		1.5		1.5
2.5.2	Gimbal Drive Actuators (2)	6.0			6.0		6.0		6.0
2.6	Back Up Guidance System	(63.0)	(37.5)				(37.5)		(37.5)
2.6.1	Programmer Assembly	20.0	7.5				7.5		7.5
2.6.2	Att., Reference Assy.*	43.0	30.0				30.0		30.0

* This is a strapped down system and includes sensor package 15#, electronics and power supply 15#.

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LEM
WEIGHT STATEMENT

CODE	ITEM	1/31/64 WEIGHT AT SEPARATION	CURRENT WEIGHT STATUS: BURN OUT	CONS'D ON ASCENT	JET. ON LURAIN	CONS'D ON DESCENT	TOTAL SEPARATION	X-LUNAR EXPEND-ABLES	EARTH LAUNCH TOTAL
3.0	Navigation & Guidance	290.7	220.0		28.0		248.0		248.0
3.1	GFE	(189.7)	(147.0)				(147.0)		(147.0)
3.1.1	IMU	59.0	42.0				42.0		42.0
3.1.2	AOT & Eyepieces	24.5	24.5				24.5		24.5
3.1.3	LGC	59.6	41.5				41.5		41.5
3.1.4	PSA	34.6	27.0				27.0		27.0
3.1.5	Star, Maintenance Book	2.0	2.0				2.0		2.0
3.1.6	Cabling	10.0	10.0				10.0		10.0
3.1.7	Navigation Base	--	--				--		--
3.1.8	Cold Plate	--	--				--		--
3.2	Rendezvous Radar	(73.0)	(73.0)				(73.0)		(73.0)
3.2.1	Gimbaled Antenna	62.0	62.0				62.0		62.0
3.2.2	Electronics								
3.2.3	Transponder	11.0	11.0				11.0		11.0
3.3	Landing Radar	(28.0)			(28.0)		(28.0)		(28.0)
3.3.1	Stabilizer Antenna	10.0			10.0		10.0		10.0
3.3.2	Electronics	18.0			18.0		18.0		18.0

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LEM
WEIGHT STATEMENT

CODE	ITEM	1/31/64 WEIGHT AT SEPARATION	CURRENT WEIGHT STATUS: BURN OUT	CONS'D ON ASCENT	JET. ON LURAIN	CONS'D ON DESCENT	TOTAL SEPARATION	X-LUNAR EXPEND-ABLES	EARTH LAUNCH TOTAL
4.0	Crew Provisions	(579.4)	568.8		5.6	5.0	579.4	-426.2	153.2
4.1	Crew Accessories	(133.0)	(133.0)				(133.0)	(-73.0)	(60.0)
4.1.1	Space Suits (2)	60.0	60.0				60.0	-60.0*	0
4.1.2	Portable Life Supt Syst. (2)	60.0	60.0				60.0		60.0
4.1.3	Radiation Dosimeter (2)	5.0	5.0				5.0	- 5.0*	0
4.1.4	Miscellaneous - GFE	8.0	8.0				8.0	- 8.0*	0
4.2	Crew (2)	353.2	353.2				353.2	-353.2*	0
4.3	Seats & Restraints (2)	50.0	50.0				50.0		50.0
4.4	Lighting **	(25.0)	(20.0)			(5.0)	(25.0)		(25.0)
4.4.1	Landing	5.0				5.0	5.0		5.0
4.4.2	Hatchway	4.0	4.0				4.0		4.0
4.4.3	Cabin	8.0	8.0				8.0		8.0
4.4.4	Running (Docking)	8.0	8.0				8.0		8.0
4.5	Sustenance & Assoc. Equip.	(18.2)	(12.6)		(5.6)		(18.2)		(18.2)
4.5.1	Drinking Water	***							***
4.5.2	Food & Storage	15.7	10.1		5.6		15.7		15.7
4.5.3	First Aid Kit	2.5	2.5				2.5		2.5
4.6	Waste Management	--					--		--

* Crew, Space Suits, Radiation Dosimeter and Miscellaneous GFE is considered part of inert weight.
** Panel lighting (10#) is under Controls and Displays.
*** Drinking water is under ECS code.

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LEM
WEIGHT STATEMENT

CODE	ITEM	1/31/64 WEIGHT AT SEPARATION	CURRENT WEIGHT STATUS: BURN OUT	CONS'D ON ASCENT	JET. ON LURAIN	CONS'D ON DESCENT	TOTAL SEPARATION	X-LUNAR EXPEND-ABLES	EARTH LAUNCH TOTAL
5.0	Environmental Control	421.1	224.8	54.6	123.4	16.3	419.1	58.3	477.4
5.1	Atmosphere Revitalization Section	(120.2)	(92.8)		(27.4)		(120.2)		(120.2)
5.1.1	Suit Circuit Assembly	30.8	30.8				30.8		30.8
5.1.2	Cabin Recirculation Assy.	19.7	19.7				19.7		19.7
5.1.3	CO_2 Removal Cannister	3.3	3.3				3.3		3.3
5.1.4	Plumbing	18.4	18.4				18.4		18.4
5.1.5.1	LIOH Cartridges-PLSS (6)	26.4	8.8		17.6		26.4		26.4
5.1.5.2	LIOH Cartridges-ECS (4)	19.6	9.8		9.8		19.6		19.6
5.1.6	CO_2 System	2.0	2.0				2.0		2.0
5.2	Heat Transport Sect.	(64.4)	(64.4)				(64.4)		(64.4)
5.2.1	Coolant Recirculation Assy.	7.0	7.0				7.0		7.0
5.2.2	Valves & Switches	27.4	27.4				27.4		27.4
5.2.3	Cold Plates *	--							
5.2.4	Coolant	30.0	30.0				30.0		30.0
5.3	O_2 Supply & Cabin Pressure Section	(35.8)	(26.3)	(7.5)			(33.8)		(33.8)
5.3.1	GOX Accumulator	18.6	15.5				15.5		15.5
5.3.2	GOX	9.0		7.5			7.5		7.5
5.3.3	Valves & Switches	8.2	10.8				10.8		10.8
5.3.4	SOX & SOX Tank **	--							
5.4	Water Management Section	(168.4)	(10.5)	(47.1)	(94.5)	(16.3)	(168.4)	(58.3)	(226.7)
5.4.1	Water Tank	29.5	6.5		23.0		29.5		29.5
5.4.2	Water	133.4	0	47.1	70.0	16.3	133.4	58.3	191.7
5.4.3	Valves & Switches	5.5	4.0		1.5		5.5		5.5

* Included in Structures.
** Included in EPS.

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LEM
WEIGHT STATEMENT

CODE	ITEM	1/31/64 WEIGHT AT SEPARATION	CURRENT WEIGHT STATUS BURN OUT	CONS'D ON ASCENT	JET. ON LURAIN	CONS'D ON DESCENT	TOTAL SEPARATION	X-LUNAR EXPEND-ABLES	EARTH LAUNCH TOTAL
5.5	Plumbing - GAEC	(32.3)	(30.8)		(1.5)		(32.3)		(32.3)
	Heat Transport & Water Management	10.5	9.0		1.5		10.5		10.5
	Atmos. Revit. & Water Supply	20.0	20.0				20.0		20.0
	Heat Exchangers *** (3)	1.8	1.8				1.8		1.8
	Total ECS - Inert	232.7	206.2	0	26.0	0	232.2	0	232.2
	Total ECS - Expendables	188.4	18.6	54.6	97.4	16.3	186.9	58.3	245.2

*** Includes an additional heat exchanger for O_2 and two heat exchangers for H_2 in EPS.

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WEIGHT STATEMENT

CODE	ITEM	1/31/64 WEIGHT AT SEPARATION	CURRENT WEIGHT STATUS: BURN OUT	CONS'D ON ASCENT	JET. ON LURAIN	CONS'D ON DESCENT	TOTAL SEPARATION	X-LUNAR EXPEND-ABLES	EARTH LAUNCH TOTAL
6.0	Landing Gear	387.0			387.0		387.0		387.0
6.1	Upper Struts	(156.0)			(156.0)		(156.0)		(156.0)
6.1.1	Tubes	104.0			104.0		104.0		104.0
6.1.2	Fittings	32.0			32.0		32.0		32.0
6.1.3	Shocks	20.0			20.0		20.0		20.0
6.2	Lower Struts	(67.0)			(67.0)		(67.0)		(67.0)
6.2.1	Tubes	28.0			28.0		28.0		28.0
6.2.2	Fittings	11.0			11.0		11.0		11.0
6.2.3	Shocks	28.0			28.0		28.0		28.0
6.3	Mechanism	104.0			104.0		104.0		104.0
6.4	Pads & Fittings	(60.0)			(60.0)		(60.0)		(60.0)
6.4.1	Pads	48.0			48.0		48.0		48.0
6.4.2	Fittings	12.0			12.0		12.0		12.0

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LEM
WEIGHT STATEMENT

CODE	ITEM	1/31/64 WEIGHT AT SEPARATION	CURRENT WEIGHT STATUS: BURN OUT	CONS'D ON ASCENT	JET. ON LURAIN	CONS'D ON DESCENT	TOTAL SEPARATION	X-LUNAR EXPEND-ABLES	EARTH LAUNCH TOTAL
7.0	Instrumentation	518.5	323.5		195.0		518.5		518.5
7.1	Operational	(83.5)	(83.5)				(83.5)		(83.5)
7.1.1	Signal Conditioner	45.0	45.0				45.0		45.0
7.1.2	PCMTE	32.5	32.5				32.5		32.5
7.1.3	Data Storage Equipment	6.0	6.0				6.0		6.0
7.2	In-Flight Status System	(50.0)	(50.0)				(50.0)		(50.0)
7.2.1	On Board Checkout Equip.	25.0	25.0				25.0		25.0
7.2.2	Emergency Detection Equip.	10.0	10.0				10.0		10.0
7.2.3	Caution & Warning Equip.	15.0	15.0				15.0		15.0
7.3	Scientific Equipment	250.0	80.0		170.0		250.0		250.0
7.4	Sensors	(135.0)	(110.0)		(25.0)		(135.0)		(135.0)
7.4.1	Structure	10.0	10.0				10.0		10.0
7.4.2	Stabilization & Control	11.0	11.0				11.0		11.0
7.4.3	Navigation & Guidance	2.0	2.0				2.0		2.0
7.4.5	Environmental Control Sys.	21.0	21.0				21.0		21.0
7.4.7	Instrumentation	2.0	2.0				2.0		2.0
7.4.8	Electrical Power Syst.	9.0	9.0				9.0		9.0
7.4.9	Propulsion	53.0	28.0		25.0		53.0		53.0
7.4.10	Reaction Control System	21.0	21.0				21.0		21.0
7.4.11	Communications	6.0	6.0				6.0		6.0

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WEIGHT STATEMENT

CODE	ITEM		1/31/64 WEIGHT AT SEPARATION	CURRENT WEIGHT STATUS: BURN OUT	CONS'D ON ASCENT	JET. ON LURAIN	CONS'D ON DESCENT	TOTAL SEPARATION	X-LUNAR EXPEND-ABLES	EARTH LAUNCH TOTAL
8.0	Electrical Power Supply*		1080.5	800.5	16.8	250.2	13.0	1080.5	21.5	1102.0
8.1	Power Generation Section		(491.5)	(259.5)	(16.8)	(202.2)	(13.0)	(491.5)	(21.5)	(513.0)
8.1.1	Fuel Cells **	(2)	150.0	150.0				150.0		150.0
8.1.2	Oxygen Tanks	(2)	23.6	2.8		20.8		23.6		23.6
8.1.3	Hydrogen Tanks	(3)	55.6	10.5		45.1		55.6		55.6
8.1.4.1	Oxygen-Ascent		11.6		11.6			11.6		11.6
8.1.4.2	-Descent		99.9			90.9	9.0	99.9	16.0	115.9
8.1.5.1	Hydrogen-Ascent		5.2		5.2			5.2		5.2
8.1.5.2	-Descent		27.0			23.0	4.0	27.0	5.5	32.5
8.1.6	Auxiliary Battery System		55.0	55.0				55.0		55.0
8.1.7.1	Plumbing *** $-O_2$ Feed		24.0	14.0		10.0		24.0		24.0
8.1.7.2	$-H_2$ Feed		28.4	16.0		12.4		28.4		28.4
8.1.8	Pyrotechnic Batteries	(2)	8.0	8.0				8.0		8.0
8.1.9	Battery Charger		3.2	3.2				3.2		3.2
8.2	Power Conversion Section		29.8	(29.8)				(29.8)		(29.8)
8.2.1	Inverters		29.8	29.8				29.8		29.8
8.2.2	Control Unit		-	-				-		-
8.3	Distribution Section		(80.0)	(80.0)				(80.0)		(80.0)
8.3.1	Distribution Boxes	(2)	20.0	20.0				20.0		20.0
8.3.2	Circuit Breaker Panels	(2)	30.0	30.0				30.0		30.0
8.3.3	Junction Boxes	(2)	10.0	10.0				10.0		10.0
8.3.4	Relay Boxes	(2)	20.0	20.0				20.0		20.0

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LEM
WEIGHT STATEMENT

CODE	ITEM	1/31/64 WEIGHT AT SEPARATION	CURRENT WEIGHT STATUS: BURN OUT	CONS'D ON ASCENT	JET. ON LURAIN	CONS'D ON DESCENT	TOTAL SEPARATION	X-LUNAR EXPEND-ABLES	EARTH LAUNCH TOTAL
8.4	Electrical Provisions	(479.2)	(431.2)		(48.0)		(479.2)		(479.2)
8.4.2	Stabilization & Control	16.2	16.2				16.2		16.2
8.4.3	Navigation and Guidance	99.5	97.0		2.5		99.5		99.5
8.4.4	Crew System	2.5	2.5				2.5		2.5
8.4.5	Environmental Control	4.8	4.8				4.8		4.8
8.4.7	Instrumentation	198.0	171.0		27.0		198.0		198.0
8.4.8	Electrical Power	96.0	81.0		15.0		96.0		96.0
8.4.9	Propulsion	22.5	19.0		3.5		22.5		22.5
8.4.10	Reaction Control	17.0	17.0				17.0		17.0
8.4.11	Communications	18.0	18.0				18.0		18.0
8.4.12	Controls and Displays	4.7	4.7				4.7		4.7
	Total EPS - Inert	936.8	800.5	0	136.3	0	936.8	0	936.8
	Total EPS - Expendables	143.7	0	16.8	113.9	13.0	143.7	21.5	165.2

* Heat Exchangers and Glycol Plumbing are included under ECS.
** Includes Fuel Cell Control Units.
*** Includes Pressure Regulators.

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LEM
WEIGHT STATEMENT

CODE	ITEM	1/31/64 WEIGHT AT SEPARATION	CURRENT WEIGHT STATUS: BURN OUT	CONS'D ON ASCENT	JET. ON LURAIN	CONS'D ON DESCENT	TOTAL SEPARATION	X-LUNAR EXPEND-ABLES	EARTH LAUNCH TOTAL
9.0	Propulsion System	21468.2	633.9	4244.3	1578.3	14626.8	21083.3		21083.3
9.1	Propellant	(19472.0)	(50.0)	(4244.3)	(166.0)	(14626.8)	(19087.1)		(19087.1)
9.1.1.1	Usable - Ascent	4320.0		4244.3			4244.3		4244.3
9.1.1.2	- Descent	14936.0				14626.8	14626.8		14626.8
9.1.2.1	Trapped- Ascent	50.0	50.0				50.0		50.0
9.1.2.2	- Descent	166.0			166.0		166.0		166.0
9.2	Propellant System	(713.9)	(219.6)		(494.3)		(713.9)		(713.9)
9.2.1	Fuel Tanks - Ascent	98.0	98.0				98.0		98.0
9.2.2	- Descent	234.0			234.0		234.0		234.0
9.2.3	Oxid. Tanks- Ascent	98.0	98.0				98.0		98.0
9.2.4	- Descent	234.0			234.0		234.0		234.0
9.2.5	Plumbing - Ascent	23.6	23.6				23.6		23.6
9.2.6	- Descent	26.3			26.3		26.3		26.3
9.3	Pressurization System	(646.7)	(142.3)		(504.4)		(646.7)		(646.7)
9.3.1	Helium Tanks - Ascent	103.0	103.0				103.0		103.0
9.3.2	- Descent	400.0			400.0		400.0		400.0
9.3.3	Helium - Ascent	11.3	11.3				11.3		11.3
9.3.4	- Descent	44.0			44.0		44.0		44.0
9.3.5	Plumbing - Ascent	28.0	28.0				28.0		28.0
9.3.6	- Descent	60.4			60.4		60.4		60.4
9.4	Engines	(635.6)	(222.0)		(413.6)		(635.6)		(635.6)

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LEM
WEIGHT STATEMENT

CODE	ITEM	1/31/64 WEIGHT AT SEPARATION	CURRENT WEIGHT STATUS: BURN OUT	CONS'D ON ASCENT	JET. ON LURAIN	CONS'D ON DESCENT	TOTAL SEPARATION	X-LUNAR EXPEND-ABLES	EARTH LAUNCH TOTAL
9.4.1	Engine - Ascent	204.0	204.0				204.0		204.0
9.4.2	- Descent	370.0			370.0		370.0		370.0
9.4.3	Shield - Ascent	5.0	5.0				5.0		5.0
	- Descent	14.6			14.6		14.6		14.6
9.4.4	Gimbal Actuators	--					--		--
9.4.5	Engine Mount - Ascent	5.0	5.0				5.0		5.0
	- Descent	8.0			8.0		8.0		8.0
9.4.6	Misc. - Ascent	8.0	8.0				8.0		8.0
	- Descent	21.0			21.0		21.0		21.0
	Total Propulsion -Inert	2212.2	633.9	0	1578.3	0	2212.2		2212.2
	Total Propulsion -Expend.	19256.0	0	4244.3	0	14626.8	18871.1		18871.1

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LEM
WEIGHT STATEMENT

CODE	ITEM	1/31/64 WEIGHT AT SEPARATION	CURRENT WEIGHT STATUS: BURN OUT	CONS'D ON ASCENT	JET. ON LURAIN	CONS'D ON DESCENT	TOTAL SEPARATION	X-LUNAR EXPEND-ABLES	EARTH LAUNCH TOTAL
10.0	Reaction Control System	849.2	361.1	342.9		143.1	847.1		847.1
10.1	Propellant	(526.9)	(38.8)	(342.9)		(143.1)	(524.8)		(524.8)
10.1.1	Attitude Control	205.1		89.9		115.2	205.1		205.1
	ΔV	283.0		253.0		27.9	280.9		280.9
10.1.2	Trapped	38.8	38.8				38.8		38.8
10.2	Propellant System*	(131.3)	(131.3)				(131.3)		(131.3)
10.2.1	Fuel Tanks	20.5	20.5				20.5		20.5
10.2.2	Oxidizer Tanks	24.6	24.6				24.6		24.6
10.2.3	Plumbing								
	-Ascent Tie-In	7.0	7.0				7.0		7.0
	-Fuel & Oxidizer Syst.**	55.2	55.2				55.2		55.2
	-Thruster Isolation Valves	24.0	24.0				24.0		24.0
10.3	Pressurization System	(54.4)	(54.4)				(54.4)		(54.4)
10.3.1	Helium Tanks	21.0	21.0				21.0		21.0
10.3.2	Helium Gas	2.1	2.1				2.1		2.1
10.3.3	Plumbing	31.3	31.3				31.3		31.3
10.4	Thruster Inst. Assy.	(96.6)	(96.6)				(96.6)		(96.6)
	Thrust Chamber Assy.	70.2	70.2				70.2		70.2
	Cluster Hardware	26.4	26.4				26.4		26.4
	TCA Failure Device	0	--				--		--
10.5	Quad Support Truss	40.0	40.0				40.0		40.0
	Total RCS - Inert	361.1	361.1	0		0	361.1		361.1
	Total RCS - Expendables	(488.1)	0	(342.9)		(143.1)	(486.0)		(486.0)
	- Att. Control Prop.	205.1		89.9		115.2	205.1		205.1
	- ΔV Propellant	283.0		253.0		27.9	280.9		280.9

* Capacity of usable propellant is 575.6#.

** Includes Propellant Quantity Gaging (12.0#).

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LEM
WEIGHT STATEMENT

CODE	ITEM	1/31/64 WEIGHT AT SEPARATION	CURRENT WEIGHT STATUS: BURN OUT	CONS'D ON ASCENT	JET. ON LURAIN	CONS'D ON DESCENT	TOTAL SEPARATION	X-LUNAR EXPEND-ABLES	EARTH LAUNCH TOTAL
11.0	Communications	104.3	67.2		31.6		98.8		98.8
11.1	VHF LEM/CM	(37.3)	(20.4)		(10.6)		(31.0)		(31.0)
11.1.1	VHF-Signal Processing ERA*	21.9	15.7				15.7		15.7
11.1.2	Inflight Antenna (2)	3.0	3.3				3.3		3.3
11.1.3	Lunar Stay Antenna (1)	10.0			10.6		10.6		10.6
11.1.4	R.F. Switch	1.0	1.0				1.0		1.0
11.1.5	B.H. Flanges (3)	.4	.4				.4		.4
11.1.6	Power Dividers (2)	1.0	0				0		0
11.2	S-Band LEM/Earth	(56.0)	(46.8)		(10.0)		(56.8)		(56.8)
11.2.1	S-Band ERA**	22.0	24.0				24.0		24.0
11.2.2	Inflight Antenna (2)	2.0	2.3				2.3		2.3
11.2.3	Erectable Antenna	10.0			10.0		10.0		10.0
11.2.4	Steerable Antenna***	20.0	19.0				19.0		19.0
11.2.5	R.F. Switch	1.0	1.0				1.0		1.0
11.2.6	B.H. Flanges (4)	.5	.5				.5		.5
11.2.7	Power Divider	.5	0				0		0
11.3	Television ****	(11.0)			(11.0)		(11.0)		(11.0)
11.3.1	Camera, Portable	4.0			4.0		4.0		4.0
11.3.2	Lens	2.5			2.5		2.5		2.5
11.3.3	Camera Thermal Equipment	2.5			2.5		2.5		2.5
11.3.4	Cable and Reel	2.0			2.0		2.0		2.0

* Includes Premodulation Processor and Audio Center 7.0#, Diplexer 2.0#, Transceiver 4.4#, and Case and Connectors 2.3#.

** Includes Transceiver 10.8#, Power Amplifier (including notch filter) 8.5#, Diplexer 1.0#, Antenna Electronics 1.0#, and Case and Connectors 2.7#.

*** Includes Earth Sensor and Drive.

**** Auxiliary Light for Television, if required, is considered part of GFE scientific equipment.

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LEM
WEIGHT STATEMENT

CODE	ITEM	1/31/64 WEIGHT AT SEPARATION	CURRENT WEIGHT STATUS: BURN OUT	CONS'D ON ASCENT	JET. ON LURAIN	CONS'D ON DESCENT	TOTAL SEPARATION	X-LUNAR EXPEND-ABLES	EARTH LAUNCH TOTAL
12.0	Controls and Displays	258.0	262.9				262.9		262.9
12.1	Structure	--							
12.2	Stabilization & Controls	(73.4)	(73.4)				(73.4)		(73.4)
12.2.1	Flight Controls	57.8	57.8				57.8		57.8
12.2.2	Back-Up Guidance	7.8	7.8				7.8		7.8
12.2.3	ΔV Panel	7.8	7.8				7.8		7.8
12.3	Navigation & Guidance	(53.9)	(58.8)				(58.8)		(58.8)
12.3.1	GFE	51.6	56.5				56.5		56.5
12.3.2	Rendezvous & Landing Radar	2.3	2.3				2.3		2.3
12.4	Crew Provisions	3.3	3.3				3.3		3.3
12.5	Environmental Control	13.1	13.1				13.1		13.1
12.6	Lunar Landing System	--							
12.7	Instrumentation	9.1	9.1				9.1		9.1
12.8	Electrical Power	(23.3)	(23.3)				(23.3)		(23.3)
12.8.1	Cryogenic Storage	12.9	12.9				12.9		12.9
12.8.2	D.C. Power Distribution	4.0	4.0				4.0		4.0
12.8.3	A.C. Power Distribution	1.2	1.2				1.2		1.2
12.8.4	Pyrotechnic Subsystem	5.2	5.2				5.2		5.2
12.9	Propulsion	10.0	10.0				10.0		10.0
12.10	Reaction Control	16.0	16.0				16.0		16.0
12.11	Communications	12.9	12.9				12.9		12.9
12.12	Instrument Panel & Side Consoles	43.0	43.0				43.0		43.0

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Table 4

LEM WEIGHT COMPARISON
AT SEPARATION BY STAGES

SUBSYSTEM CODE	ITEM	1/31/64 WEIGHT	CURRENT WEIGHT	Δ WEIGHT
A.	Ascent Stage Weight at Separation	9448.7	9285.7	-163.0
1.0	Structure	924.7	924.7	0
2.0	Stabilization and Control	104.0	74.6	-29.4
3.0	Navigation and Guidance	280.7	238.0	-42.7
4.0	Crew Provisions	574.4	574.4	0
5.0	Environmental Control	308.8	306.8	- 2.0
6.0	Landing Gear	---	---	
7.0	Instrumentation - Operational	243.5	243.5	0
	- Scientific	40.0	40.0	0
8.0	Electrical Power Supply	817.3	817.3	0
9.0	Propulsion System	(4953.9)	(4878.2)	(-75.7)
	Propulsion Inert	583.9	583.9	0
	Propellant (Includes 50# trapped)	4370.0	4294.3	-75.7
10.0	Reaction Control	(849.2)	(847.1)	(-2.1)
	Propulsion Inert	322.3	322.3	0
	Propellant (Includes 38.8# trapped)	526.9	524.8	-2.1
11.0	Communications	94.2	78.2	-16.0
12.0	Controls and Displays	258.0	262.9	+ 4.9
B.	Descent Stage Weight at Separation	18484.9	18186.2	-298.7
1.0	Structure	940.5	940.5	0
2.0	Stabilization and Control	7.5	7.5	0
3.0	Navigation and Guidance	10.0	10.0	0
4.0	Crew Provisions	5.0	5.0	0
5.0	Environmental Control	112.3	112.3	0
6.0	Landing Gear - Fixed	387.0	387.0	0
7.0	Instrumentation - Operational	25.0	25.0	0
	- Scientific	210.0	210.0	0
8.0	Electrical Power Supply	263.2	263.2	0
9.0	Propulsion System	(16514.3)	(16205.1)	(-309.2)
	Propulsion Inert	1412.3	1412.3	0
	Propellant (Includes 166# trapped)	15102.0	14792.8	-309.2
11.0	Communications (Portable)	10.1	20.6	+ 10.5
	Total Separation Weight (A & B)	27933.6	27471.9	-461.7

DISCUSSION OF INERT WEIGHT CHANGES BY STAGES SINCE LAST REPORT *

		Increment Weight Changes		
		Ascent	Descent	Separation
2.0	Stabilization and Control	(-29.4)		(-29.4)
	Changed the Guidance Coupler Assembly, based on a change in location. Current components are an engine logic box and a mode switch.	- 4.5		- 4.5
	Incorporated vendor proposal weights for Rate Gyro Assembly.	+ .6		+ .6
	Reduced Attitude Reference Assembly weight due to decision to use a strapped down system in lieu of the platform type system.	-13.0		-13.0
	Reduced Programmer Assembly weight because of the decision to use the T-1 guidance law.	-12.5		-12.5
3.0	Navigation and Guidance	(-42.7)		(-42.7)
	Revised MIT data per Rev. 16 of E-1142, dated 1/15/64	-42.7		-42.7
5.0	Environmental Control	(- 2.0)		(- 2.0)
	Decreased GOX (-1.5#) and GOX Accumulator (-3.1#) weights to previous values, since accumulator capacity is sufficient for cabin volume of 220 cubic feet.	- 4.6		- 4.6
	Added second pressure relief and dump valve to provide a valve on each hatch. This provides a means of balancing the LEM's and command module's pressures at docking.	+ 2.6		+ 2.6
11.0	Communications	(-16.0)	(+10.5)	(- 5.5)
	Packaged communication components into two Electronic Replaceable Assemblies (ERA). The VHF-Signal Processing ERA includes the premodulation processor and audio center, diplexer, transceiver, and case and connectors. The S-Band ERA includes the transceiver, Power Amplifier, diplexer, antenna electronics, and case and connectors.	- 4.2		- 4.2
	Staged the VHF Lunar Stay Antenna and revised its estimated weight.	-10.0	+10.6	+ .6
	Deleted power dividers, revised estimate of other antennas, etc.	- 1.8	- .1	- 1.9

DISCUSSION OF INERT WEIGHT CHANGES BY STAGES SINCE LAST REPORT *

	Increment Weight Changes		
	Ascent	Descent	Separation
12.0 Controls and Displays	(+ 4.9)		(+ 4.9)
Revised MIT data per Rev. 16 of E-1142, dated 1/15/64.	+ 4.9		+ 4.9
Total Inert Weight Changes	-85.2	+10.5	-74.7

* Inert weight excludes ΔV Propellant

LIST OF REFERENCES

1. MSC letter SI-63-13-498, dated 26 November 1963, "Contract NAS-9-1100, Mission Time Line for Use in Developing Electrical Energy Profile."

2. MSC letter SO-63-543, dated 21 December 1963, "Contract NAS 9-1100, Mission Time Line For Use in Developing Electrical Energy Profile."

3. LMO-540-215, dated 23 January 1964, "Control Weight Mission"

4. LMO-500-37 Revision D, dated 8 February 1964, "LEMΔV Budget".

5. LMO-310-58, dated 14 September 1963, "Criteria Used For RCS Tank Sizing".

6. LMO-490-84, dated 26 November 1963, "Resizing of LEM Ascent and Descent Tanks, and Criteria Used".

7. LED-490-5, dated 31 January 1964, "LEM Mass Property Report".

8. LLO-340-133 Revision A, dated 9 December 1963, "Equipment Arrangement Ascent Stage" Drawing.

9. LDW-280-100-50 Revision B, dated 2 January 1964, "Geometry Ascent Stage -2 Tank" Drawing.

10. LDW-280-17000 Revision A, dated 13 December 1963, "General Arrangement Descent Stage" Drawing.

11. MIT Report E-1142, Rev. 16, dated 15 January 1964, "MIT Apollo Guidance and Navigation - Systems Status Report".

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