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SE 015-005-1A

OFFICE OF MANNED SPACE FLIGHT

APOLLO PROGRAM

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WEIGHT AND PERFORMANCE SUMM[illegible]

JULY, 1966

CLASSIFICATION CHANGE

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NASA

APOLLO SYSTEMS ENGINEERIN[illegible]

This do[illegible]ment contain[illegible]ormation affe[illegible]the National Defe[illegible] of the [illegible]ates, [illegible]eaning [illegible] Es[illegible]; Ti[illegible]., Sec[illegible] [illegible]ansmission or re[illegible]ation of which [illegible] man[illegible] to [illegible]nauthorized person is prohibited by law.

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(NASA-TM-X-61019) WEIGHT AND PERFORMANCE SUMMARY (National Aeronautics and Space Administration) 17 p

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NATIONAL AERONAUTICS AND SPACE ADM[illegible]ATION

WASHINGTON, D.C. 20546

DRF

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C69-1823

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1.0 INTRODUCTION

This report presents current status of the weight and performance of Apollo space vehicles. The report contains selected monthly data in formats identical to those in the Quarterly Weight and Performance Report (U), SE 015-002-1.

Section 2.0 is devoted to the first potential lunar landing mission, which has been identified as AS-504.

Section 3.0 presents the weight and performance of the Saturn V space vehicles assigned to missions AS-501 through AS-506.

Section 4.0 presents the weight and performance of the Saturn IB space vehicles assigned to flight test missions AS-202 and AS-204 through AS-208.

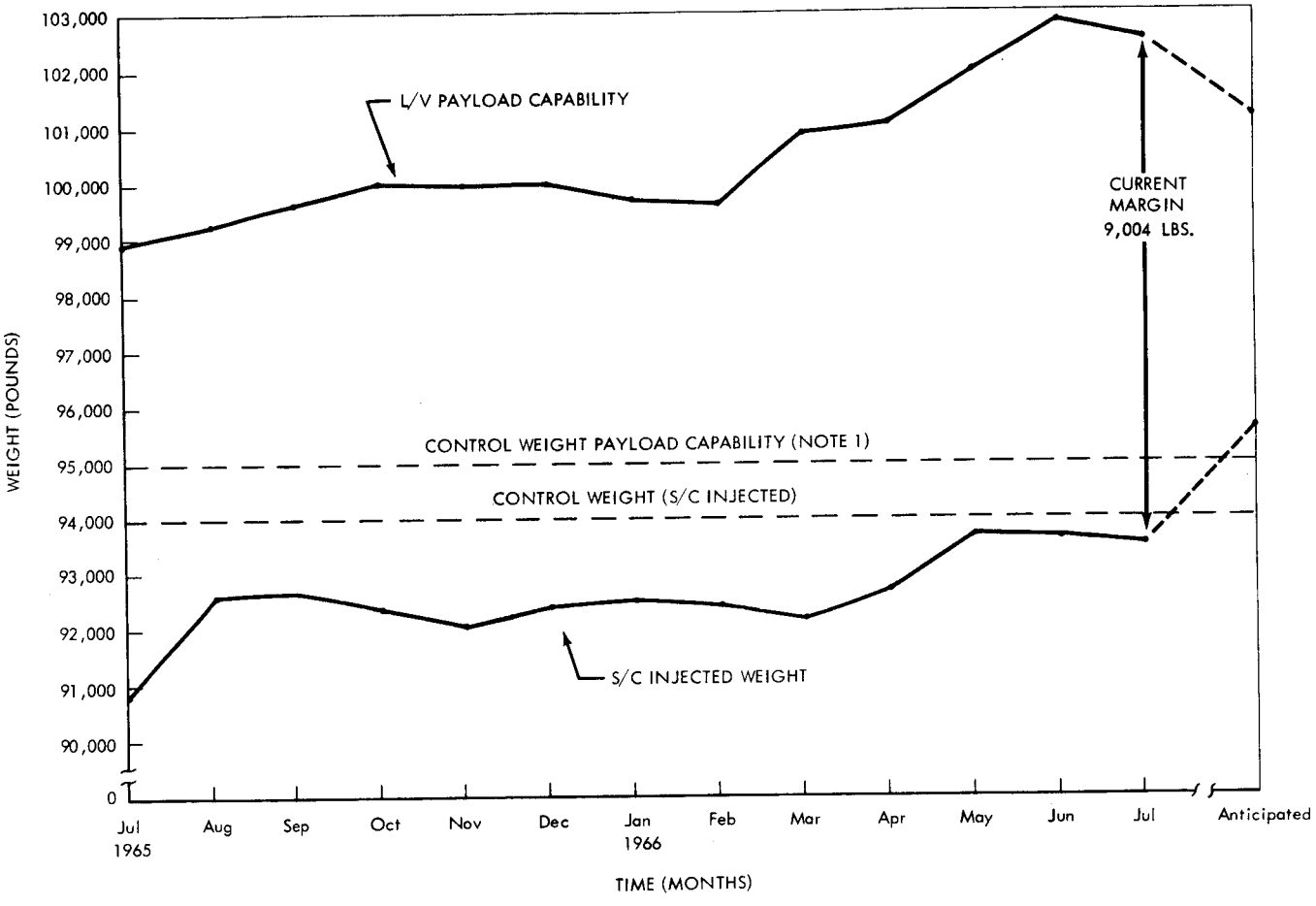
Control weight and performance values and definitions presented here are those used in the Apollo Program Specification, SE 005-001-1 Appendix 10.1.

Anticipated weight and performance changes for the first potential lunar landing mission are included in this report. These changes are based on engineering estimates of pending changes not incorporated in the reported weights.

2.1.1 PAYLOAD MARGIN HISTORY

LUNAR LANDING MISSION

L/V 504, CSM 103, LM 4

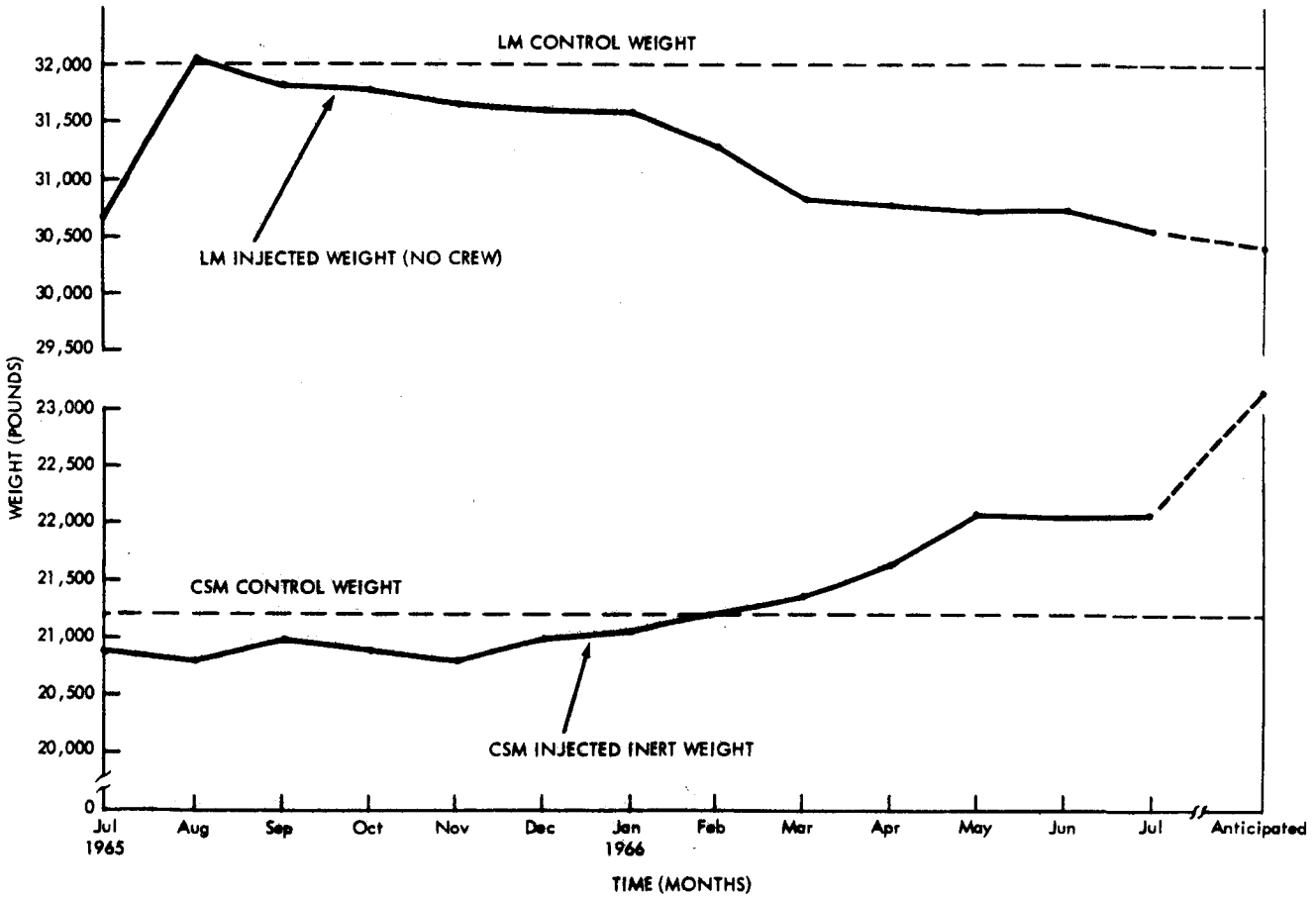


Note 1: Control weights are being revised for launch vehicles 504 and 505 to increase the payload capability from 93,000 to 95,000 pounds as required for a lunar mission.

2.1.2 S/C WEIGHT HISTORY

LUNAR LANDING MISSION

CSM 103, LM 4



2.2 WEIGHT/PERFORMANCE CHANGES

2.2.1 LAUNCH VEHICLE CHANGES

(June, 1966 to July, 1966)

LUNAR LANDING MISSION
L/V 504

CHANGES	STAGE	SEPARATION WEIGHT (Lbs.)	PAYLOAD CAPABILITY (Lbs.)
APPROVED			
Improved Weight Data Due to Revised Estimates, Layouts, Calculations and Actual Weights	S-IC S-II S-IVB IU	+ 1241 + 84 - 1 + 57	- 82 - 25 + 1 - 57
Special Fasteners For Cracked Stringers	S-II	+ 320	- 97
Revise Instrumentation	S-II	+ 140	- 42
Add J-2 Insulation	S-II S-IVB	+ 230 + 65	- 69 - 65
Add Insulation to Forward and Aft Domes	S-IVB	+ 50	- 50
Miscellaneous	S-IC S-II S-IVB IU	+ 33 + 65 + 39 - 4	- 2 - 20 -39 + 4
Improved Performance Estimates			+ 212
TOTAL APPROVED CHANGES			- 331
ANTICIPATED			
Remove Helium Heater and Replace with Ambient System	S-IVB	+ 850	- 850
Structural Change for Aerodynamic Characteristics	S-IVB	+ 200	- 200
Rapid Engine Restart Pressurization Change	S-IVB	+ 300	- 300
Miscellaneous	S-IC S-II	+ 480 + 75	- 31 - 23
TOTAL ANTICIPATED CHANGES			- 1404

2.2.2 CSM CHANGES

(June, 1966 to July, 1966)

LUNAR LANDING MISSION
CSM 103

CHANGES	STAGE	INERT WEIGHT (Lbs.)	INJECTED WEIGHT (Lbs.)
APPROVED			
Improved Weight Data	CSM SLA	- 8 - 12	- 18 - 12
Incorporate Passive Thermal Protection at the Sextant Heat Shield Interface	CM	+ 27	+ 59
Increase Boost Protection	SLA	+ 54	+ 54
Miscellaneous	CSM	+ 22	+ 48
SPS Propellant Due to LM Changes			- 81
TOTAL APPROVED CHANGES	CSM SLA	+ 41 + 42	+ 50
ANTICIPATED			
Improved Weight Data	CSM	+ 4	+ 9
Incorporate 10.6 Day Loading	CSM	+ 114	+ 251
Increase RCS Capacity	SM	+ 900	+ 1,980
Increase Propellant Loading Tolerance	SM	+ 44	+ 97
Miscellaneous	CSM	+ 4	+ 9
SPS Propellant Due to LM Anticipated Changes			- 82
TOTAL ANTICIPATED CHANGES	CSM	+ 1,066	+ 2,264

2.2.3 LM CHANGES

(June, 1966 to July, 1966)

LUNAR LANDING MISSION

LM 4

CHANGES	STAGE	INERT WEIGHT (Lbs.)	SEPARATION WEIGHT (Lbs.)
APPROVED			
Improved Weight Data	Asc. Des.	-53.0 -12.6	-116.2
Results from Critical Design Review	Asc. Des.	+9.2 +4.8	+46.0
SWIP Changes	Asc. Des.	-38.2 -99.6	-374.3
Decrease in Descent Engine I_{sp}			+191.8
Miscellaneous	Asc.	+8.1	+34.2
TOTAL APPROVED CHANGES	Asc. Des.	-73.9 -107.4	-218.5
ANTICIPATED			
Improved Weight Data	Asc.	+ .5	+ 2.1
Results from Critical Design Review	Asc. Des.	+16.4 +.9	+71.2
Revise Unusable Propellant	Asc. Des.	+1.3 -98.8	-206.5
Re-locate 2 Descent Batteries Due to CG Problem	Des.	-49.4	-106.0
Design Changes to Meet Thermal Requirements	Des.	+10.5	+22.5
Add Hat Sections and Screens to Tanks	Asc. Des.	+ 4.2 + 13.6	+46.9
SWIP Changes	Asc. Des.	-9.4 -8.0	-56.9
Miscellaneous	Asc. Des.	+8.2 +8.0	+51.7
TOTAL ANTICIPATED CHANGES	Asc. Des.	+21.2 -123.2	-175.0

2.3 WEIGHT STATUS

2.3.1 WEIGHT DATA MATURITY

2.3.1.1 LAUNCH VEHICLE WEIGHT DATA MATURITY

LUNAR LANDING MISSION

L/V 504

		Percent of Dry Weight		
		Estimated	Calculated	Actual
S-IC	June, 1966	3	66	31
	Current	2	66	32
S-II	June, 1966	39	41	20
	Current	39	41	20
S-IVB	June, 1966	10	51	39
	Current	12	50	38
IU	June, 1966	40	60	0
	Current	37	63	0

2.3.1.2 SPACECRAFT WEIGHT DATA MATURITY

LUNAR LANDING MISSION

CSM 103, LM 4

		Percent of Inert Weight		
		Estimated	Calculated	Actual
Command Module	June, 1966	25	39	36
	Current	26	38	36
Service Module	June, 1966	6	74	20
	Current	6	77	17
Adapter	June, 1966	5	74	21
	Current	5	75	20
LM	June, 1966	29.7	46.1	24.2
	Current	23.1	50.0	26.9
Launch Escape System	June, 1966	0	18	82
	Current	0	14	86

2.3.2 LAUNCH VEHICLE WEIGHT STATUS

LUNAR LANDING MISSION

L/V 504

STAGE	CONTROL WEIGHT (Lbs.)	CURRENT WEIGHT (7/66) (Lbs.)	CHANGE IN WEIGHT SINCE JUNE, 1966 (Lbs.)	CONTROL WEIGHT MARGIN (Lbs.)
Lift-off Weight (Note 1)		6,411,650	+ 45,248	
S-IC				
Separation Weight	373,518	340,058	+ 1,232	33,460
Usable Propellant	4,400,000 (Note 2)	4,584,842	+ 29,843	
S-IC/S-II Interstage	14,100	13,280	+272	820
S-II				
Separation Weight	93,839	94,280	+ 609	441
Usable Propellant	930,000 (Note 2)	970,000	- 1	
S-II/S-IVB Interstage	7,700	7,682	+ 18	18
S-IVB				
Injection Weight	30,391	26,066	+ 135	4,325
Usable Propellant	230,000 (Note 2)	230,000	0	
Vehicle Instrument Unit	4,650	4,047	+ 53	603
L/V Payload Capability	95,000 (Note 3)	102,524	- 331	7,524

Note 1: Includes 8300 pound Launch Escape System.

Note 2: Minimum required propellant tank capacity.

Note 3: Control weights are being revised for launch vehicles 504 and 505 to increase the payload capability from 93,000 to 95,000 pounds as required for a lunar mission.

2.3.3 SPACECRAFT WEIGHT STATUS

LUNAR LANDING MISSION

CSM 103
LM 4

STAGE OR MODULE	CONTROL WEIGHT (Lbs.)	CURRENT WEIGHT (7/66) (Lbs.)	CHANGE IN WEIGHT SINCE JUNE, 1966 (Lbs.)	CONTROL WEIGHT MARGIN (Lbs.)
Total Spacecraft Lift-off Weight	102,200	102,063	- 127	137
Launch Escape System	8,200	8,545	+ 5	- 345
Command Module				
Injected Inert Weight (Including Crew)	11,000	11,794	+ 38	- 794
Service Module				
Injected Inert Weight	10,200	10,304	+3	-104
Usable Propellant	37,000	37,050 (Note 1)	-33	-50
Adapter				
Injected Inert Weight	3,800	3,797	+ 42	3
LM Descent Stage				
Injected Inert Weight	4,775	4,580	- 105	195
Usable Propellant	17,315	16,552 (Note 1)	- 23	763
LM Ascent Stage				
Injected Inert Weight	4,835	4,645	- 36	190
Usable Propellant	5,075	4,799 (Note 1)	- 15	276
Total Injected Weight	94,000	93,518	- 132	482

Note 1: Usable propellant is that required to satisfy the current ΔV Budget.

3.2 WEIGHT STATUS

3.2.1 LAUNCH VEHICLE PAYLOAD STATUS

MISSION	CONTROL PAYLOAD (Lbs.)	CURRENT PAYLOAD CAPABILITY (7/66) (Lbs.)	CHANGE IN PAYLOAD SINCE JUNE, 1966 (Lbs.)	PAYLOAD MARGIN (Lbs.)
AS 501	85,000	91,100	-282	6,100
AS 502	85,000	92,134	-311	7,134
AS 503	85,000	93,525	-392	8,525
AS 504 (Note 1)	95,000	102,524	-331	7,524
AS 505 (Note 1)	95,000	102,533	-362	7,533
AS 506 AND SUBS.	95,000	103,586	-381	8,586

Note 1: Control weights are being revised for launch vehicles 504 and 505 to increase the payload capability from 93,000 to 95,000 pounds as required for a lunar mission.

3.2.2 SPACECRAFT INERT WEIGHT STATUS

MISSION AND SPACECRAFT MODULE	CONTROL WEIGHT (Lbs.)	CURRENT WEIGHT (7/66) (Lbs.)	CHANGE IN WEIGHT SINCE JUNE, 1966 (Lbs.)	CONTROL WEIGHT MARGIN (Lbs.)
AS 501				
LM (LTA)	(Note 1)			
CM (017)	11,000	11,403	+42	-403
SM (017)	10,200	10,137	-91	63
ADAPTER	3,800	3,892	+36	-92
AS 502				
LM (LTA)	(Note 1)			
CM (020)	11,000	11,403	+42	-403
SM (020)	10,200	10,116	-91	84
ADAPTER	3,800	3,892	+36	-92
AS 503				
LM (3)	--	9,229	-230	--
CM (102)	11,000	11,874	+44	-874
SM (102)	10,200	10,309	+4	-109
ADAPTER	3,800	3,836	+31	-36
AS 504 AND SUBS.				
LM (4)	9,610	9,225	-141	385
CM (103)	11,000	11,794	+38	-794
SM (103)	10,200	10,304	+3	-104
ADAPTER	3,800	3,797	+42	3

Note 1: LTA's will be ballasted to simulate fueled LM as required by missions AS-501 and AS-502.

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4.2 WEIGHT STATUS

4.2.1 WEIGHT DATA MATURITY

4.2.1.1 LAUNCH VEHICLE (OPERATIONAL SATURN I-B)

		Percent of Dry Weight		
		Estimated	Calculated	Actual
S-IB	June, 1966	6	28	66
	Current	6	28	66
S-IVB	June, 1966	5	38	57
	Current	6	38	56
IU	June, 1966	41	59	0
	Current	39	47	14

4.2.1.2 SPACECRAFT (OPERATIONAL BLOCK I CSM)

CSM's 012 and 014

		Percent of Inert Weight		
		Estimated	Calculated	Actual
CM	June, 1966	2	19	79
	Current	2	18	80
SM	June, 1966	3	29	68
	Current	3	25	72

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4.2.3 LAUNCH VEHICLE PAYLOAD STATUS

MISSION	CONTROL PAYLOAD (Lbs.)	CURRENT PAYLOAD (7/66) (Lbs.)	CHANGE IN PAYLOAD SINCE JUNE, 1966 (Lbs.)	PAYLOAD MARGIN (Lbs.)
AS 202	47,600	48,385	0	(Note 1)
AS 204	35,300	36,741	+149	1,441
AS 205	35,300	39,487	+150	4,187
AS 206	37,100	41,145	+104	4,045
AS 207	38,100	40,027	-1,267	2,027
AS 208	--	40,204	+768	--

Note 1: The Control Payload for AS-202 is being revised to the current payload value.

4.2.4 SPACECRAFT INERT WEIGHT STATUS

MISSION AND SPACECRAFT MODULE	CONTROL WEIGHT (Lbs.)	CURRENT WEIGHT (7/66) (Lbs.)	CHANGE IN WEIGHT SINCE JUNE, 1966 (Lbs.)	CONTROL WEIGHT MARGIN (Lbs.)
AS 202				
CM (011)	11,000	11,950	+57	-950
SM (011)	10,200	10,063	-4	137
ADAPTER	3,900	3,808	-6	92
LES	8,200	8,607	+9	-407
AS 204				
CM (012)	11,000	11,850	+51	-850
SM (012)	10,200	10,239	+37	-39
ADAPTER	3,900	3,667	-3	233
LES	8,200	8,570	+52	-370
AS 205				
CM (014)	11,000	11,951	+52	-951
SM (014)	10,200	10,697	+38	-497
ADAPTER	3,900	3,617	-52	283
LES	8,200	8,607	+52	-407
AS 206				
LM (1)	--	9,630	-219	--
ADAPTER	--	3,915	0	--
NOSE CONE	--	1,400	0	--
AS 207				
CM (101)	11,000	12,066	+35	1,066
SM (101)	10,200	9,784	+6	416
ADAPTER	3,800	3,836	+31	-36
LES	8,200	8,615	0	-415
AS 208				
LM (2)	--	9,513	-195	--
ADAPTER	--	3,915	0	--
NOSE CONE	--	1,400	0	--