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# APOLLO

## GUIDANCE AND NAVIGATION

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E-1142 (REV. 14)

(UNCLASSIFIED TITLE)

SYSTEMS STATUS
REPORT

November 15, 1963

[redacted]

## INSTRUMENTATION LABORATORY

CAMBRIDGE 39, MASSACHUSETTS

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## ABSTRACT

The System Status Report, E-1142, is distributed monthly on the 15th. This month's revision, Rev. 14, contains weight and balance data and power requirement information for the guidance and navigation equipment in the Lunar Excursion and Command Modules. In addition, the status of the Command Module computer programs is included.

Section 1

# INTRODUCTION

## 1-1 INTRODUCTION

The following information is included in this month's report: (1) weights, centers of gravity, and moments of inertia of G&N equipment in the Command Module and weights of G&N equipment in the Lunar Excursion Module, (2) power requirements of G&N equipment in the Command and Lunar Excursion Modules, and (3) the status of Command Module computer programs.

Weights in this report for the Command Module are based upon the current "Block I" design releases. Purely weight-saving design changes have been held, in general, for the "Block II" release scheduled for early 1964. The Lunar Excursion Module weights are based on the best estimate of those expected for the LEM design release which will also occur early in 1964.

## 1-2 ACCURACY

The accuracy of numerical values reported in this revision should not be considered to be within the tolerances implied by the significant figures quoted. The reported values, although based upon the most current information, are subject to normal changes as design and development phases approach completion.

# COMMAND MODULE

Section 2

## COMMAND MODULE DATA

### 2-1 WEIGHTS

Table 2-I presents the weights of all Block I equipment, grouped according to its specific location within the Command Module. Weights are reported to the component level and to the nearest tenth of a pound.

Given component weights are identified as estimated, calculated, and measured in the order of increasing accuracy. These terms are defined by North American Aviation as follows.

Estimated weights (E) are based on rough calculations. Calculated weights (C) are based on detailed calculations made from final production drawings that will be used to build flyable equipment. Measured weights (M) are the actual weights of equipment built to the production drawings.

Since most weight values now reported can be classified as only estimated weights, MIT herein affixes a prime to the (E) symbol, i.e., (E'), to denote values which MIT, for various reasons, feels to be more accurate than estimated values, yet which cannot be defined as either calculated or measured weights.

North American Aviation will provide and be responsible for coldplate weights which are not integral with guidance and navigation equipment.

2-1.1 WEIGHTS STATUS REPORTING. Table 2-I also offers a comparison of present component weight values with those listed in System Status Report, E-1142 (Rev. 13), October 15, 1963. All weight changes are explained in paragraph 2-2. Figure 2-1 presents the chronological weight development of the Command Module G&N system.

2-1.2 SPEC. WEIGHT. The "Spec. Weight" column in table 2-I contains "proposed MSC weights," that is, goals set forth by MSC in a memo to MIT dated December 5, 1962.

2-1.3 DESIGN LOAD WEIGHT. The "Design Load Weight,"column contains worst-estimate design weights assigned to G&N subassemblies attached to the spacecraft structure. These values are included in this report as the result of an S&ID

Table 2-I. Current Weight Status of Command Module (lbs)

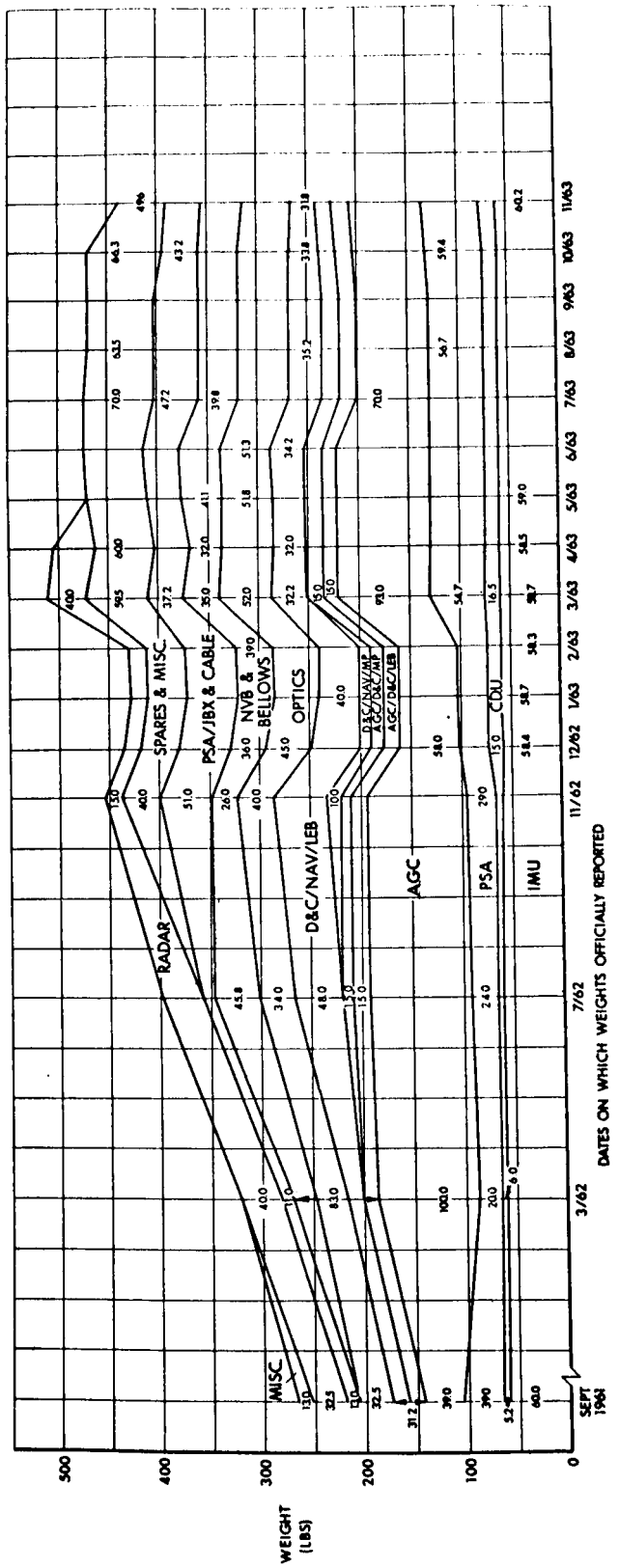
| Item | Spec. Wt. 12/62 (a) | (b-a) | Status 10/63 (b) | (c-b) | Status 11/63 (c) | Design Load Wt. 11/63 (d) |
|---|---|---|---|---|---|---|
| LOWER EQUIPMENT BAY | | | | | | |
| CDU & Frame Assy | 6.0 | +10.5 | 16.5 | 0.0 | 16.5(E) | 17.2 |
| Optical Subsystem | | | | | | |
| SXT | 12.0 | 0.0 | 12.0 | 0.0 | 12.0(E) | 154.2 |
| SCT | 9.0 | 0.0 | 9.0 | 0.0 | 9.0(E) | |
| Optical Base & Gearing | 14.0 | + 7.0 | 21.0 | 0.0 | 21.0(E) | |
| Optical Eyepieces | | | | | | |
| SXT | 2.0 | + 1.8 | 1.5 | 0.0 | 1.5(E) | |
| SCT | | | 2.3 | 0.0 | 2.3(E) | |
| IMU | 40.0 | +19.0 | 59.0 | +1.2 | 60.2(M) | |
| NVB & Shock Mounts | 16.0 | +11.2 | 27.2 | 0.0 | 27.2(E) | |
| Bellows Assy | 8.0 | + 4.6 | 12.6 | 0.0 | 12.6(E) | |
| G&N Interconnection Assy | 30.0 | +13.2 | 35.2 | 0.0 | 35.2(E) | 42.8 |
| G&N to S/C Interface Assy | | | 8.0 | 0.0 | 8.0(E) | |
| D&C Nav Station | | | | | | |
| IMU Control Panel | 30.3 | - 5.0 | 2.5 | 0.0 | 2.5(M) | 6.8 |
| D&C Electronics | | | 5.6 | 0.0 | 5.6(E') | 7.7 |
| Control Electronics | | | 1.7 | 0.0 | 1.7(E') | |
| Optical Shroud | | | 3.8 | 0.0 | 3.8(E') | 4.2 |
| G&N Ind Cont Panel | | | 11.7 | -2.0 | 9.7(E') | 13.2 |
| D&C/AGC | 15.0 | 0.0 | 15.0 | 0.0 | 15.0(E) | 19.4 |
| M&DV (including 1 film) | 5.0 | + 3.5 | 8.5 | 0.0 | 8.5(E) | 10.0 |
| AGC (no spares) | 80.0 | +15.0 | 70.0 | 0.0 | 70.0(E) | 126.4 |
| Spare Tray | | | 25.0 | 0.0 | 25.0(E) | |
| PSA | 25.0 | +34.4 | 59.4 | 0.0 | 59.4(E') | 65.0 |
| Coolant Hoses | 0.0 | + 1.0 | 1.0 | 0.0 | 1.0(E') | |

(cont)

Table 2-I. Current Weight Status of Command Module (lbs) (cont)

| Item | Spec. Wt. 12/62 (a) | (b-a) | Status 10/63 (b) | (c-b) | Status 11/63 (c) | Design Load Wt. 11/63 (d) |
|---|---|---|---|---|---|---|
| MAIN PANEL AREA | | | | | | |
| D&C/AGC | 5.0 | + 10.0 | 15.0 | 0.0 | 15.0(E) | 17.2 |
| D&C/NAV | 8.0 | - 8.0 | -- | -- | -- | |
| LOOSE STORED ITEMS | | | | | | |
| Eye Relief Eyepieces | -- | + 1.5 | 1.5 | 0.0 | 1.5(E) | |
| Film Cartridges (4) | -- | + 3.0 | 3.0 | 0.0 | 3.0(E) | |
| AGC Loose Spares | 20.0 | + 17.0 | 17.3 | 0.0 | 17.3(E) | |
| PSA Loose Spares | | | 16.7 | -16.7 | 0.0(E) | |
| CDU Spare Gearbox | | | 3.0 | 0.0 | 3.0(E) | |
| Horizon Photometer | -- | + 4.0 | 4.0 | 0.0 | 4.0(E) | |
| Spare Relay & Diode Module | -- | + 0.3 | 0.3 | 0.0 | 0.3(E) | |
| TOTAL | 325.3 | +144.0 | 469.3 | -17.5 | 451.8 | |
| TOTAL (Exclusive of "Loose Stored Items") | | | 423.5 | -0.8 | 422.7 | |

# COMMAND MODULE




Chronological weight status of G&N equipment

request, at NASA Coordination Meeting No. 8, that one total weight figure for supported G&N load be assigned for structural design use. MIT herein assigns a total G&N design load weight, in table 2-I, which does not include items termed "loose stored items." The breakdown of this total weight into the individual items of column "d" is typical only.

## 2-2 REPORTED WEIGHT CHANGES

The weight changes since last month's report, E-1142 (Rev. 13), October 15, 1963, shown in table 2-I are explained below.

2-2.1 IMU. The 1.2-pound increase in the IMU weight is a result of weighing IMU 5. This increase is attributed to: (1) the PIP suspension capacitors, wires, and connectors which weigh 0.66 pound more than estimated, (2) the blower speed control modules, not previously considered, weighing 0.170 pounds, (3) a heavier stub shaft design resulting in a 0.10-pound increase, and (4) the wire covers which weigh 0.34 pound more than previously estimated.

2-2.2 G&N IND. CONT. PANEL. The weight decrease is due to the deletion of Block II items, namely, the NVE-Vernier, the NVE-level gain, and the resistor module.

2-2.3 PSA LOOSE SPARES. Reliability studies at MIT/IL have indicated reliability requirements can be met without sparing any PSA modules.

## 2-3 CENTERS OF GRAVITY

Table 2-II presents the centers of gravity of each weight component or packaged assembly, determined with respect to the basic X, Y, Z axes of the Command Module shown in figure 2-2. Center of gravity values are given to the nearest tenth of an inch.

## 2-4 MOMENTS OF INERTIA

Table 2-II also presents the moments of inertia of each weight component or packaged assembly, determined about each of the component axes which (1) run through the center of gravity of the component and (2) are parallel to the basic X , Y, Z axes of the Command Module.

## 2-5 COMMAND MODULE POWER REQUIREMENTS

The power requirements of the Command Module G&N equipment on the primary + 28-VDC power supply are shown in figure 2-3, which presents the magnitude and

Table 2-II. Command Module Center of Gravity and Moment of Inertia Data

| Item | Weight (lbs) | Centers of Gravity (inches) | | | Moments of Inertia ($lb\text{-}in^2$) | | |
|---|---|---|---|---|---|---|---|
| | | X | Y | Z | Ixx | Iyy | Izz |
| LOWER EQUIPMENT BAY | | | | | | | |
| CDU & Frame Assy | 16.5 | 63.5 | -14.4 | 35.8 | 50 | 470 | 470 |
| Optical Subsystem | | | | | | | |
| SXT | 12.0 | 70.5 | - 3.5 | 34.7 | | | |
| SCT | 9.0 | 70.5 | 5.5 | 34.7 | | | |
| Opt. Base & Gearing | 21.0 | 67.9 | 0.0 | 30.7 | | | |
| Optical Eyepieces | | | | | | | |
| SXT | 1.5 | 65.1 | - 3.5 | 26.2 | 5 | 10 | 5 |
| SCT | 2.3 | 65.1 | 4.5 | 26.2 | 10 | 10 | 10 |
| IMU | 60.2* | 56.6 | 0.0 | 41.7 | 1330 | 1330 | 1330 |
| NVB & Shock Mounts | 27.2 | 64.3 | - 0.1 | 41.3 | 3270 | 4050 | 5210 |
| Bellows Assy | 12.6 | | | | | | |
| G&N Interconnection Assy | 35.2 | | | | | | |
| G&N to S/C Signal Assy | 8.0 | | | | | | |
| D&C/NAV Station | | | | | | | |
| IMU Cont Panel | 2.5 | 74.0 | -15.4 | 30.9 | | | |
| D&C Electronics | 5.6 | 49.5 | - 9.6 | 39.6 | 40 | 40 | 15* |
| Control Electronics Assy | 1.7 | 63.0* | 10.8* | 35.5* | 2* | 3* | 2* |
| Optical Shroud | 3.8 | 66.8 | 0.0 | 28.9 | 280 | 60 | 300 |
| G&N Ind. Control Panel | 9.7* | 54.1 | 0.1 | 33.9 | 560 | 150 | 720 |
| D&C/AGC | 15.0 | | | | | | |
| M&DV (includes 1 film) | 8.5 | 73.5 | - 4.5 | 31.0 | | | |
| AGC (no spares) | 70.0 | 37.8 | 1.3 | 46.1 | 4980 | 3990 | 1770 |
| Spare Tray | 25.0 | 38.2 | - 7.7 | 45.3 | 1290 | 1360 | 140 |

Table 2-II Command Module Center of Gravity and Moment of Inertia Data (cont)

| Item | Weight (lbs) | Centers of Gravity (inches) | | | Moments of Inertia ($lb-in^2$) | | |
|---|---|---|---|---|---|---|---|
| | | X | Y | Z | Ixx | Iyy | Izz |
| PSA | 59.4 | 45.0 | -1.1 | 41.5 | 3940* | 1460* | 2620* |
| Coolant Hoses | 1.0 | | | | | | |
| MAIN PANEL AREA | | | | | | | |
| D&C/AGC | 15.0 | | | | | | |
| LOOSE STORED ITEMS | | | | | | | |
| Eye Relief Eyepieces (2) | 1.5 | (SCT, 4-5/8" x 2-1/2" dia; SXT, 3' x 2-1/4' dia.) | | | | | |
| Film Cartridges (4) | 3.0 | (Each cartridge, 1-1/2 x 3 x 6 inches) | | | | | |
| AGC Loose Spares | 17.3 | | | | | | |
| CDU Spare Gearbox | 3.0 | (approximately 6.0 x 1-13/16 x 5.5 inches) | | | | | |
| Horizon Photometer | 4.0 | (6 x 6 x 3 inches) | | | | | |
| Spare Relay & Diode Mod | 0.3 | (3 x 3 x 2 inches) | | | | | |

* These values represent changes since the last report, E-1142 (Rev. 13), dated October 15, 1963.

location of dissipated power values on a subassembly level. This chart assumes a 14-day lunar orbit mission as defined by S&ID for power profile computation (Ref: S&ID letter 63 MA 7332).

Table 2-III shows the magnitude and location of power dissipation for the established G&N activities, each of which consists of various power levels of operation.

Table 2-IV shows the energy requirements for each G&N activity on a power level basis. The table is based upon MIT letter AG 679-6, "G&N Power Profile Status," dated August 14, 1963. The vertical column to the left indicates the various G&N activities (phases of operation) for the model 14-day mission submitted by S&ID in S&ID letter 63 MA 7332. This column also indicates the power consumption and operating time for each specific activity. The top row indicates the various power levels along with the power consumption and operating time of each power level.

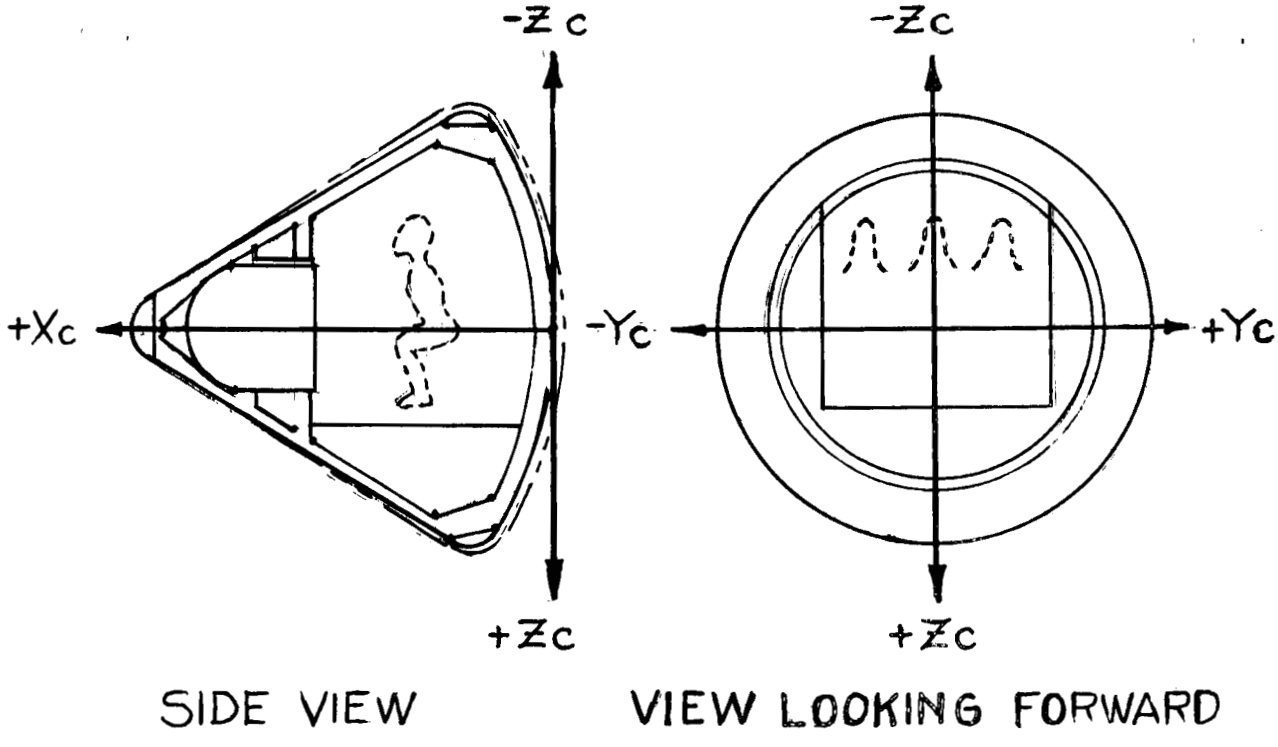



Figure 2-2. X, Y, Z axes of Command Module

# COMMAND MODULE

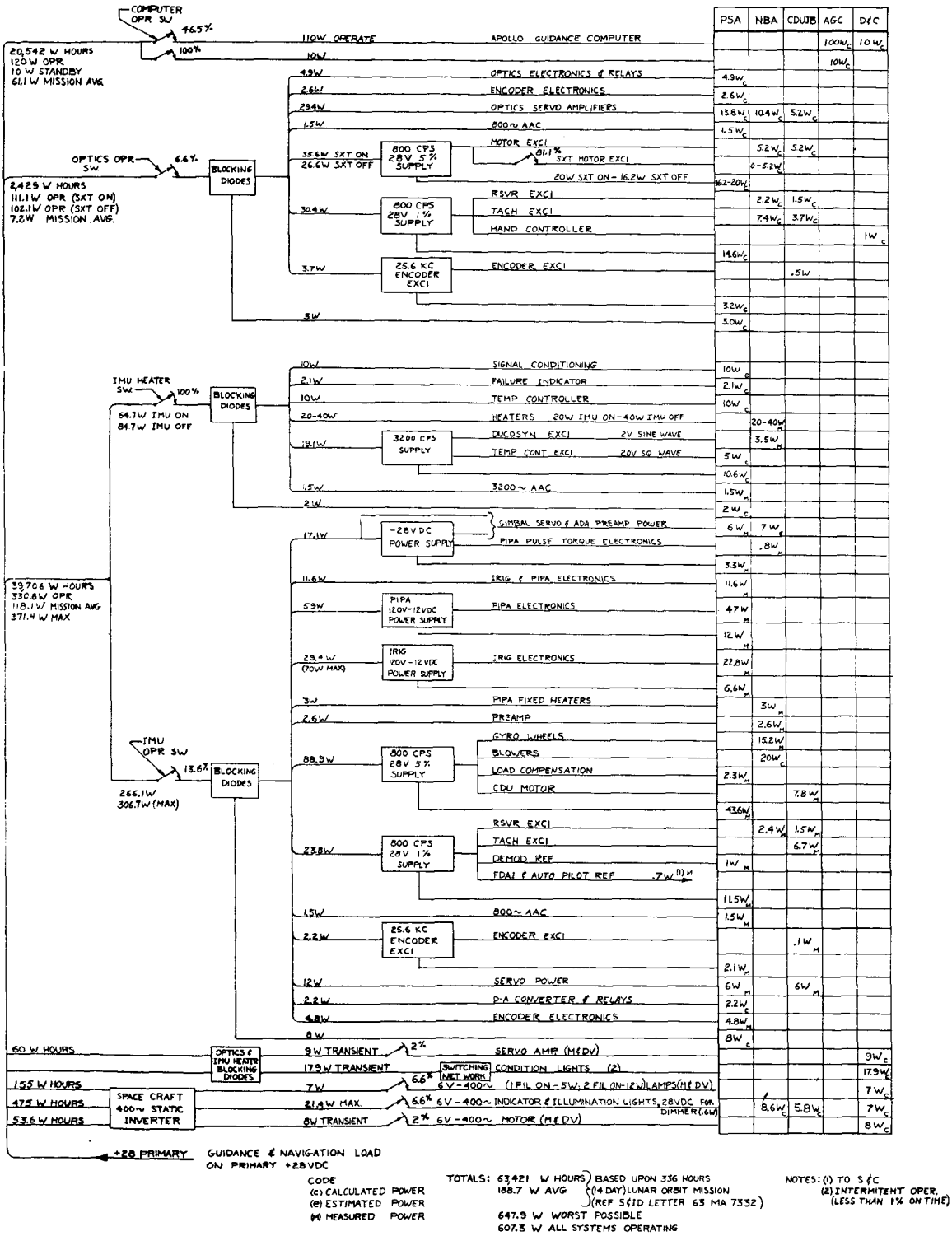



Figure 2-3. Electrical load on primary +28-VDC power supply

Table 2-III. Nominal Power Dissipation (watts) vs G&N Activity

| MODE | G&N Activity (power levels) | NBA | | CDUJB | PSA | | AGC | Thermal Load on S/C Coolant | D&C and S&C | Electrical Load |
|---|---|---|---|---|---|---|---|---|---|---|
| | | IMU | OBA | | IMU | OBA | | | | |
| A | IMU & AGC Operate (1,4) | 74.5 | 0 | 22.1 | 233.5 | 0 | 110 | 440.1 | 10.7 | 450.8 |
| B | IMU Alignment (1, 2, 4, 6) | 74.5 | 39 | 44 | 233.5 | 63.6 | 110 | 564.6 | 42.7 | 607.3 |
| C | Low-Orbit Navigation (1, 3, 4, 6) | 74.5 | 33.8 | 44 | 233.5 | 59.8 | 110 | 555.6 | 42.7 | 598.3 |
| D | Standby & Computing (1, 5) | 43.5 | 0 | 0 | 41.2 | 0 | 110 | 194.7 | 10 | 204.7 |
| E | Midcourse Navigation (1, 2, 5, 6) | 43.5 | 39 | 21.9 | 41.2 | 63.6 | 110 | 319.2 | 42 | 361.2 |
| F | IMU & AGC Standby (5, 7) | 43.5 | 0 | 0 | 41.2 | 0 | 10 | 94.7 | 0 | 94.7 |
| G | IMU Operate & AGC Standby (4, 7) | 74.5 | 0 | 22.1 | 233.5 | 0 | 10 | 340.1 | 0.7 | 340.8 |

1. AGC 120 watts
2. Optics, SXT on 111.1 watts
3. Optics, SXT off 102.1 watts
4. IMU Operate 330.8 watts
5. IMU Standby 84.7 watts
6. Display and Control 45.4 watts
7. AGC Standby 10 watts

Table 2-IV. Block I Command Module Power Profile for 14-Day Lunar Orbit Mission

| MODE | G&N Activity | Power Consumption by Levels (kwh) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | (1) AGC Operate 120 watts 156.09 hrs | (2) Optics, SXT On 111.1 watts 17.99 hrs | (3) Optics, SXT Off 102.1 watts 4.2 hrs | (4) IMU Operate 330.8 watts 45.28 hrs | (5) IMU Standby 84.7 watts 292.46 hrs | (6) Display & Control 45.4 watts 22.19 hrs | (7) AGC Standby 10.0 watts 181.65 hrs | TOTAL |
| A | IMU & AGC Operate 450.8 watts, 28.00 hrs | 3.360 | -- | -- | 9.262 | -- | -- | -- | 12.622 |
| B | IMU Alignment 607.3 watts, 7.33 hrs | 0.880 | 0.814 | -- | 2.425 | -- | 0.333 | -- | 4.452 |
| C | Low-Orbit Navigation 598.3 watts, 4.20 hrs | 0.504 | -- | 0.429 | 1.388 | -- | 0.191 | -- | 2.512 |
| D | Standby & Computing 204.7 watts, 105.9 hrs | 12.708 | -- | -- | -- | 8.969 | -- | -- | 21.677 |
| E | Midcourse Navigation 361.2 watts, 10.66 hrs | 1.279 | 1.184 | -- | -- | 0.903 | 0.484 | -- | 3.850 |
| F | IMU & AGC Standby 94.7 watts, 175.9 hrs | -- | -- | -- | -- | 14.899 | -- | 1.759 | 16.658 |
| G | IMU Operate & AGC Standby 340.8 watts, 5.75 hrs | -- | -- | -- | 1.902 | -- | -- | 0.058 | 1.960 |
| | TOTAL | 18.731 | 1.998 | 0.429 | 14.977 | 24.771 | 1.008 | 1.817 | 63.731 |

## 2-6 CURRENT STATUS OF COMMAND MODULE AGC PROGRAMS

Table 2-V lists current Command Module memory estimates and the status of AGC programs. The status of LEM AGC programs is not reported at this time.

A high and low word estimate is given with each program. Each status is defined as follows:

(1) Planning stage
(2) Programming stage
(3) Checkout on AGC simulation
(4) Checkout on G&N simulation
(5) Checkout on AGC

Table 2-V. Current Memory Estimates and the Status of Command Module AGC Programs

| Program | Status | Memory Estimate (words) | |
|---|---|---|---|
| | | High | Low |
| List Processing Interpreter | (4)* | 1600 | 1600 |
| AGC Executive | (4)* | 250 | 250 |
| AGC Waitlister | (4)* | 150 | 150 |
| AGC System Exerciser, Checkout, and Error Handler | (3)* | 1000 | 750* |
| G&N System Exerciser & Checkout | (2)* | 1000 | 750 |
| Display, Keyboard, and Telemetry | (4)* | 1500 | 1500* |
| Input/Output Control | (2) | 850 | 350 |
| Midcourse and Orbital Navigation | (3)* | 2000 | 1500 |
| Midcourse and Orbital Guidance | (2)* | 500 | 500 |
| Prelaunch Platform Alignment | (4)* | 400* | 400* |
| In-Flight Platform Alignment | (2) | 980 | 900 |
| Reentry Control | (1) | 1290 | 1024 |
| Injection and De-Boost | (2)* | 1000 | 400 |
| Totals | | 12520* | 10074* |

* These items have changed since the last report, E-1142 (Rev. 13), dated October 15, 1963.

# LUNAR EXCURSION MODULE

Section 3

LUNAR EXCURSION MODULE DATA

## 3-1 POWER REQUIREMENTS FOR LEM

The current estimate of LEM G&N power and energy (see table 3-I) is based upon the fixed-telescope concept and the use of the Command Module IMU and computer.

The values shown in table 3-I are center value estimates and do not include any safety factor for bad estimating.

Transient power peaks, occuring at higher power levels during turn-on and slewing operations, are considered to consume negligible energy. When they become available data on these peaks will be included.

Table 3-I. LEM Power Requirements
(Based upon GAEC Profile, Ref: NASA Coord. Meeting L3A)

| | Power (watts) | Time (hrs) | Energy (kwh) |
|---|---|---|---|
| IMU Standby | 84.7 | 103.8 | 8.78 |
| IMU Operate | 348.0 | 26.4 | 9.19 |
| AGC Standby | 10.0 | 21.3 | 0.21 |
| AGC Operate | 115.0 | 26.4 | 3.04 |
| Radar CDU | 18.4 | 23.8 | 0.44 |
| Optics | Negligible | | |
| Display and Controls | 12.2 | 3.0 | 0.04 |
| Rendezvous Radar | * | 2.0 | * |
| Landing Radar | * | 1.0 | * |
| TOTALS | 493.6 (peak) | | 21.70 |
| * Totals do not include radar loads. | | | |

Note that the total energy drawn, 21.70 kwh, is considerably higher than for a "normal" mission since the estimate provides for full operate power for the 18 hours of "orbit contingency" mode. Without this contingency the G&N takes about 13 kwh using the GAEC profile.

Separate power turn-on switches are assumed for "IMU operate," "computer standby," "computer operate," and "radar CDU." The LEM G&N uses only the spacecraft + 28-VDC power supply except for operation of condition lights. The condition lights operate from the spacecraft 400-cps power supply.

## 3-2 WEIGHTS FOR LEM

Lunar Excursion Module weights are presented in table 3-II. In general the data conform to the information contained in paragraphs 2-1 and 2-1.1.

Column (a), Target Weight, was taken from GAEC LMD 490-39, Enclosure 1, submitted to MIT at a weights review meeting on September 10, 1963. GAEC reported that G&N weights associated with D&C will be reported by them as part of the total spacecraft D&C. Therefore, target weights were not given by GAEC to supply the five items denoted by asterisks in column (a).

The row labeled Bare Guidance System is inserted to provide for comparisons with similarly specified systems.

## 3-3 REPORTED LEM WEIGHT CHANGES

The weight changes since last month's report, E-1142 (Rev. 13), October 15, 1963, are explained below.

3-3.1 IMU. For explanation of the weight increase see section 2-2.1.

3-3.2 PSA. The 0.2-pound weight decrease is a result of the itemized weight breakdown of the PSA in Appendix B, System Status Report, E-1142 (Rev. 13), dated October 15, 1963.

Table 3-II. Estimated Weights of LEM G&N Components (lbs at 1 g)

| Item | Target Wt 8/63 (a) | (b-a) | Status 10/63 (b) | (c-b) | Status 11/63 (c) | Design Load Wt. (d) |
|---|---|---|---|---|---|---|
| CDU's | * | | 13.7 | 0.0 | 13.7(E) | ** |
| Telescope and all Eyepieces | 12 | + 12.5 | 24.5 | 0.0 | 24.5(E) | |
| Navigation Base | 4 | - 4.0 | -- | -- | -- | |
| Eye Register for Reticule | * | | 2.0 | 0.0 | 2.0(E) | |
| Two-Digit Readout for Reticule | * | | 5.0 | 0.0 | 5.0(E) | |
| IMU | 58 | + 1.0 | 59.0 | +1.2 | 60.2(M) | |
| AGC/PSA Interconnection Assy | 15 | - 5.0 | 10.0 | 0.0 | 10.0(E) | |
| AGC Display and Controls | * | | 15.0 | 0.0 | 15.0(E) | |
| Other Display and Controls | * | | 15.9 | 0.0 | 15.9(E) | |
| Book of Procedures, etc. | 2 | 0 | 2.0 | 0.0 | 2.0(E) | |
| AGC | 60 | - 0.4 | 59.6 | 0.0 | 59.6(E) | |
| PSA | 35 | - 0.4 | 34.6 | 0.2 | 34.4(C) | |
| Coldplate | 5 | - 5.0 | -- | -- | -- | |
| TOTAL | 191 plus * items not yet given | | 241.3 | +1.0 | 242.3 | |
| Bare Guidance System (IMU, PSA and computer): ** No design load weight has been assigned. | | | 153.2 | +1.0 | 154.2 | |

Section 4

# GLOSSARY*

AGC: APOLLO Guidance Computer--complete computer except display and keyboard. Includes all structural mounting details, one logic and one memory tray, the AGC end connector assembly, and a beryllium toe plate.

AGC SPARES: Consists of a complete spare logic tray to be stored in the computer spares area and one spare module for each module not already spared, i.e., a spare for each unique module to be stored as a loose spare.

BELLOWS ASSEMBLY: Connection between Command Module and Optical Subsystem consisting of SXT and SCT bellows plus bellows seals.

COOLANT HOSES: Consists of (1) three aluminum flex coolant hoses between IMU and spacecraft, optics and spacecraft, and optics and IMU, (2) bracket assembly screws and clamp, and (3) entrapped coolant.

CDU AND FRAME ASSEMBLY: Coupling Display Units and Frame Assembly--In Command Module (Block I), five interchangeable gear boxes and frame assembly used as a data interface among the optics, IMU, AGC, and spacecraft autopilot. In LEM, five electronic CDU's including mounting frame, screws, interwiring, and connectors.

D & C/AGC: Display and Control, Computer--consists of letter and number readout, keyboard, control panel, relays, and support structure. One is located in lower equipment bay and one is located in main panel.

D & C/NAV: Display and Control Navigation--consists of G&N Indicator Control Panel, IMU Control Panel, D&C Electronics, and Optical Shroud. The above includes meters, switches, lights etc., except as reported elsewhere. The weight does not include the clock group which is supplied by NAA.

G&N IND. CONT. PANEL: G&N Indicator Control Panel--consists of the necessary switches, indicators, and controls for navigation that are not reported elsewhere. Includes optics hand controller, altitude impulse control, panel wiring, panel, and supporting hardware.

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* This applies specifically to Command Module, though it can provide a guide to the interpretation of LEM items. As unique LEM details become better identified, descriptions will be included.

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