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NO. 153499

MCDONNELL *Aircraft Corporation*
Lambert Saint Louis MUNICIPAL AIRPORT • BOX 516, ST. LOUIS, MO. 63166

15 APR 1966
Ref: 306-450-62293

National Aeronautics and Space Administration
Manned Spacecraft Center
2101 Webster-Seabrook Road
Houston, Texas 77058

Attention: Gemini Program Office, Phyllis T. Jenness

Subject: Contract NAS 9-170, Project Gemini - Transmittal of Data

Reference: (a) MAC Report 8580-8, Gemini Program Documentation Plan,
Revised 4 February 1966, Data Item Number 11.20 and
11.21

Enclosure: (1) Project Gemini Mission Weight and Balance Summary
Report Number 233-K-500-28 dated 1 April 1966
(18 copies)

1. In compliance with Reference (a), Enclosure (1) is transmitted
herewith

MCDONNELL AIRCRAFT CORPORATION

R.P. Gillooly
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MACB
 CONTROL
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PROJECT GEMINI
 MISSION WEIGHT AND BALANCE SUMMARY
 NUMBER 28
 1 APRIL 1966

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FOREWORD

This report is prepared and submitted in fulfillment of the requirements specified in the Gemini Program Documentation Plan, Report 8580-8, Item 11.20 and 11.21, of Contract NAS 9-170.

These data are based on configuration as known on the 18th day of the month prior to date of this report.

Spacecraft No. 3 and up have a thickened heat shield. This results in a 0.34 inch increase in distance between the Re-entry and the Adapter Modules. Longitudinal centers of gravity of the combined Re-entry and Adapter Modules are referred to as Z* stations as defined below.

$$Z^* = Z + d \left(\frac{W_1}{W_1 + W_2} \right) \text{ where:}$$

W_1 = Re-entry Module Weight

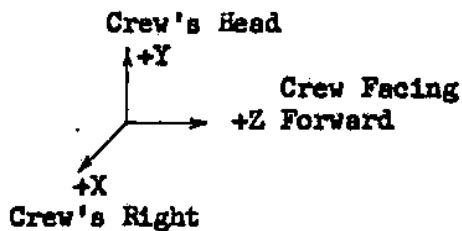
W_2 = Adapter Module Weight

Z = The design Z stations that are called out on the respective Module drawings.

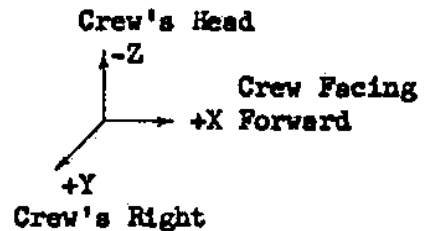
d = Increased thickness of heat shield of 0.34 inches.

The following sketches and table show the conversion from the Design and Weights Coordinate System to obtain the inertia in the Control Dynamics and Aerodynamics Coordinate System for Project Gemini.

**I. DESIGN & WEIGHTS GROUP
COORDINATE SYSTEM**



**II. CONTROL DYNAMICS AND AERODYNAMICS
GROUP COORDINATE SYSTEM**



III. CONVERSION TABLE

I. Design & Weights

II. Control Dynamics and Aerodynamics

I_x	I_{yy}
I_y	I_{zz}
I_z	I_{xx}
I_{xy}	$-I_{yz}$
I_{xz}	I_{xy}
I_{yz}	$-I_{xz}$

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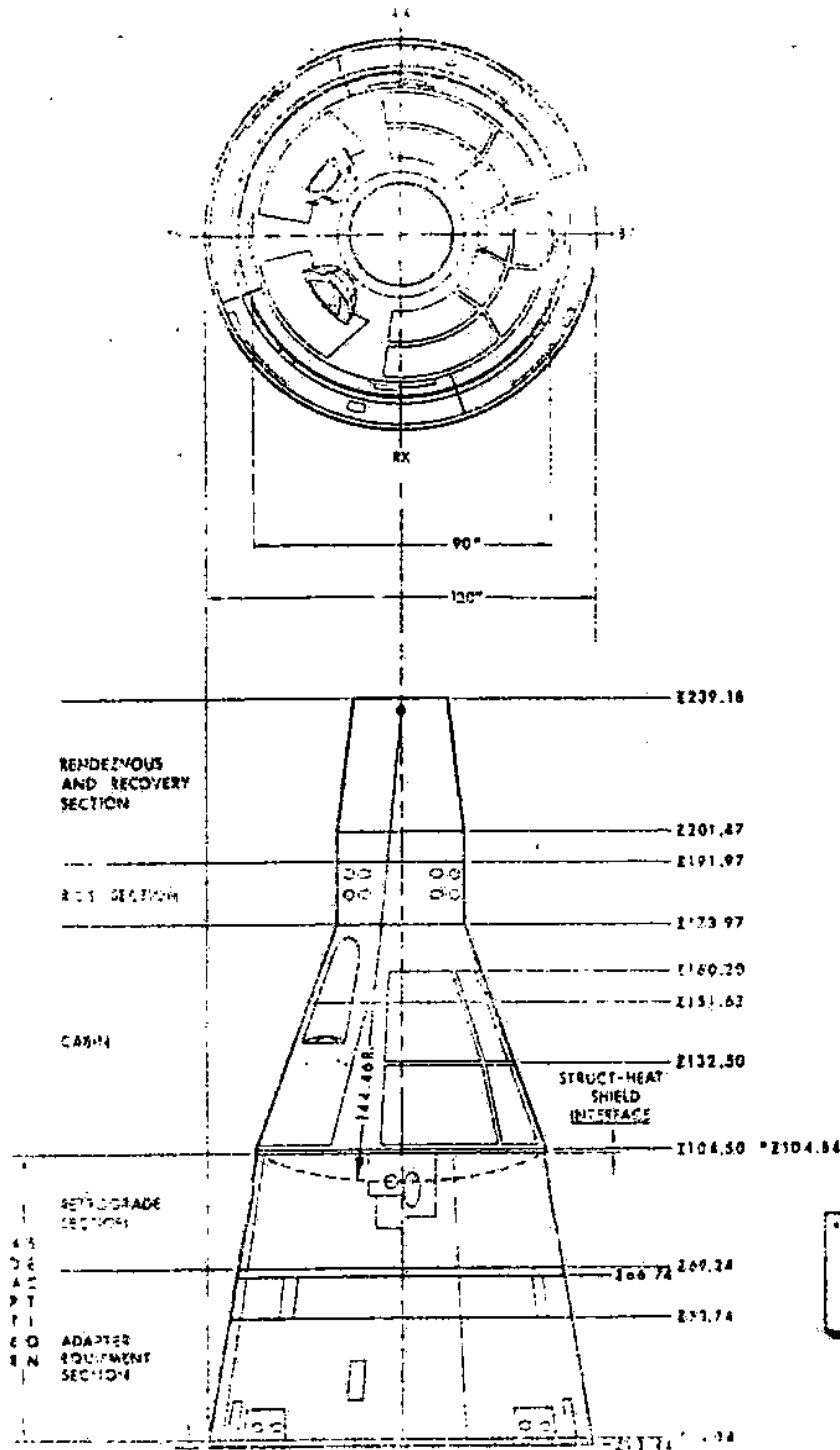
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MODEL Gemini

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GEMINI SPACECRAFT DIMENSIONAL DATA

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MODEL Gemini

PROJECT GEMINI
MISSION WEIGHT AND BALANCE SUMMARY
SPACECRAFT 10
THREE-DAY MISSION WITH AGENA RENDEZVOUS

MISSION CONDITION	WEIGHT	CENTER OF GRAVITY		
		Z*	X	Y
LAUNCH GROSS WEIGHT	8191.92	104.86	-1.30	2.11
ADAPTER MATING SECTION	-35.93			
LAUNCH COOLING WATER	-0.50			
SEPARATION PROPELLANT	-9.26			
ATTITUDE SEPARATION PROP	-1.29			
INSERTION WEIGHT	8144.94	105.34	-1.30	2.09
NOSE FAIR & HORIZ SENSOR COVER	-38.13			
WINDOW COVERS	-6.94			
ORBIT PRE-RENDEZVOUS WEIGHT	8099.87	104.74	-1.29	2.08
RENDEZVOUS & DOCKING PROP	-328.79			
ATTITUDE RENDEZVOUS PROP	-71.52			
POST-RENDEZVOUS WEIGHT	7699.56	107.70	-1.27	0.88
MISSION PROPELLANT	-244.05			
ATTITUDE MISSION PROP	-252.62			
RESIDUAL & RESERVE PROP	-22.57			
EVA EQUIPMENT RELOCATION	-66.11			
EVA EQUIPMENT	-12.26			
BIOLOGICAL & ENVIRONMENT CHG	-0.36			
EQUIP. & EXP. RELOCATION	-4.00			
PRE-RETROGRADE CHECK-RCS	-2.00			
ADAPTER EQUIPMENT SECTION	-1562.04			
RETROGRADE WEIGHT	5533.55	129.92	0.12	-1.07
ATTITUDE PROPELLANT	-6.74			
RETRO-ROCKET PROPELLANT	-222.48			
RETROGRADE FIRED WEIGHT	5304.33	131.64	0.12	-1.11
HORIZON SENSOR HEADS	-12.86			
DOCKING BAR & LATCH JETTISON	-2.51			
RETROGRADE SECTION	-563.77			
MISSION CONDITION	WEIGHT	Z	X	Y
RE-ENTRY WEIGHT	4725.19	136.79	0.17	-1.46
ATTITUDE & TOUCHDOWN PROP	-17.00			
ABLATIVE MATERIAL	-20.00			
DROGUE CHUTE DEPLOYMENT WEIGHT	4688.19	136.84	0.17	-1.48
DROGUE & PILOT CHUTES	-26.00			
RECOVERY SECTION	-335.44			
PARACHUTE DEPLOYMENT WEIGHT	4326.75	129.94	0.14	-1.59
PARACHUTE	-110.81			
TOUCHDOWN WEIGHT - NO PARACHUTE	4215.94	127.85	0.14	-1.65

NOTE: 1. LX & BY are shown as negative values.
2. See page 2 for explanation of Z* station.

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PROJECT GEMINI
 MISSION WEIGHT BALANCE AND INERTIA SUMMARY
 SPACECRAFT 11
 THREE-DAY MISSION WITH AGENA RENDEZVOUS

MISSION CONDITION	WEIGHT	CENTER OF GRAVITY			MOMENT OF INERTIA			PRODUCT OF INERTIA		
		Z*	X	Y	IZ (ROLL)	IX (PITCH)	IY (YAW)	IXZ	IYZ	IXY
LAUNCH GROSS WEIGHT	8253.81	104.58	-1.13	1.89	1751.4	5357.5	5358.2	130.0	-303.7	-6.4
ADAPTER MATING SECTION	-35.93									
LAUNCH COOLING WATER	-0.50									
SEPARATION PROPELLANT	-9.26									
ATTITUDE SEPERATION PROP	-1.29									
INSERTION WEIGHT	8206.83	105.05	-1.14	1.87	1720.2	5270.1	5271.4	131.1	-302.9	-5.4
NOSE FAIR + HORIZ SENSOR COVER	-38.13									
WINDOW COVERS	-6.94									
ORBIT PRE-RENDEZVOUS WEIGHT	8161.76	104.45	-1.13	1.86	1717.2	5140.9	5141.6	132.5	-302.0	-6.0
RENDEZVOUS + DOCKING PROP	-328.79									
ATTITUDE RENDEZVOUS PROP	-71.52									
EVA EQUIPMENT RELOCATION	-64.99									
EVA EQUIPMENT	-12.26									
POST-RENDEZVOUS WEIGHT	7684.19	107.35	-1.12	0.52	1591.1	4763.1	4778.7	134.8	-174.8	-8.3
MISSION PROPELLANT	-244.05									
ATTITUDE MISSION PROP	-252.62									
RESIDUAL + RESERVE PROP	-22.57									
BIOLOGICAL + ENVIRONMENT CHG	-0.36									
EQUIP + EXP RELOCATION	-4.00									
PRE-RETROGRADE CHECK-RCS	-2.00									
ADAPTER EQUIPMENT SECTION	-1591.12									
RETROGRADE WEIGHT	5567.48	129.75	0.14	-1.39	863.5	2141.2	2126.3	-5.4	28.7	2.5
ATTITUDE PROPELLANT	-6.74									
RETRO-ROCKET PROPELLANT	-222.48									
RETROGRADE FIRED WEIGHT	5338.26	131.46	0.15	-1.45	856.8	2047.0	2032.2	-5.7	31.5	2.5
HORIZON SENSOR HEADS	-12.86									
DOCKING BAR + LATCH JETTISON	-2.51									
RETROGRADE SECTION	-584.12									
MISSION CONDITION	WEIGHT	Z	X	Y	IZ (ROLL)	IX (PITCH)	IY (YAW)	IXZ	IYZ	IXY
RE-ENTRY WEIGHT	4738.77	136.82	-0.00	-1.49	666.5	1617.9	1549.6	7.5	31.0	9.1
ATTITUDE + TOUCHDOWN PROP	-17.00									
RELATIVE MATERIAL	-20.00									
DROGUE CHUTE DEPLOYMENT WT	4701.77	136.87	-0.00	-1.50	662.1	1605.4	1546.9	7.5	30.9	9.1
DROGUE + PILOT CHUTES	-26.00									
RECOVERY SECTION	-335.44									
PARACHUTE DEPLOYMENT WEIGHT	4340.33	129.99	-0.04	-1.60	643.8	1004.8	987.1	4.1	21.3	8.4
PARACHUTE	-110.81									
TOUCHDOWN WEIGHT-NO PARACHUTE	4229.52	127.91	-0.05	-1.66	641.8	844.8	827.5	4.0	17.5	8.5

- NOTES: 1. IX & IY are shown as negative values.
 2. Inertia units are in slug-feet squared.
 3. See page 2 for explanation of Z* station.
 4. See page 9 for experiment summary.

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PROJECT GEMINI
 MISSION WEIGHT BALANCE AND INERTIA SUMMARY
 SPACECRAFT 12
 THREE-DAY MISSION WITH AGENA RENDEZVOUS

MISSION CONDITION	WEIGHT	CENTER OF GRAVITY			MOMENT OF INERTIA			PRODUCT OF INERTIA		
		Z*	X	Y	Iz (ROLL)	Ix (PITCH)	Iy (YAW)	Ixz	Iyz	Ixy
LAUNCH GROSS WEIGHT	8365.83	103.46	-1.31	2.04	1741.3	5435.1	5437.0	139.0	-299.3	-5.0
ADAPTER MATING SECTION	-35.93									
LAUNCH COOLING WATER	-0.50									
SEPARATION PROPELLANT	-5.26									
ATTITUDE SEPARATION PROP	-1.29									
INSERTION WEIGHT	8318.85	103.92	-1.32	2.02	1710.1	5349.6	5352.0	140.3	-298.6	-5.0
NOSE FAIR + HORIZ SENSOR COVER	-38.13									
WINDOW COVERS	-6.94									
ORBIT PRE-RENDEZVOUS WEIGHT	8273.78	103.33	-1.31	2.02	1707.1	5210.0	5219.9	141.5	-297.6	-5.0
RENDEZVOUS + DOCKING PROP	-328.79									
ATTITUDE RENDEZVOUS PROP	-71.52									
EVA EQUIPMENT RELOCATION	-52.40									
EVA EQUIPMENT	-187.95									
POST-RENDEZVOUS WEIGHT	7633.12	107.51	-1.37	0.71	1580.2	4735.1	4748.6	150.1	-183.9	-5.0
MISSION PROPELLANT	-244.05									
ATTITUDE MISSION PROP	-252.62									
RESIDUAL + RESERVE PROP	-22.57									
BIOLOGICAL + ENVIRONMENT CHG	-0.36									
EQUIP + EXP RELOCATION	-4.00									
PRE-RETROGRADE CHECK-RCS	-2.00									
ADAPTER EQUIPMENT SECTION	-1556.50									
RETROGRADE WEIGHT	5551.03	129.79	-0.00	-1.12	866.9	2133.7	2118.4	1.9	13.9	4.0
ATTITUDE PROPELLANT	-6.74									
RETRO-ROCKET PROPELLANT	-222.48									
RETROGRADE FIRED WEIGHT	5321.81	131.50	-0.00	-1.17	860.2	2039.4	2024.1	1.9	16.1	4.0
HORIZON SENSOR HEADS	-12.86									
DOCKING BAR + LATCH JETTISON	-2.51									
RETROGRADE SECTION	-562.46									
MISSION CONDITION	WEIGHT	Z	X	Y	Iz (ROLL)	Ix (PITCH)	Iy (YAW)	Ixz	Iyz	Ixy
RE-ENTRY WEIGHT	4743.98	136.60	-0.00	-1.49	667.2	1630.9	1602.1	6.3	33.9	0.0
ATTITUDE + TOUCHDOWN PROP	-17.00									
ABLATIVE MATERIAL	-20.00									
DROGUE CHUTE DEPLOYMENT WT	4706.98	136.65	-0.00	-1.50	662.7	1618.4	1589.4	6.3	33.8	0.0
DROGUE + PILOT CHUTES	-26.00									
RECOVERY SECTION	-335.44									
PARACHUTE DEPLOYMENT WEIGHT	4345.54	129.76	-0.04	-1.61	644.4	1014.8	986.6	2.9	24.2	0.0
PARACHUTE	-110.81									
TOUCHDOWN WEIGHT-NO PARACHUTE	4234.73	127.67	-0.05	-1.67	642.5	853.8	826.1	2.8	20.4	0.0

- NOTES: 1. LX & BY are shown as negative values.
 2. Inertia Units are in slug-feet squared.
 3. See page 2 for explanation of Z* stations.
 4. See page 9 for experiment summary.

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MODEL Gemini**EXPERIMENT DESIGNATIONS**Experiment No.Title

D-4	Radiometric Background Measurements
D-5	Star Occultation Measurement Spacecraft Navigation
D-7	Objects in Space
D-10	Electronic Measuring Techniques - Spacecraft Navigation
D-12	Modular Astronaut Maneuvering Unit
D-15	Low Light Level Television
D-16	Minimum Reaction Power Tools
M-5	Bio-Chemical Analysis of Body Fluids
MSC-3	Tri-Axis Magnetometer
MSC-5	Lunar UV Spectral Reflectance
MSC-6	Beta Spectrometer
MSC-7	Bremsstrahlung Spectrometer
MSC-8	Color Patch Photography
MSC-12	Landmark Contrast Measurements
S-1	Zodiacal Light Photography
S-4	Radiation and Zero-G on Blood
S-5	Synoptic Terrain Photography
S-6	Synoptic Weather Photography
S-7	Cloud-Top Altitude Spectrometer
S-9	Nuclear Emulsion
S-10	Agens Micrometeorite Collection
S-11	Airglow Horizon Photography
S-12	Micrometeorite Collections
S-13	UV Astronomical Camera
T-2	Manual Navigation Sightings

EXPERIMENT WEIGHT SUMMARY

EXPERIMENT	SPACECRAFT 10		SPACECRAFT 11		SPACECRAFT 12	
	EXPER. WEIGHT	BALLAST	EXPER. WEIGHT	BALLAST	EXPER. WEIGHT	BALLAST
D-4 & D-7	2.76	-2	2.76	-2	2.76	-2
D-5 & MSC-12	2.53	2				
D-10	47.72	0			47.67	0
D-12					215.79	0
D-15			125.15	-26		
D-16			30.34	0		
M-5	.36	2	.36	2	.36	2
MSC-3	14.17	0			13.91	0
MSC-6	19.49	0			19.49	0
MSC-7	9.19	2			9.19	2
MSC-8	2.38	2				
S-1	4.24	2				
S-4			5.80	6		
S-5 & S-6	.88	1			1.75	1
S-7					4.01	3
S-9			24.23	12		
S-10	.22	2	.22	2		
S-11			3.48	2	3.48	2
S-12	11.36	1				
S-13 & MSC-5	7.64	4	7.14	4	7.14	4
T-2					9.50	7
TOTALS	122.94	16	199.48	0	335.05	19
		138.94		199.48		354.05