JSC 08818

SKYLAB 4
PRELIMINARY BIOMEDICAL REPORT

National Aeronautics and Space Administration

LYNDON B. JOHNSON SPACE CENTER

Houston, Texas

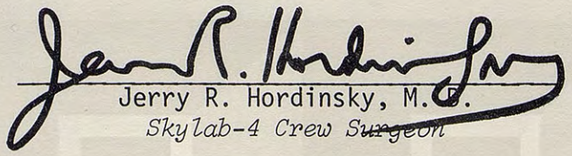
JANUARY 1975

LIFE SCIENCES DIRECTORATE

INTERNAL NOTE

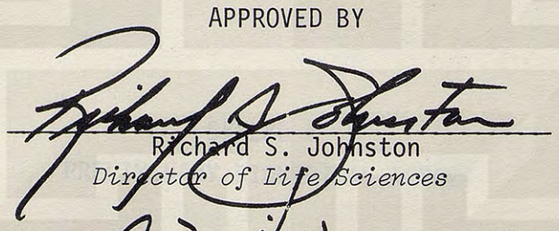
SKYLAB-4 PRELIMINARY BIOMEDICAL REPORT

COLLATED BY

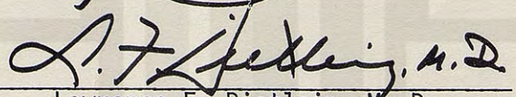


Jerry R. Hordinsky, M.D.
Skylab-4 Crew Surgeon

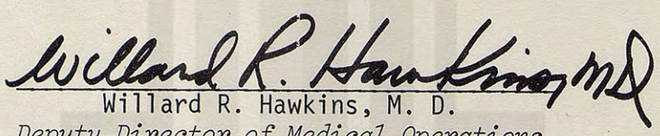
APPROVED BY



Richard S. Johnston
Director of Life Sciences



Lawrence F. Dietlein, M. D.
Deputy Director of Life Sciences



Willard R. Hawkins, M. D.
Deputy Director of Medical Operations

Copy Preparation Under Contract No. NAS9-13655
with
The Boeing Company,
Sylvia A. Rose, Senior Technical Writer/Editor
Houston, Texas 77058

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LYNDON B. JOHNSON SPACE CENTER
January 1975

SKYLAB 4

PRELIMINARY BIOMEDICAL REPORT

ACKNOWLEDGEMENT

The best acknowledgment to this report is to draw attention to the Directory of Authors and highlight the large group of people who were instrumental in formulating the data contained within this report.

Numerous other participants in the Skylab project are referenced in the operational discussions of the report. They, too, served well in building a successful mission, and thus the substrate for the report, from the Skylab 4 crew to the MOCR Medical Team to the Medical Recovery Team.

Jerry Hordinsky, M.D.
Skylab 4 Crew Surgeon

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LIST OF FIGURES (cont.)

LIST OF FIGURES (concluded)

SKYLAB-4 EVENTS

Date	Mission Day	Time (G.m.t.)	Elapsed Time (sec.)	Event
11/16/73	1	14:01:23.4	0	
			10.3	Initiate pitch/roll maneuvers
			129.6	Tilt arrest
			134.8	TB 2
			137.8	S-IB inboard engines cutoff
			140.8	S-IB outboard engines cutoff, TB3
			142.1	Separation signal
			143.5	S-2 ignition sequence start
			154.1	Jettison ullage rockets
			170.8	Launch escape system jettison
			576.7	Guidance cutoff
			576.9	TB 4
	1	14:11	586.7	Insertion
	1	22:02		CSM docking to Saturn Workshop
2/8/74	85	10:28		Undocking
	85	11:32		SPS shaping maneuver
	85	14:36		SPS retrofire maneuver
	85	15:17		Splash
	85	15:59		Crew recovery to PRS

Duration of mission 84 days, one hour, 15 minutes, 32 seconds.

INTRODUCTION

Jerry R. Hordinsky, M.D.

The Skylab-4 (SL-4) flight was to be a 60-day mission open ended to at least 85 days. The two prior Skylab flights of 29 and 59 days, respectively, had provided medical data that pointed to the feasibility of extending the time past 60 days. The upper limit of 85 days was a reflection of the limitation of food resupply to continue the M071 experiment and of the recovery being possible close to San Diego in daylight. Special survival food for 10-day emergency extension was also provided.

The launch date of the mission was at one time considered for as early as 24 September. This would have been carried out only if stability of the Skylab was such that SL-4 crew manning was required prior to the SL-3 crew departure.

The crew for SL-4 consisted of Commander (CDR) Jerry Carr, age 42, a Lieutenant Colonel in the Marine Corps; Scientist Pilot (SPT) Edward Gibson, aged 37, holder of a Ph.D. in Engineering (with a physics minor); and Pilot (PLT) Bill Pogue, aged 43, a Colonel in the Air Force. The three were medically evaluated for the Astronaut Corps during the years 1965 and 1966. The Backup Crew, who also served as backup for SL-3, consisted of CDR Vance Brand, aged 42, SPT Bill Lenoir, aged 34, and PLT Don Lind, aged 43. In addition, Mr. Brand and Dr. Lind were the pilots for the SL-4 rescue mission in the event such became a necessity.

The Skylab Flight Crew Health Stabilization Program (SFCHSP) (sec. 1.3) was initiated for the prime and backup crews on 20 October 1973. The preflight medical examinations and history reviews did not reveal anything of permanent significance to the planned operational aspects of the flight.

The upcoming flight was intended to continue the accumulation of new medical data, data on the sun and other stars, data on Earth resources, as well as a host of data from investigations into physical and biological phenomena elicited only in zero-g. Additionally, the comet Kohoutek was in timely synchrony for study by this last Skylab mission.

The SL-4 flight began on 16 November 1973 at 08:01:23 c.s.t. A hard dock was achieved at 1602 hours c.s.t. after two unsuccessful docking attempts. Eighty-four days, 1 hour, 15 minutes and 32 seconds later, the mission was terminated with splash at 1017 hours c.d.t. on 8 February 1974. In the interim the crew completed 1214 revolutions of the Earth for a total distance of 34.5 million miles. Four successful extravehicular activities (EVA's) were completed.

1.0 BIOMEDICAL EVALUATION

1.0 BIOMEDICAL EVALUATION

Jerry R. Hordinsky, M.D.

1.1 Biomedical Evaluation Summary

The SL-4 mission demonstrated the relative medical stability of the crew in spite of the failure to optimize such basic areas as their work-rest cycles, eating patterns, exercise, and ground-air resolution of conflicting inputs on specific problems.

The launch, with insertion occurring at 9 minutes and 47 seconds later, was medically uneventful. Heart rates remained below 125 beats per minute (bpm) for all crewmembers. Zero-g adaptation was variably tolerated; the SPT had the fewest problems and the PLT had the most. All crewmembers were on a mandated antimotion sickness medication regimen. By the fourth day all significant symptomatology had receded for all crewmembers. Working within the prescheduled time lines proved to be very taxing to the crew. In retrospect, in evaluating the mission events and especially the contents of the operational conference around mission day (MD) 45 (sec. 2.2.2.7), the crew seemed to have been scheduled to perform at a pace that was too rapid and too rigid too early in the mission, especially when considering the overall intended length of the mission.

Food intake was satisfactory with all showing small amounts of weight loss, the least amount of any of the Skylab crews. The high density food bars were found to be acceptable and taste and aroma testing did not reveal any consistent threshold shifts (sec. 2.3).

Water intake and urine output remained satisfactory. Two off nominal entities included the addition of boric acid to the urine bags to preclude loss in the event of freezer failure, and a requirement for 36-hour urine pools due to the shortage of sample bags (sec. 3.2).

Mass Measurement Devices were operationally satisfactory (sec. 3.3).

Bone mineral measurements showed a range of changes free of any clinical hazard, and continued to mirror the bed rest studies of equivalent duration (sec. 3.1).

Lower body negative pressure (LBNP) (sec. 3.5) tolerance was well maintained with early terminations generally associated with such factors as fatigue, elevated temperature, *et cetera*.

Trends established on in-flight vectorcardiograms (VCG) were generally similar to prior Skylab mission trends and demonstrated a rapid return to preflight values in the postflight period.

In-flight plasma volume and red blood cell mass (sec. 3.9) loss was again noted but with no progression past any of the levels noted in SL 1/2 (1) or SL-3 (2).

The crew demonstrated the same in-flight immunity to motion sickness as provoked by the M131 protocol (sec. 3.12). The oculogyral illusion (OGI) and spatial localization tests demonstrated no overall trends.

The sleep monitoring data (sec. 3.13) on the SPT compared roughly to the trends seen in SL 1/2.

In-flight physiological responses of the crew to exercise (sec. 3.15) were essentially within the preflight baseline ranges throughout the mission.

Postflight pulmonary function testing (sec. 3.16) showed no significant difference from preflight.

Postflight muscle testing (sec. 2.12) was not associated with any significant decrement in arm or leg muscle function.

Anthropometric studies (sec. 2.4) demonstrated an in-flight temporary increase in height and reduction in abdominal and chest circumference. Leg girth measurements confirmed an early fluid shift out of the legs. Center of gravity measurements confirmed the cephalad shift of mass.

Visual light flash experiments (sec. 2.15) tend to confirm the cosmic ray etiology of the phenomena experienced by the crew.

Although radiation doses were the highest of the three Skylab missions, all doses were less than one-fourth of the third manned mission allowable.

The crew was adequately trained in basic use of the Inflight Medical Support System (IMSS) (sec. 2.2.6). The primary use in-flight was as a source of drugs for the conditions detailed in the Crew Health section (sec. 2.0). Hemoglobin values were checked regularly in-flight, but routine specific gravity determinations were deleted early.

Exercise was maintained at high levels, including the regular use of the treadmill (sec. 2.4.3).

There were no problems in maintaining the limits of environmental parameters of total pressure, oxygen, and carbon dioxide (fig. 1.2-1 sec. 1.2 and sec. 2.2.2.4). Temperatures tended to range toward the low 80's in

the high beta angle period around MD 60, and work-arounds in scheduling were instituted. Humidity tended to be on the dry side throughout the mission.

No toxicology problems (sec. 2.16) occurred in the mission. An atmospheric volatile concentration measurement device was used to collect and trap organic molecules for postflight quantitative analysis. No irritating chronic odors existed.

Lighting was generally satisfactory. Noise levels were generally acceptable except in the multiple docking assembly (MDA) which was higher than desired, and in the sleep compartments where the lack of insulation, both from each other and from the rest of the workshop, was bothersome.

Maintaining personal cleanliness onboard was reasonably well performed, but was time consuming. Microbiologically (sec. 2.13), *Klebsiella pneumoniae* showed the most buildup in-flight. Additionally, fungus was discovered to be growing prominently on the liquid-cooled garments (LCG's). The high levels of *Staphylococcus aureus* noted in SL-3 were not an SL-4 observation.

The deactivation phase (sec. 2.2.2.9) omitted several housekeeping procedures in view of no follow-on mission. This permitted two full 8-hour sleep periods on MD 83 and 84, albeit the first one was displaced forward a couple of hours and the latter was located midday (Houston time) to compensate for the circadian shift required.

Reentry was preceded by mandatory use of antimotion sickness medication. Splashdown was medically uneventful. Initial pulse rates on the water were: CDR, 70; SPT, 80; and PLT, 80 bpm.

Inside the Command Module, after retrieval and onboard the Prime Recovery Ship (PRS), the crewmembers demonstrated their ability to move around easily. They tolerated the maximum cardiovascular stress possible, namely, going from a supine position with the antihypotensive garment suit inflated, to a sitting, semi-standing position with the antihypotensive garment suit deflated. Protocols for recovery (R+0, R+1 and R+2 days) were carried out in the Skylab Mobile Laboratories (SML's) on the USS U.S.S. *New Orleans* without any major medical incident.

Normal testing continued through R+68 days. Details of postflight status are included in the body of this report. A generalization can be made that the SL-4 crew was found to be clinically equal to or better than the other two crews on all medical parameters investigated.

REFERENCES

1) JSC-08439 *Skylab 1/2, Preliminary Biomedical Report*, September 1973.

2) JSC-08668 *Skylab-3 Preliminary Biomedical Report*, February 1974.

1.2 Mission Medical Trend Data Summaries

Richard S. Johnston
Director of Life Sciences Division, JSC

The Mission Medical Trend charts, figures 1.2-1 through 1.2-18, contain selected data from the medical experiments which were used for real time crew health monitoring. The data plotted on these charts were established by the medical experiment team and medical operations personnel and are defined in *The Skylab Medical Operations Plan* (MSC-07731). These data were not meant to portray all of the medical experiment protocols but are used as a method to provide a comprehensive overview, while presenting only a small portion of the total medical information.

During the mission these charts were updated daily as data were received from the Mission Control Center. Raw data were initially plotted for each experiment test. The medical experiment principal investigators reviewed this raw data and within 24-48 hours validated data were submitted and then plotted on the trend charts. This system of data analysis and display worked well throughout the mission and was available for the daily medical operations team meetings.

Discussion of this trend data is included in section 3.0 for each applicable experiment.

Additional graphs were maintained by the crew surgeons which allowed more detailed analysis of 10-day segments of the mission (figures 1.2-19 through 1.2-25).

Figure 1.2-1

APRIL 23, 1974
SKYLAB ENVIRONMENTAL PARAMETERS
NOVEMBER
DECEMBER
JANUARY
FEBRUARY
MISSION SL-4
DATE
JD
MD
OWS AMBIENT PRESSURE (PS)A)
OWS AMBIENT TEMP (°F)
OWS DEW POINT (°F)
PP O2 (PSIA)
PP CO2 (mm Hg)

Figure 1.2-1

1.2 Mission Medical Trend Data Summaries

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Director of Life Sciences Division, JSC

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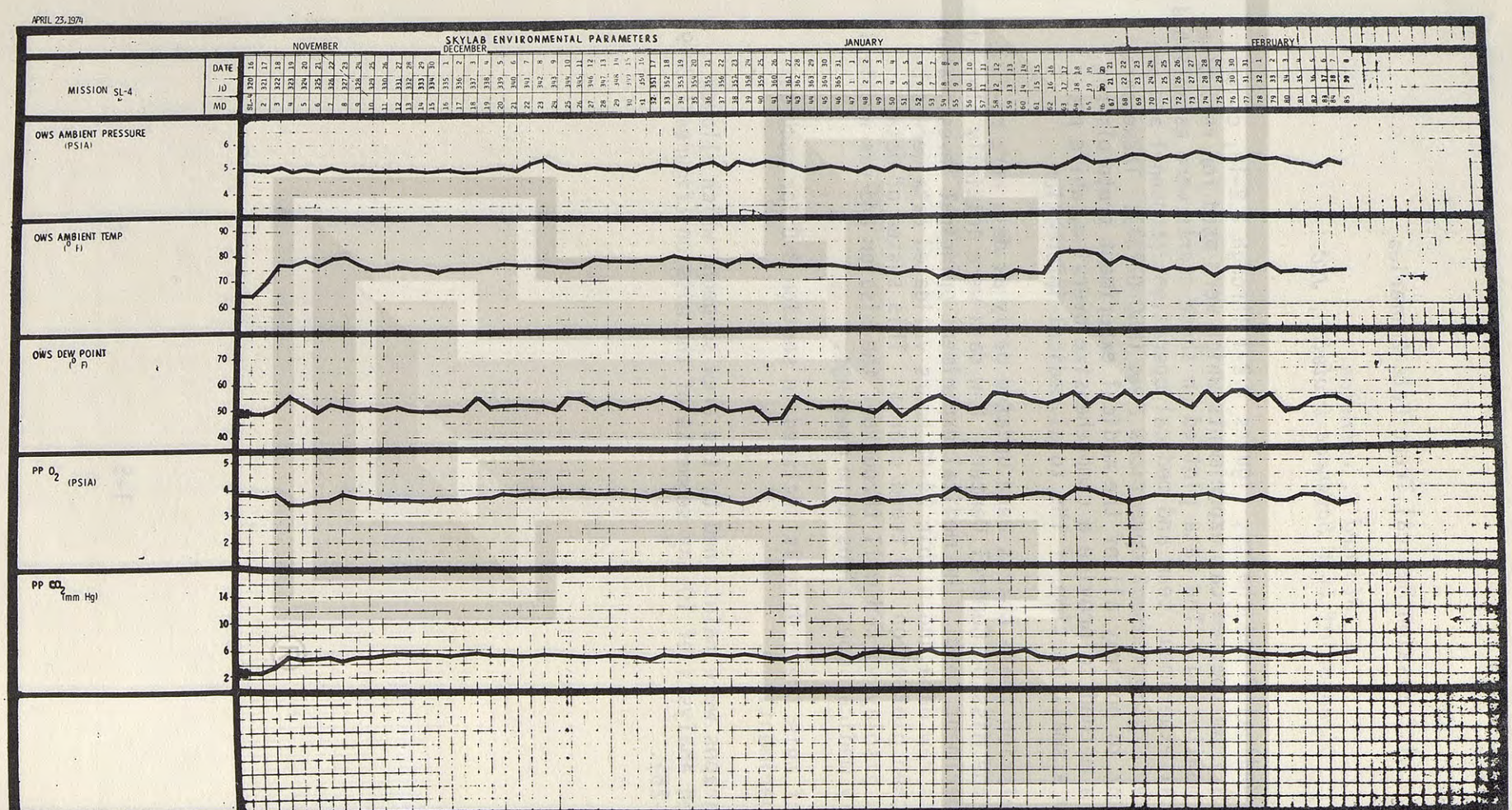
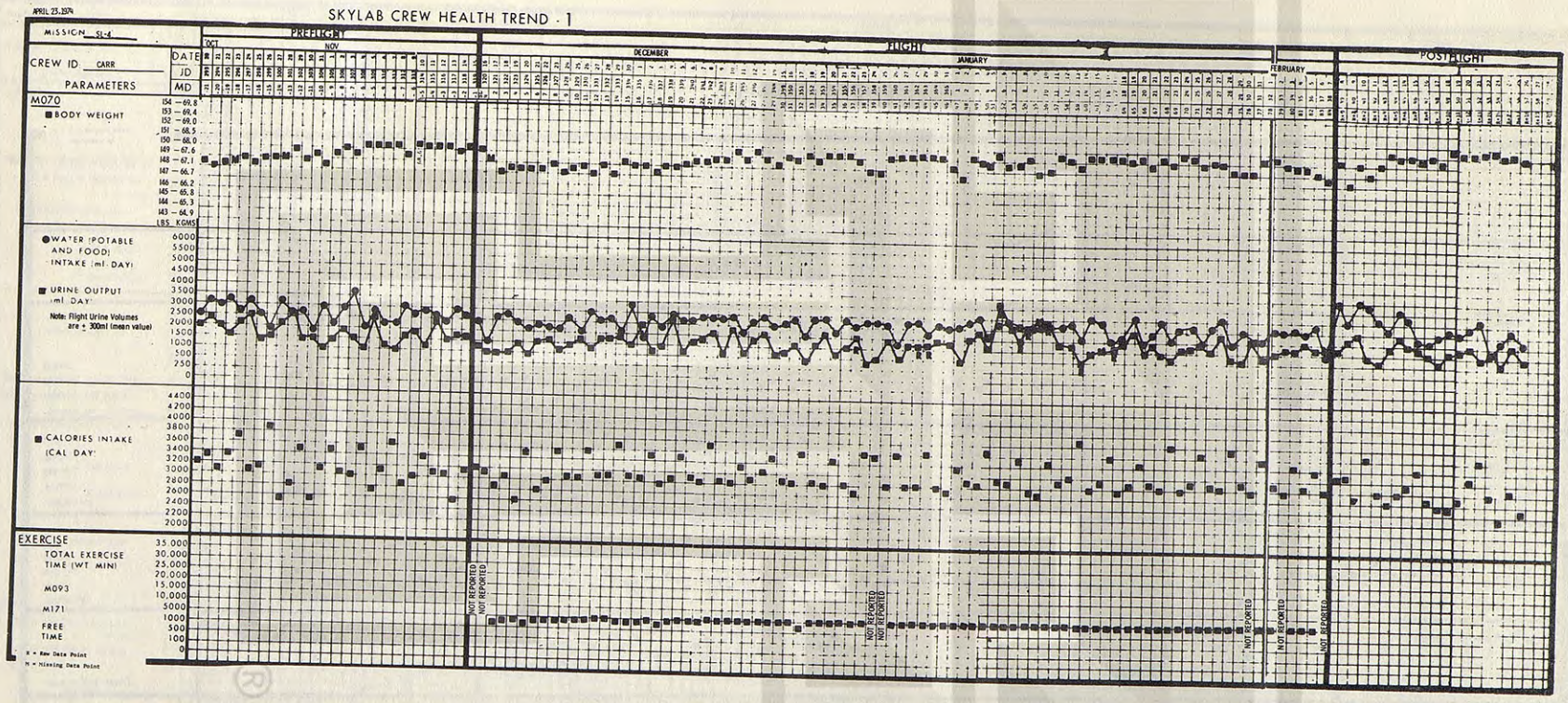

APRIL 23, 1974
SKYLAB ENVIRONMENTAL PARAMETERS
NOVEMBER
DECEMBER
JANUARY
FEBRUARY
MISSION SL-4
DATE
ID
MD
OWS AMBIENT PRESSURE (PSIA)
6
5
4
OWS AMBIENT TEMP (°F)
90
80
70
60
OWS DEW POINT (°F)
70
60
50
40
PP O2 (PSIA)
5
4
3
2
PP CO2 (mm Hg)
14
10
6
2

Figure 1.2-1

Figure 1.2-1



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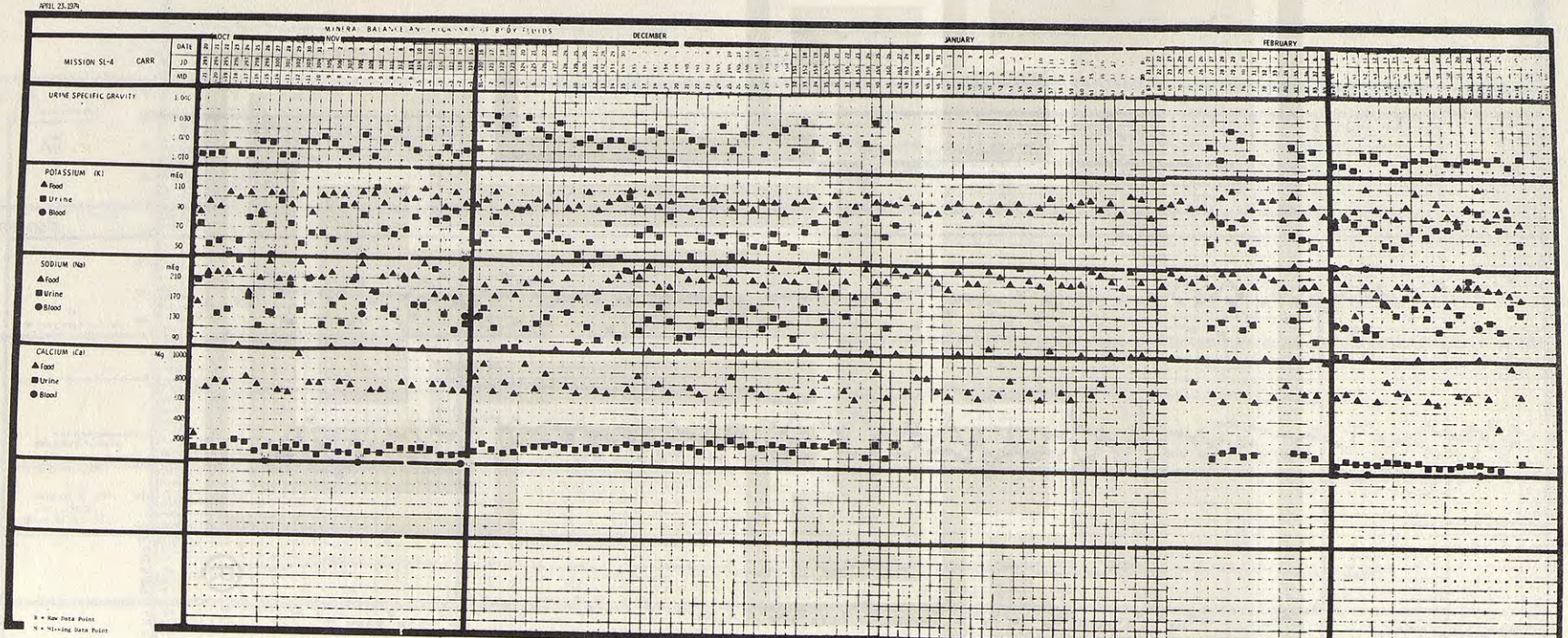
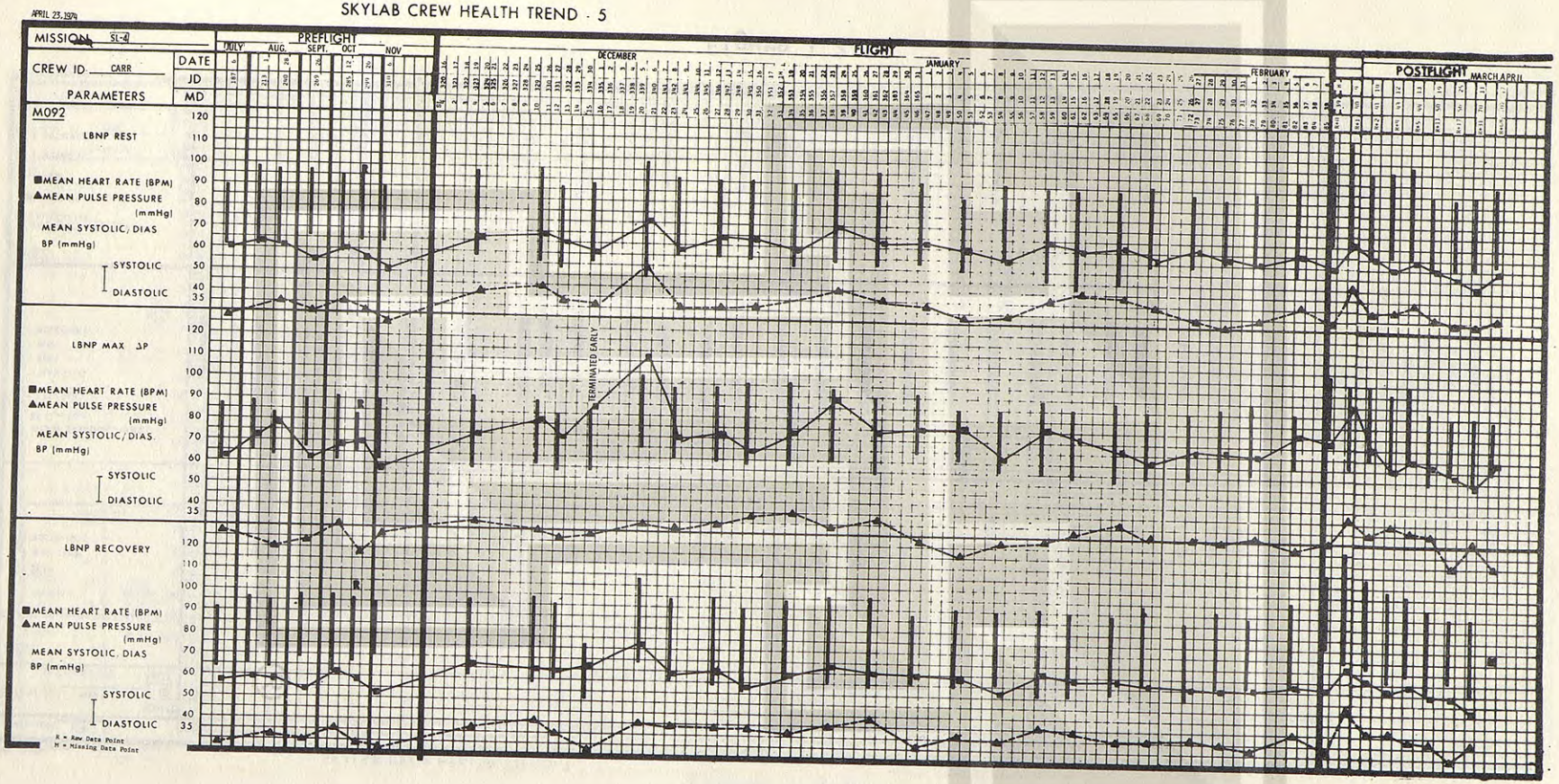

APRIL 23, 1974
MINERAL BALANCE AND HISTORY OF BODY FLUIDS
MISSION SL-4 CARR
DATE
JD
MD
OCT
NOV
DECEMBER
JANUARY
FEBRUARY
URINE SPECIFIC GRAVITY
1.040
1.030
1.020
1.010
POTASSIUM (K)
mEq
Food
Urine
Blood
110
90
70
50
SODIUM (Na)
mEq
Food
Urine
Blood
210
170
130
90
CALCIUM (Ca)
Mg
Food
Urine
Blood
1000
800
600
400
200
R = Raw Data Point
M = Moving Data Point

Figure 1.2-3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SKYLAB CREW HEALTH TREND - 5
MISSION SL-4
CREW ID CARR
DATE
JD
MD
PARAMETERS
PREFLIGHT
JULY
AUG.
SEPT.
OCT
NOV
FLIGHT
DECEMBER
JANUARY
FEBRUARY
POSTFLIGHT
MARCH/APRIL
M092
LBNP REST
LBNP MAX ΔP
LBNP RECOVERY
MEAN HEART RATE (BPM)
MEAN PULSE PRESSURE (mmHg)
MEAN SYSTOLIC/DIAS BP (mmHg)
SYSTOLIC
DIASTOLIC
120
110
100
90
80
70
60
50
40
35
TERMINATED EARLY
R = Raw Data Point
M = Missing Data Point

Figure 1.2-4

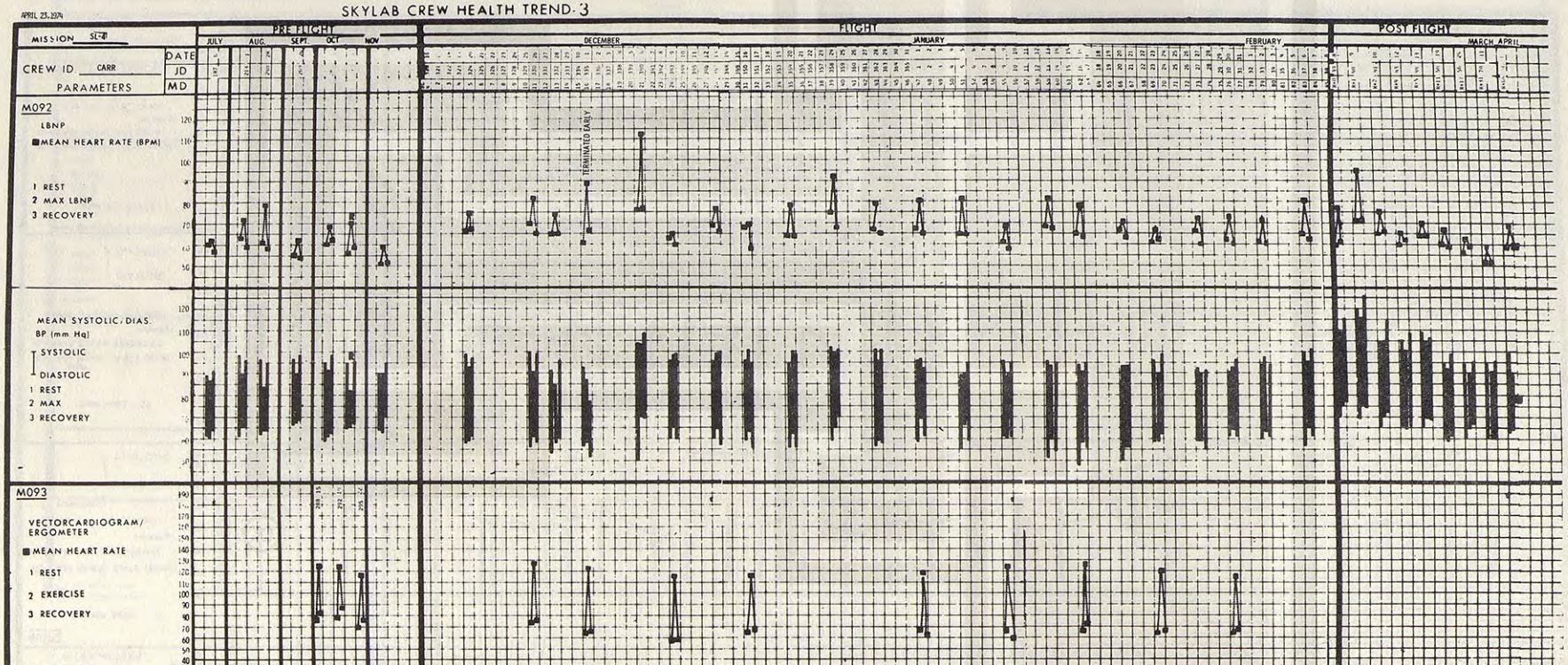
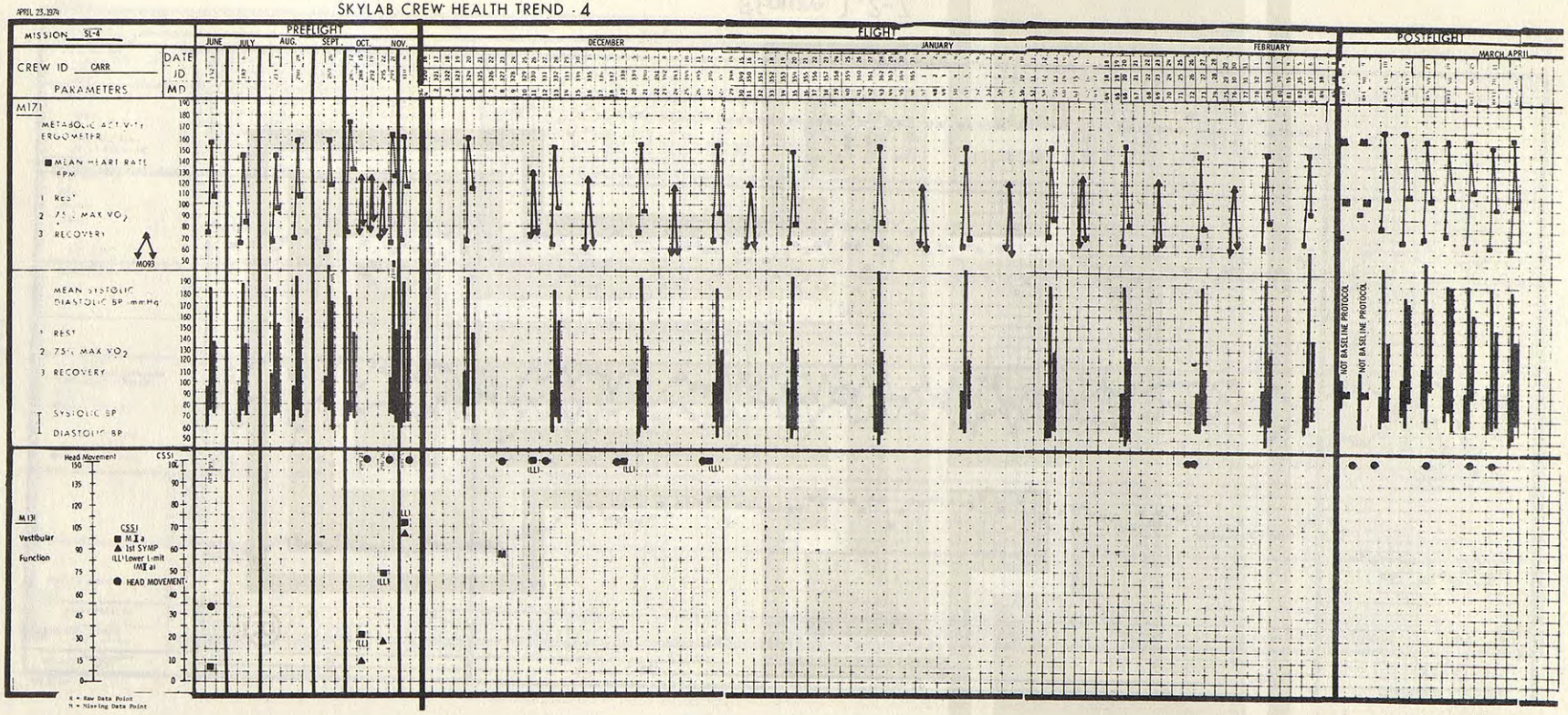

APRIL 23, 1974
SKYLAB CREW HEALTH TREND-3
MISSION SL-2
CREW ID CARR
PARAMETERS
DATE
JD
MD
PRE FLIGHT
JULY
AUG.
SEPT.
OCT
NOV
FLIGHT
DECEMBER
JANUARY
FEBRUARY
POST FLIGHT
MARCH
APRIL
M092
LBNP
MEAN HEART RATE (BPM)
1 REST
2 MAX LBNP
3 RECOVERY
TERMINATED EARLY
MEAN SYSTOLIC/DIAS. BP (mm Hg)
SYSTOLIC
DIASTOLIC
1 REST
2 MAX
3 RECOVERY
M093
VECTORCARDIOGRAM/ ERGOMETER
MEAN HEART RATE
1 REST
2 EXERCISE
3 RECOVERY
R = Raw Data Point
M = Missing Data Point

Figure 1.2-5

Figure 1.2-5



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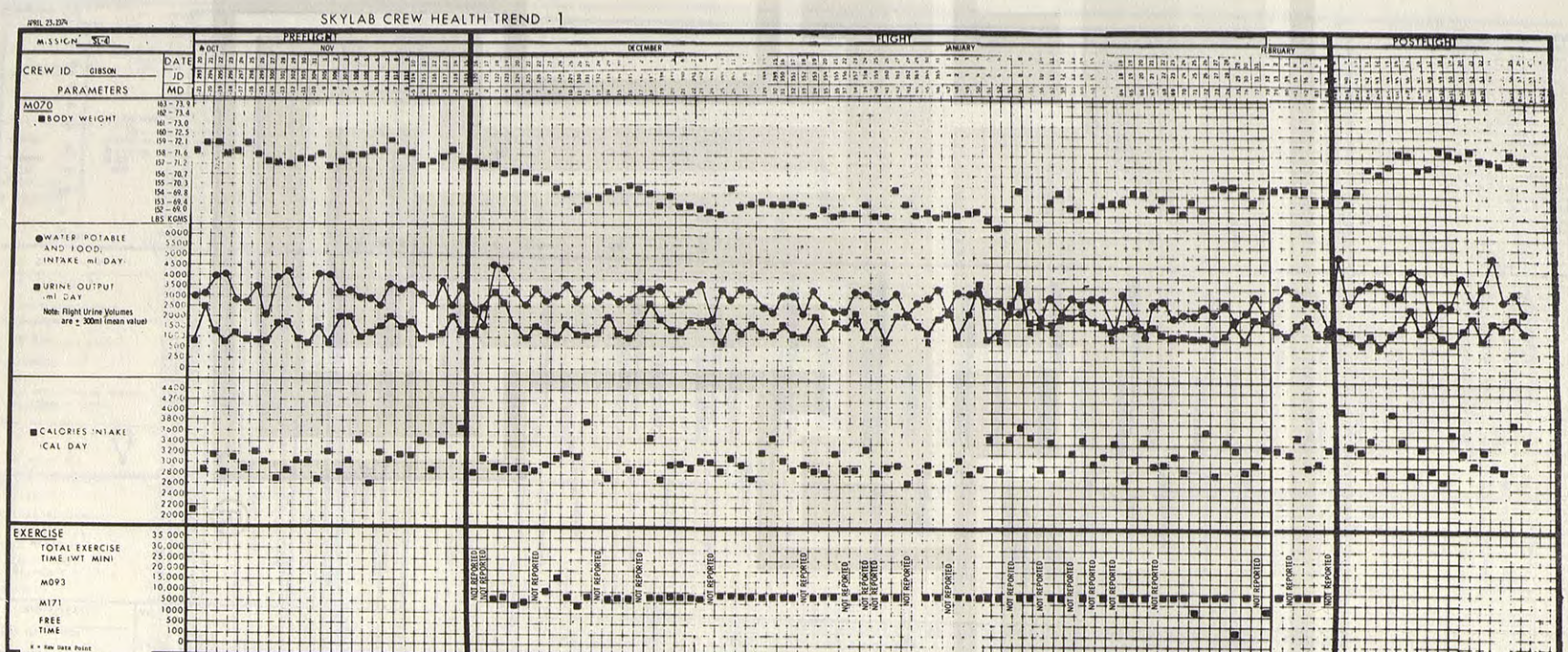
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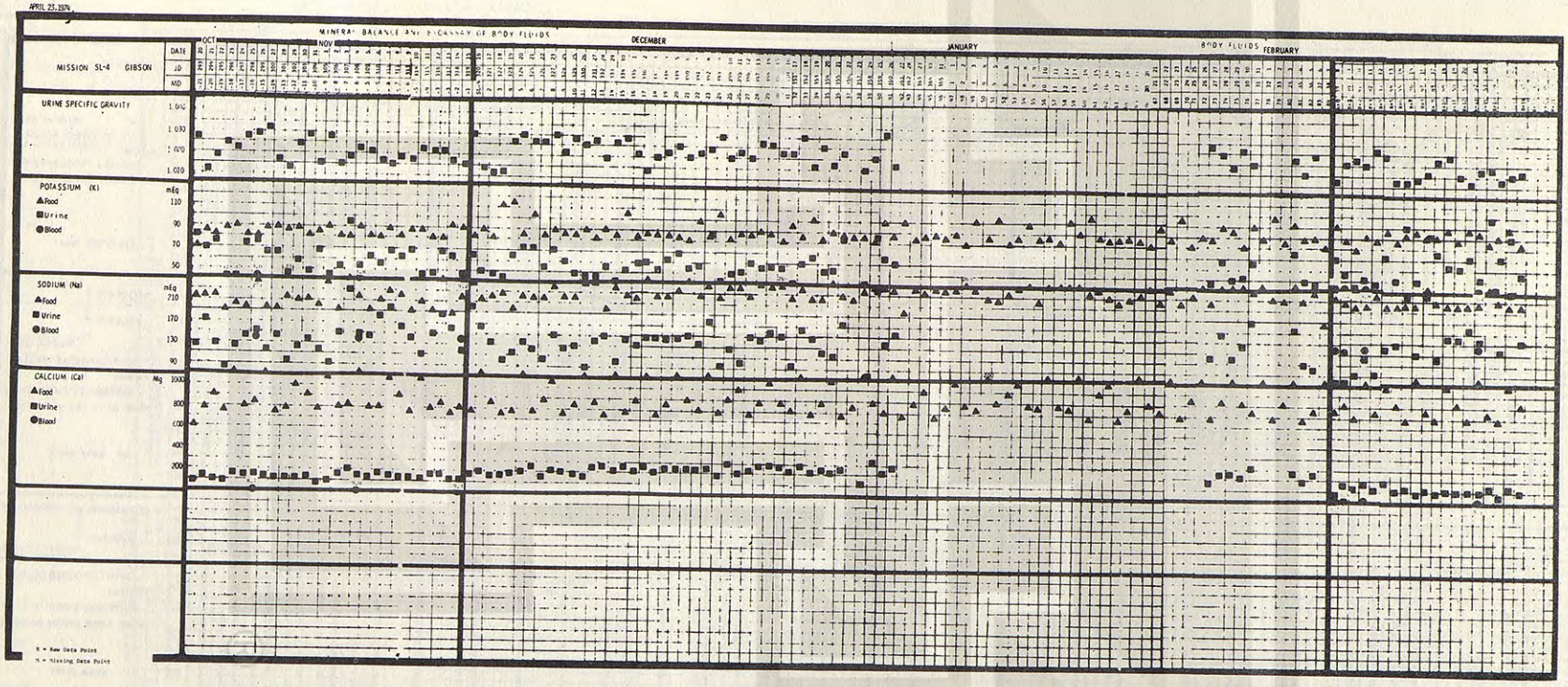
SKYLAB CREW HEALTH TREND - 1
MISSION SL-4
CREW ID GIBSON
PARAMETERS
DATE
JD
MD
PREFLIGHT
FLIGHT
POSTFLIGHT
OCT
NOV
DECEMBER
JANUARY
FEBRUARY
M070
BODY WEIGHT
LBS KGMS
WATER POTABLE AND FOOD INTAKE ml DAY
URINE OUTPUT ml DAY
Note: Flight Urine Volumes are ± 300ml (mean value)
CALORIES INTAKE ICAL DAY
EXERCISE
TOTAL EXERCISE TIME IWT MIN
M093
M171
FREE TIME
NOT REPORTED

Figure 1.2-7

Figure 1.2-7



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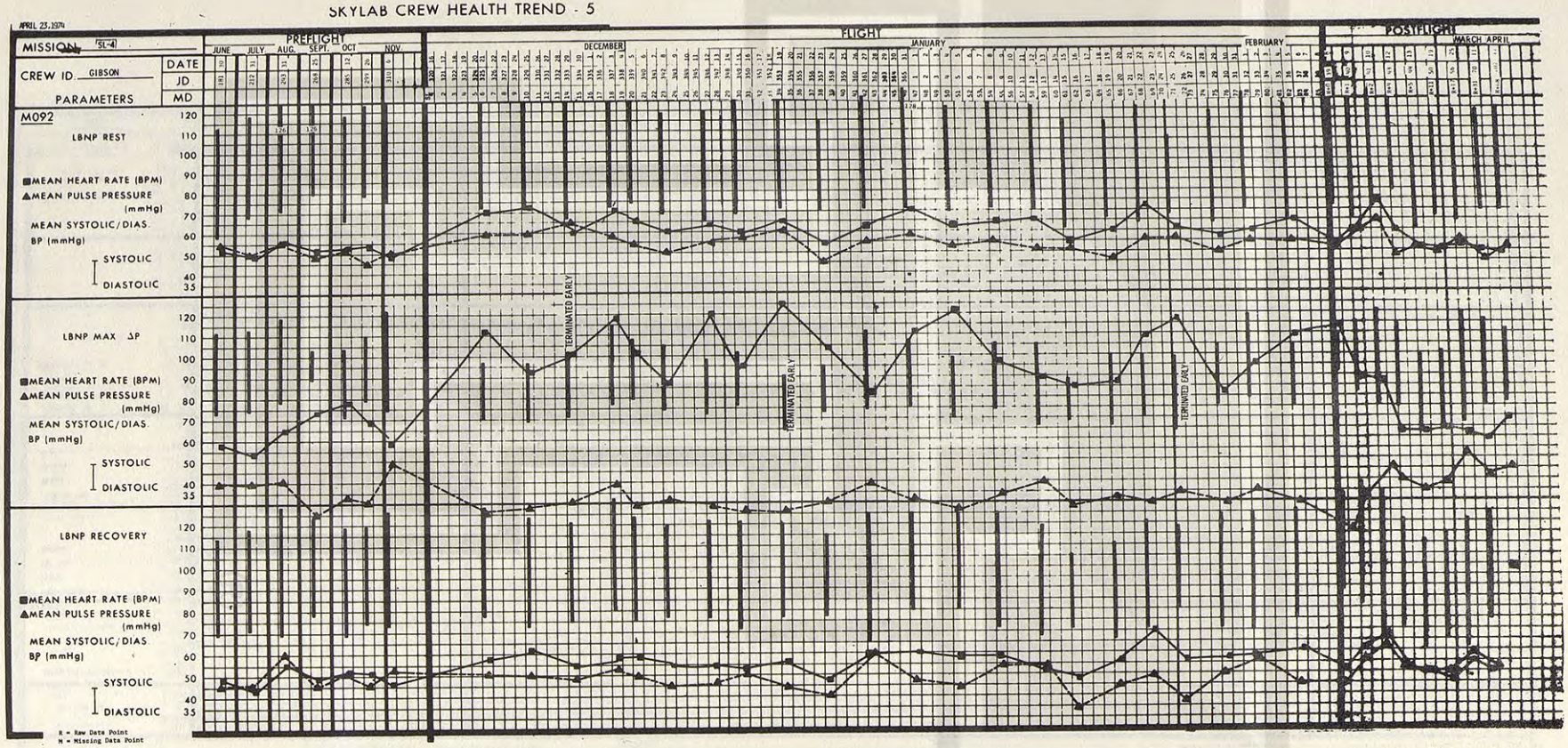
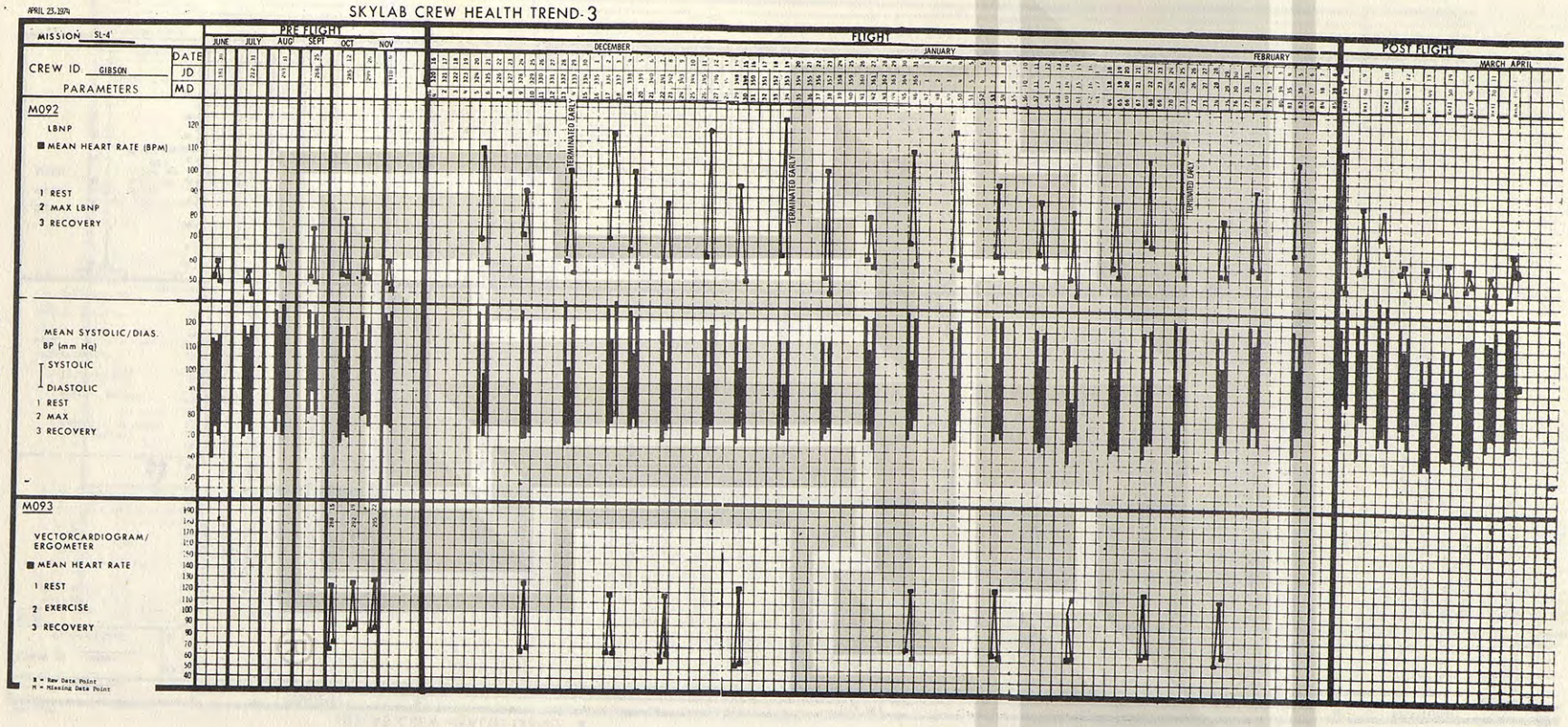

SKYLAB CREW HEALTH TREND - 5
APRIL 23, 1974
MISSION SL-4
CREW ID. GIBSON
PARAMETERS
DATE
JD
MD
PREFLIGHT
FLIGHT
POSTFLIGHT
JUNE
JULY
AUG.
SEPT.
OCT
NOV.
DECEMBER
JANUARY
FEBRUARY
MARCH
APRIL
M092
LBNP REST
LBNP MAX ΔP
LBNP RECOVERY
MEAN HEART RATE (BPM)
MEAN PULSE PRESSURE (mmHg)
MEAN SYSTOLIC/DIAS. BP (mmHg)
SYSTOLIC
DIASTOLIC
120
110
100
90
80
70
60
50
40
35
TERMINATED EARLY
TERMINATED EARLY
TERMINATED EARLY
R = Raw Data Point
M = Missing Data Point

Figure 1.2-9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SKYLAB CREW HEALTH TREND-3
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MD
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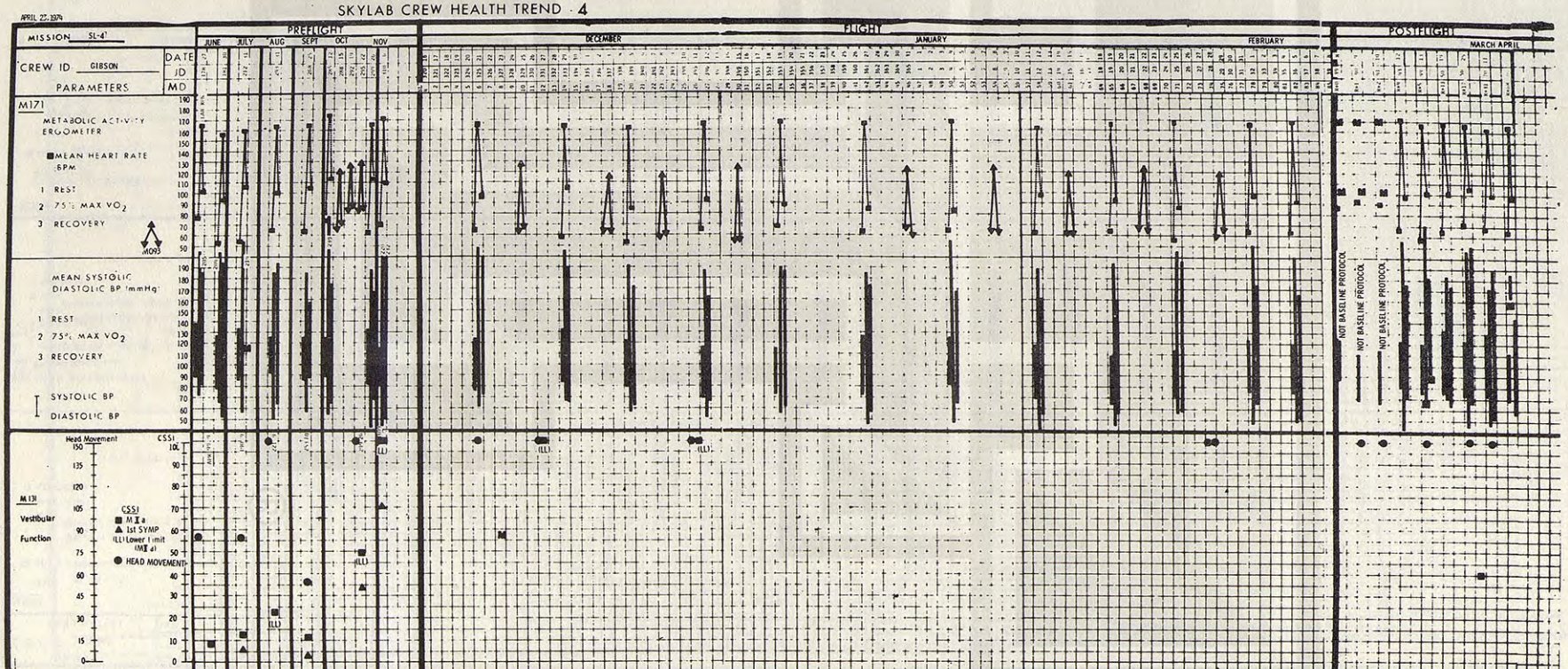
FLIGHT
POST FLIGHT
JUNE
JULY
AUG
SEPT
OCT
NOV
DECEMBER
JANUARY
FEBRUARY
MARCH
APRIL
M092
LBNP
MEAN HEART RATE (BPM)
1 REST
2 MAX LBNP
3 RECOVERY
MEAN SYSTOLIC/DIAS. BP (mm Hg)
SYSTOLIC
DIASTOLIC
1 REST
2 MAX
3 RECOVERY
M093
VECTORCARDIOGRAM/ ERGOMETER
MEAN HEART RATE
1 REST
2 EXERCISE
3 RECOVERY
TERMINATED EARLY
TERMINATED EARLY
TERMINATED EARLY
B = Raw Data Point
M = Missing Data Point

Figure 1.2-10


SKYLAB CREW HEALTH TREND - 4
APRIL 23, 1974
MISSION SL-4
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POSTFLIGHT
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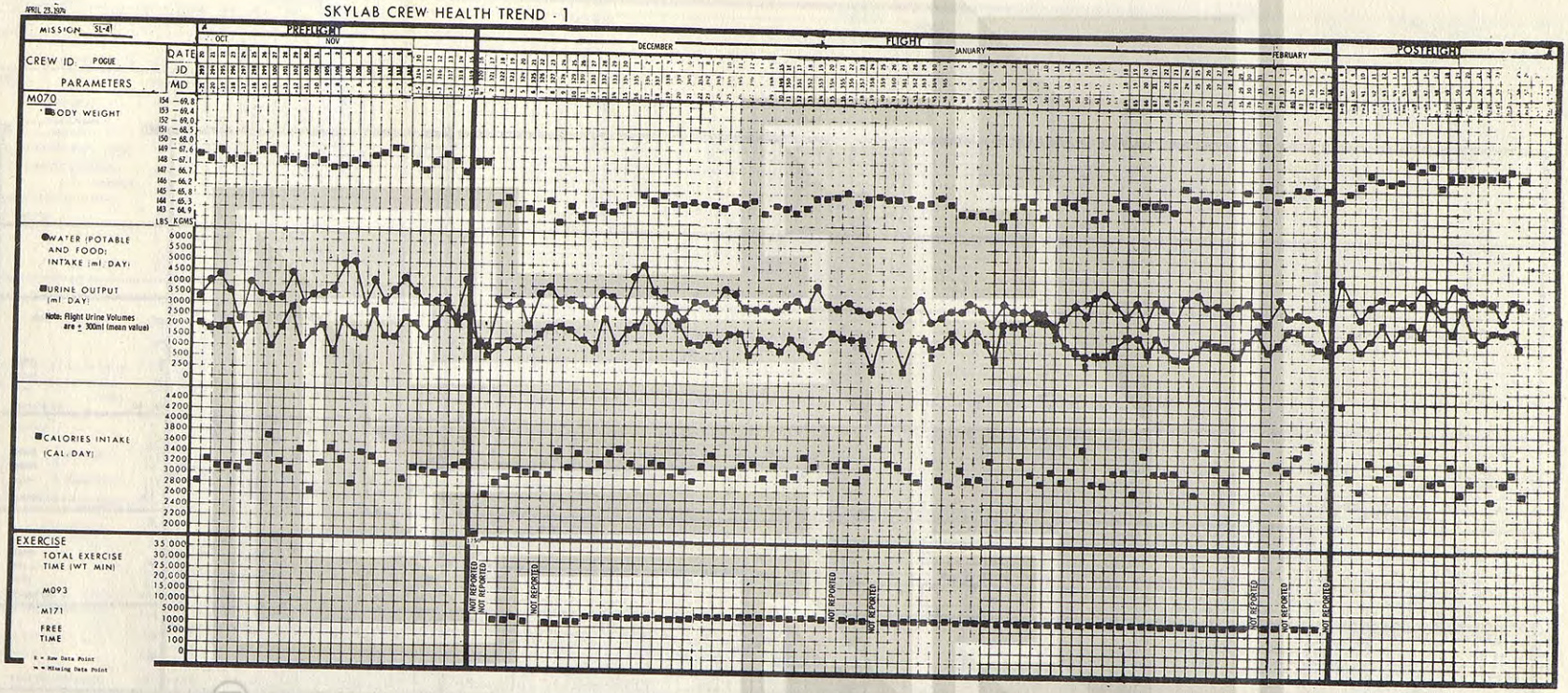
AUG
SEPT
OCT
NOV
DECEMBER
JANUARY
FEBRUARY
MARCH
APRIL
M171
METABOLIC ACTIVITY ERGOMETER
MEAN HEART RATE BPM
1 REST
2 75% MAX VO2
3 RECOVERY
M093
MEAN SYSTOLIC DIASTOLIC BP (mmHg)
1 REST
2 75% MAX VO2
3 RECOVERY
SYSTOLIC BP
DIASTOLIC BP
NOT BASELINE PROTOCOL
M131
Vestibular Function
Head Movement
CSS1
CSS1
M Ia
1st SYMP
(LL) Lower Limit (M1 a)
HEAD MOVEMENT
R= Raw Data Point
M = Missing Data Point

Figure 1-2-11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MISSION SL-4
CREW ID POGUE
PARAMETERS
DATE
JD
MD
PREFLIGHT
FLIGHT
POSTFLIGHT
OCT
NOV
DECEMBER
JANUARY
FEBRUARY
M070
BODY WEIGHT
LBS KGMS
WATER (POTABLE AND FOOD) INTAKE (ml/DAY)
URINE OUTPUT (ml/DAY)
Note: Flight Urine Volumes are ± 300ml (mean value)
CALORIES INTAKE (CAL/DAY)
EXERCISE
TOTAL EXERCISE TIME (WT MIN)
M093
M171
FREE TIME
NOT REPORTED

Figure 1.2-12

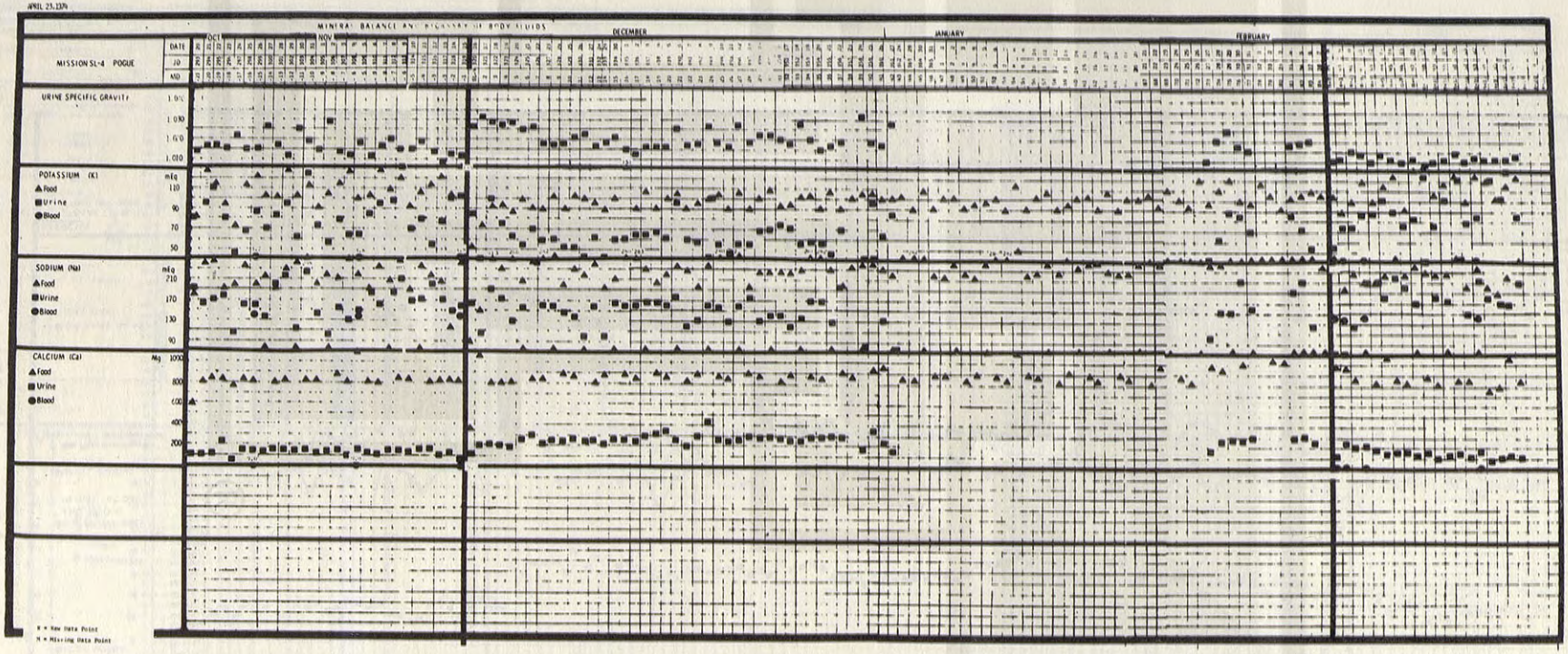

APRIL 25, 1974
MINERAL BALANCE AND BIOASSAY OF BODY FLUIDS
MISSION SL-4 POGUE
DATE
JD
MD
OCT
NOV
DECEMBER
JANUARY
FEBRUARY
URINE SPECIFIC GRAVITY
1.040
1.030
1.020
1.010
POTASSIUM (K)
meq
Food
Urine
Blood
110
90
70
50
SODIUM (Na)
meq
Food
Urine
Blood
210
170
130
90
CALCIUM (Ca)
Mg
Food
Urine
Blood
1000
800
600
400
200
X = New Data Point
M = Missing Data Point

Figure 1.2-13

Figure 1.2-13

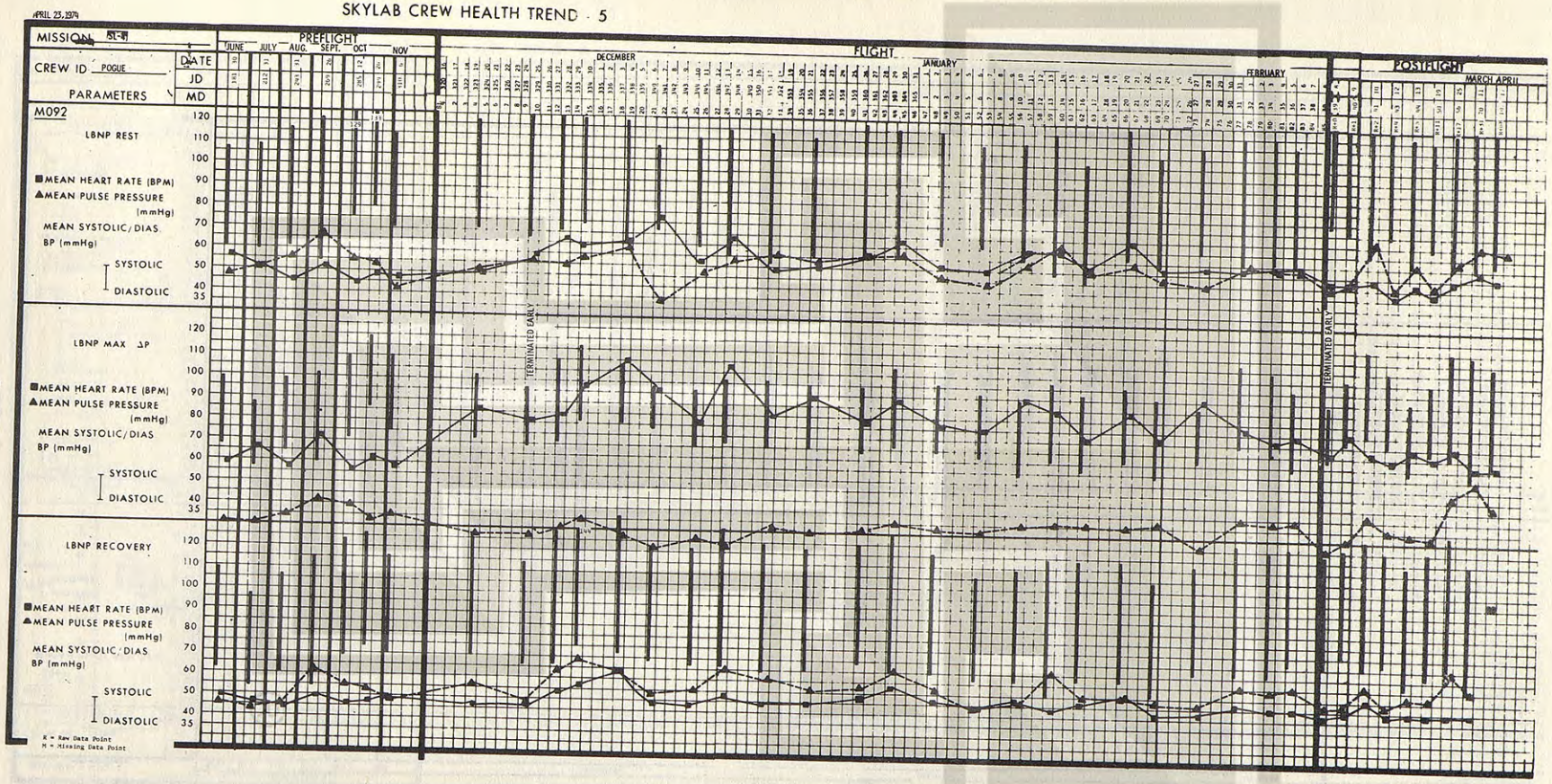


Figure 1.2-14

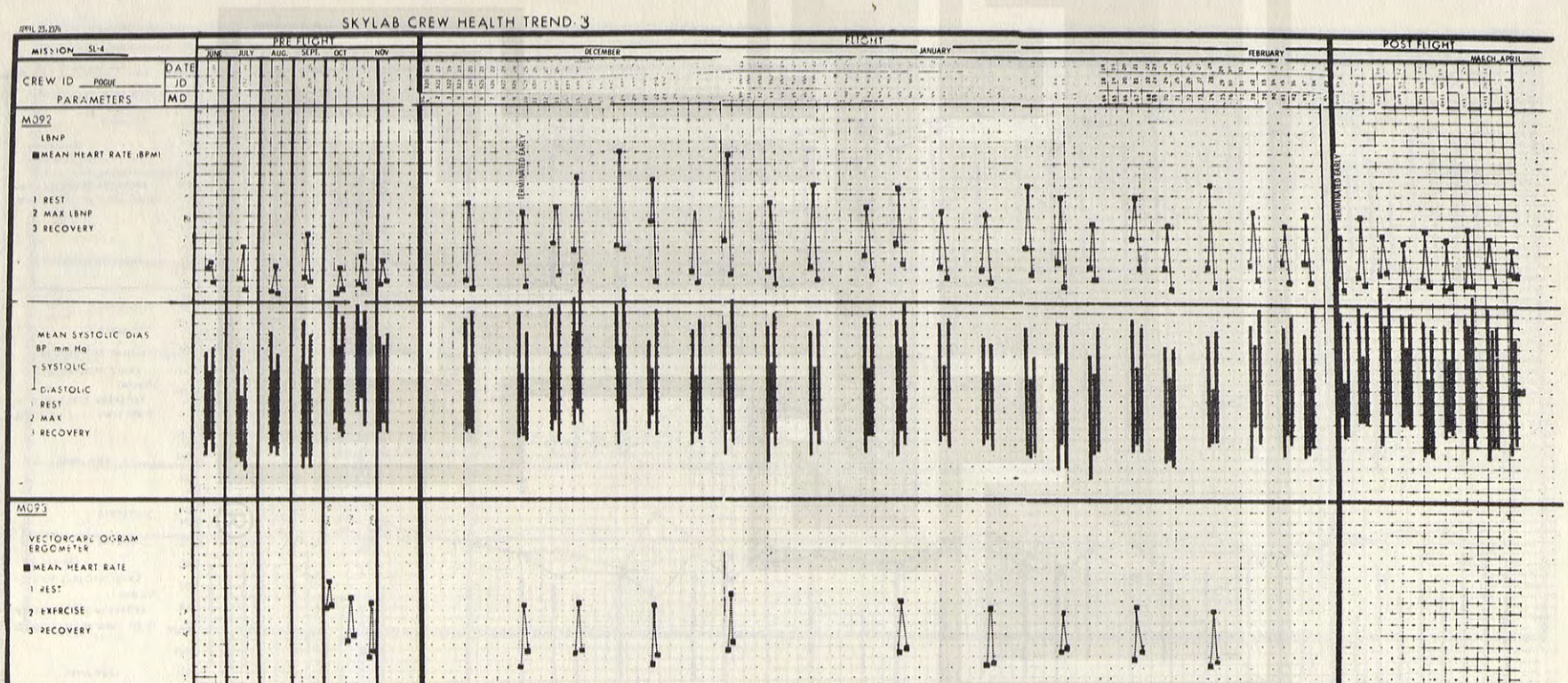

SKYLAB CREW HEALTH TREND 3
APRIL 23, 1974
MISSION SL-4
CREW ID POGUE
PARAMETERS
DATE
JD
MD
PRE FLIGHT
JUNE
JULY
AUG.
SEPT.
OCT
NOV
FLIGHT
DECEMBER
JANUARY
FEBRUARY
POST FLIGHT
MARCH, APRIL
TERMINATED EARLY
TERMINATED EARLY
M092
LBNP
MEAN HEART RATE (BPM)
1 REST
2 MAX LBNP
3 RECOVERY
MEAN SYSTOLIC DIAS
BP mm Hg
SYSTOLIC
DIASTOLIC
1 REST
2 MAX
3 RECOVERY
M093
VECTORCARDIOGRAM
ERGOMETER
MEAN HEART RATE
1 REST
2 EXERCISE
3 RECOVERY

Figure 1.2-15

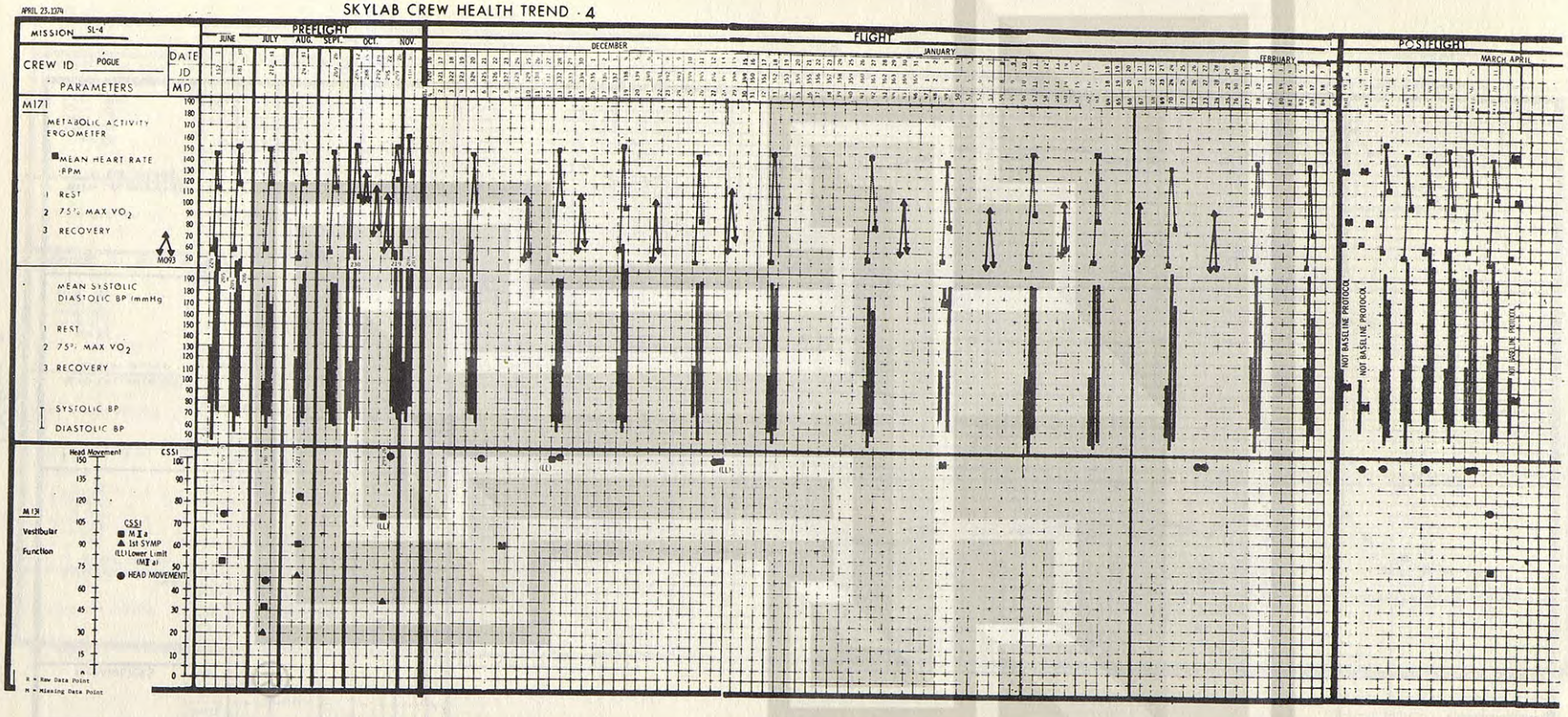

APRIL 23.1974
SKYLAB CREW HEALTH TREND - 4
MISSION SL-4
CREW ID POGUE
DATE
JD
MD
PARAMETERS
PREFLIGHT
FLIGHT
POSTFLIGHT
JUNE
JULY
AUG.
SEPT.
OCT.
NOV
DECEMBER
JANUARY
FEBRUARY
MARCH
APRIL
M171
METABOLIC ACTIVITY ERGOMETER
MEAN HEART RATE - BPM
1 REST
2 75% MAX VO2
3 RECOVERY
M093
MEAN SYSTOLIC DIASTOLIC BP (mmHg
SYSTOLIC BP
DIASTOLIC BP
NOT BASELINE PROTOCOL
M131
Vestibular Function
Head Movement
CSSI
M I a
1st SYMP
(L) Lower Limit (M I a)
HEAD MOVEMENT
R = Raw Data Point
M = Missing Data Point

Figure 1.2-16

SKYLAB CREW HEALTH TREND - 5A

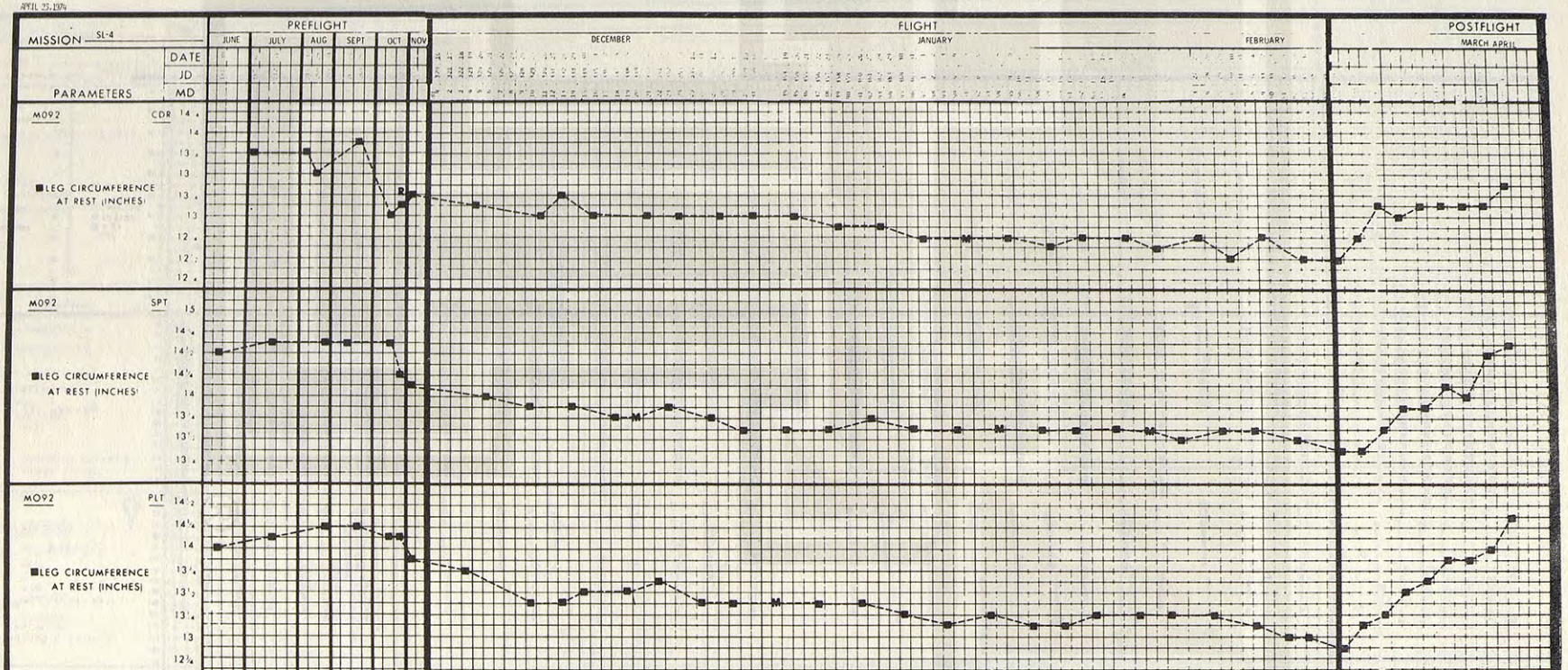


Figure 1.2-17

Figure 1.2-17

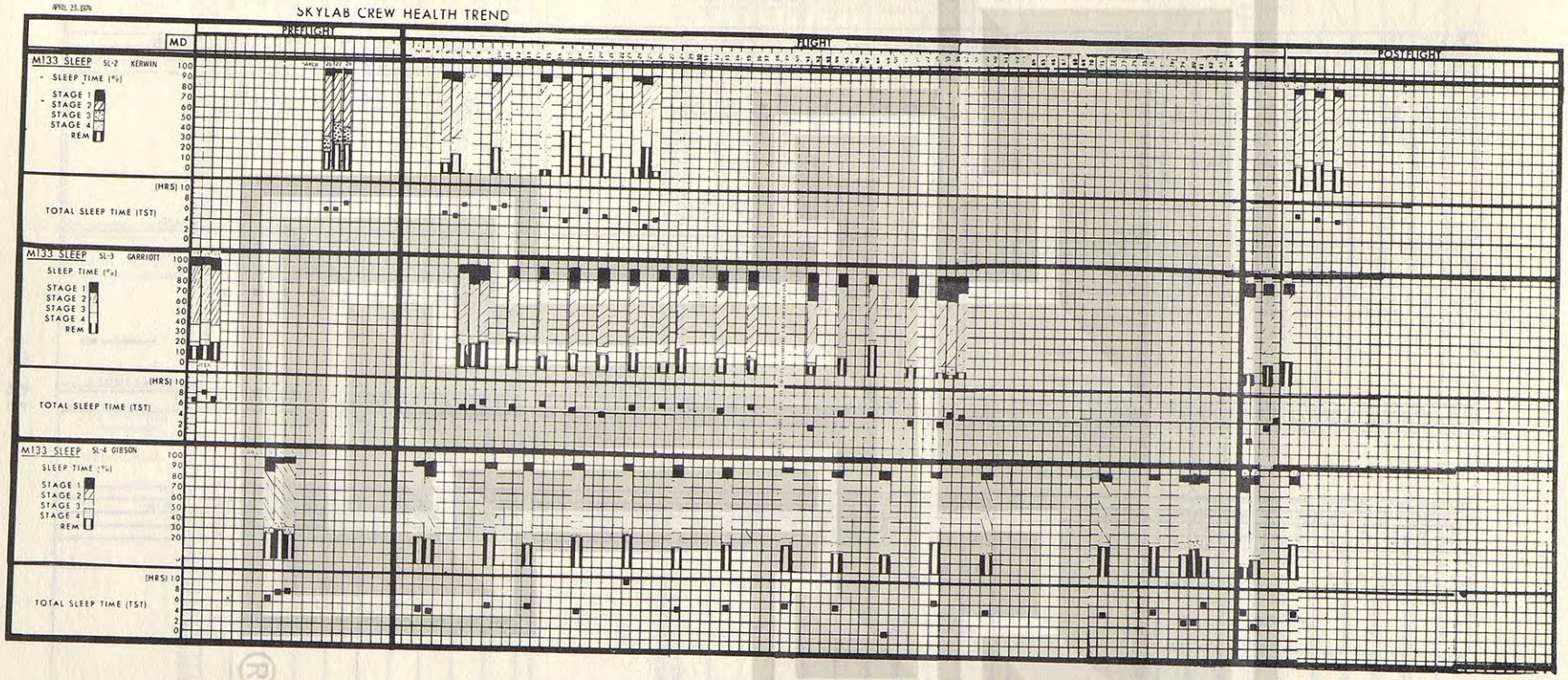


Figure 1.2-18

IN-FLIGHT

DATE	320/1	321/2	322/3	323/4	324/5	325/6	326/7	327/8	328/9	329/10
ISOMETRIC (REPETITIONS) CDR	NONE	NONE	NONE	BACK	NONE	NONE	NONE	NONE	NONE	NONE
min	NONE	NONE	NONE	UNK.	NONE	NONE	NONE	NONE	NONE	NONE
A	NONE	NONE	NONE	0	NONE	NONE	NONE	NONE	NONE	NONE
B				0						
TOTAL TIME	0	0	0	UNK.	0	0	0	0	0	0
OTHER				10						

IN-FLIGHT

DATE	330/11	331/12	332/13	333/14	334/15	335/16	336/17	337/18	338/19	339/20
ISOMETRIC (REPETITIONS) CDR	NONE	NONE	AB	AB	AB	NONE	NONE	AB	AB	AB
min	NONE	NONE	UNK.	AB	AB	NONE	NONE	AB	AB	AB
A	NONE	NONE	10	10	10	NONE	NONE	10	10	10
B			10	10	10			10	10	10
TOTAL TIME	0	0	UNK.	4 MIN	4 MIN	0	0	4 MIN	3 MIN	3 MIN

IN-FLIGHT

DATE	340/21	341/22	342/23	343/24	344/25	345/26	346/27	347/28	348/29	349/30
ISOMETRIC (REPETITIONS) CDR	AB	AB	AB	NONE	NONE	AB	AB	AB	AB	AB
min	AB	AB	AB	NONE	NONE	AB	AB	AB	AB	AB
A	10	10	10	NONE	NONE	10	10	10	10	10
B	10	10	10			10	10	10	10	10
TOTAL TIME	3 MIN	3 MIN	3 MIN	0	0	3 MIN	3 MIN	3 MIN	3 MIN	3 MIN

IN-FLIGHT

DATE	350/31	351/32	352/33	353/34	354/35	355/36	356/37	357/38	358/39	359/40
ISOMETRIC (REPETITIONS) CDR	AB	AB	AB	AB	AB	AB	AB	AB	AB	NONE
min	AB	AB	AB	AB	AB	AB	AB	AB	AB	NONE
A	10	10	10	10	10	10	10	10	10	NONE
B	10	10	10	10	10	10	10	10	10	
TOTAL TIME	3 MIN	3 MIN	3 MIN	3 MIN	3 MIN	3 MIN	3 MIN	3 MIN	3 MIN	0

IN-FLIGHT

DATE	360/41	361/42	362/43	363/44	364/45	365/46	001/47	002/48	003/49	004/50
ISOMETRIC (REPETITIONS) CDR	AB	AB	AB	NONE	AB	AB	AB	AB	AB	AB
min	AB	AB	AB	NONE	AB	AB	AB	AB	AB	AB
A	10	10	10	NONE	10	10	10	10	10	10
B	10	10	10		10	10	10	10	10	10
TOTAL TIME	3 MIN	3 MIN	3 MIN	0	3 MIN	3 MIN	3 MIN	3 MIN	3 MIN	3 MIN

IN-FLIGHT

DATE	005/51	006/52	007/53	008/54	009/55	010/56	011/57	012/58	013/59	014/60
ISOMETRIC (REPETITIONS) CDR	AB	AB	AB	AB	AB	AB	AB	ABC DE&F	ABC DE&F	ABC DE&F
min	AB	AB	AB	AB	AB	AB	AB	ABC DE&F	ABC DE&F	ABC DE&F
A	10	10	10	10	10	10	10	10	10	10
B	10	10	10	10	10	10	10	10	10	10
TOTAL TIME	3 MIN	3 MIN	3 MIN	3 MIN	3 MIN	3 MIN	3 MIN	3 MIN	3 MIN	3 MIN
OTHER								40	40	40

AB = Hip Abduction/Adduction
CD = Neck Anterior/Posterior (Flex/Extend)
EF = Neck Left Lateral/Right Lateral

NOTE = CDEF done as part of other activities and no additional exercise time required.

IN-FLIGHT

DATE	015/61	016/62	017/63	018/64	019/65	020/66	021/67	022/68	023/69	024/70
ISOMETRIC (REPETITIONS) CDR										
min										
A										
B										
TOTAL TIME										

IN-FLIGHT

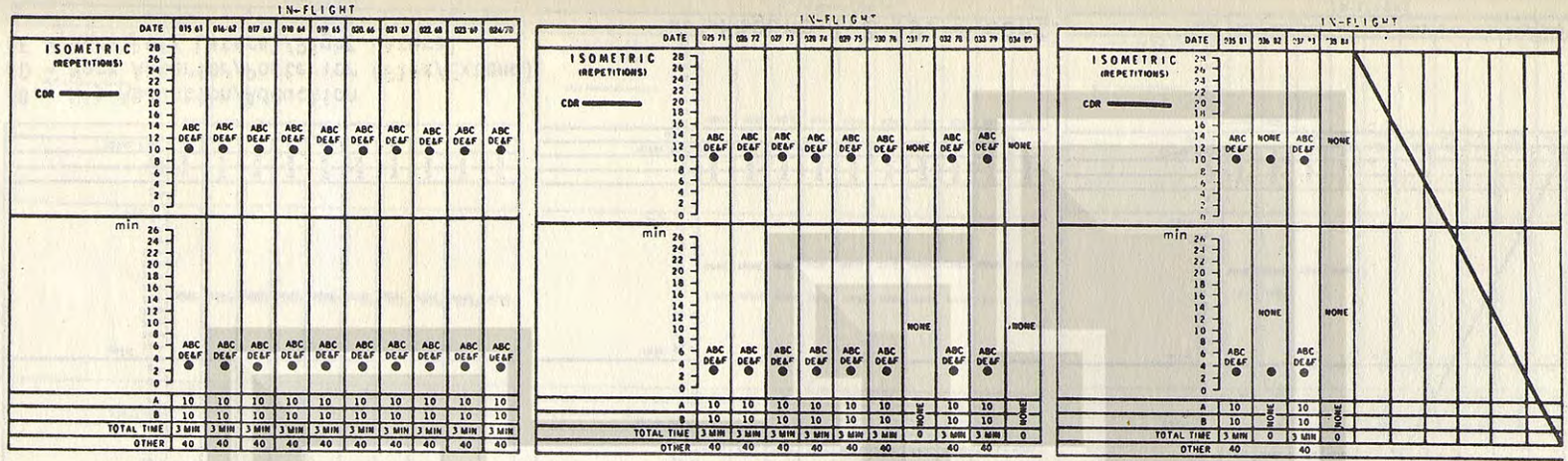
DATE										
ISOMETRIC (REPETITIONS) CDR										
min										
A										
B										
TOTAL TIME										

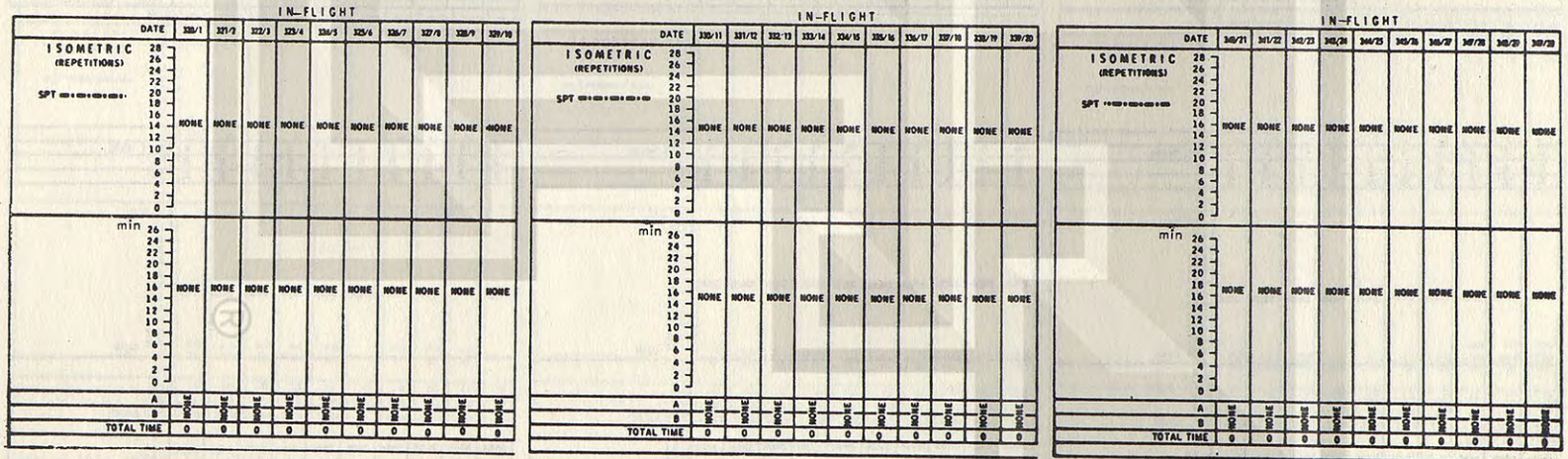
IN-FLIGHT

DATE										
ISOMETRIC (REPETITIONS) CDR										
min										
A										
B										
TOTAL TIME										

AB = Hip Abduction/Adduction
CD = Neck Anterior/Posterior (Flex/Extend)
EF = Neck Left Lateral/Right Lateral

NOTE = CDEF done as part of other activities and no additional exercise time required.





AB = Hip Abduction/Adduction
CD = Neck Anterior/Posterior (Flex/Extend)
EF = Neck Left Lateral/Right Lateral

Figure 1.2-19. - cont.

IN-FLIGHT

DATE	338/31	351/32	352 33	353/34	354/35	355/36	356/37	357/38	358/39	359/40
ISOMETRIC (REPETITIONS) SPT	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
min	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
A	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
B										
TOTAL TIME	0	0	0	0	0	0	0	0	0	0

IN-FLIGHT

DATE	360/41	361/42	362/43	363/44	364/45	365/46	001/47	002/48	003/49	004/50
ISOMETRIC (REPETITIONS) SPT	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
min	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
A	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
B										
TOTAL TIME	0	0	0	0	0	0	0	0	0	0

IN-FLIGHT

DATE	005/51	006/52	007 53	008/54	009/55	010/56	011/57	012/58	013/59	014/60
ISOMETRIC (REPETITIONS) SPT	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
min	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
A	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
B										
TOTAL TIME	0	0	0	0	0	0	0	0	0	0

IN-FLIGHT

DATE	015 61	016/62	017 63	018 64	019 65	020 66	021 67	022 68	023/69	024/70
ISOMETRIC (REPETITIONS) SPT	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
min	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
A	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
B										
TOTAL TIME	0	0	0	0	0	0	0	0	0	0

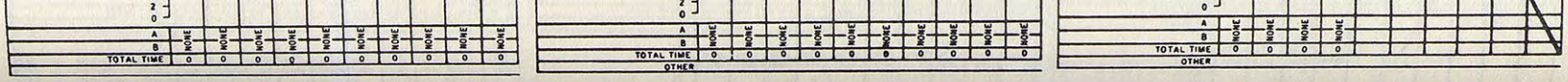
IN-FLIGHT

DATE	025 71	026 72	027 73	028 74	029 75	030 76	031 77	032 78	033 79	034 80
ISOMETRIC (REPETITIONS) SPT	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
min	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
A	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
B										
TOTAL TIME	0	0	0	0	0	0	0	0	0	0
OTHER										

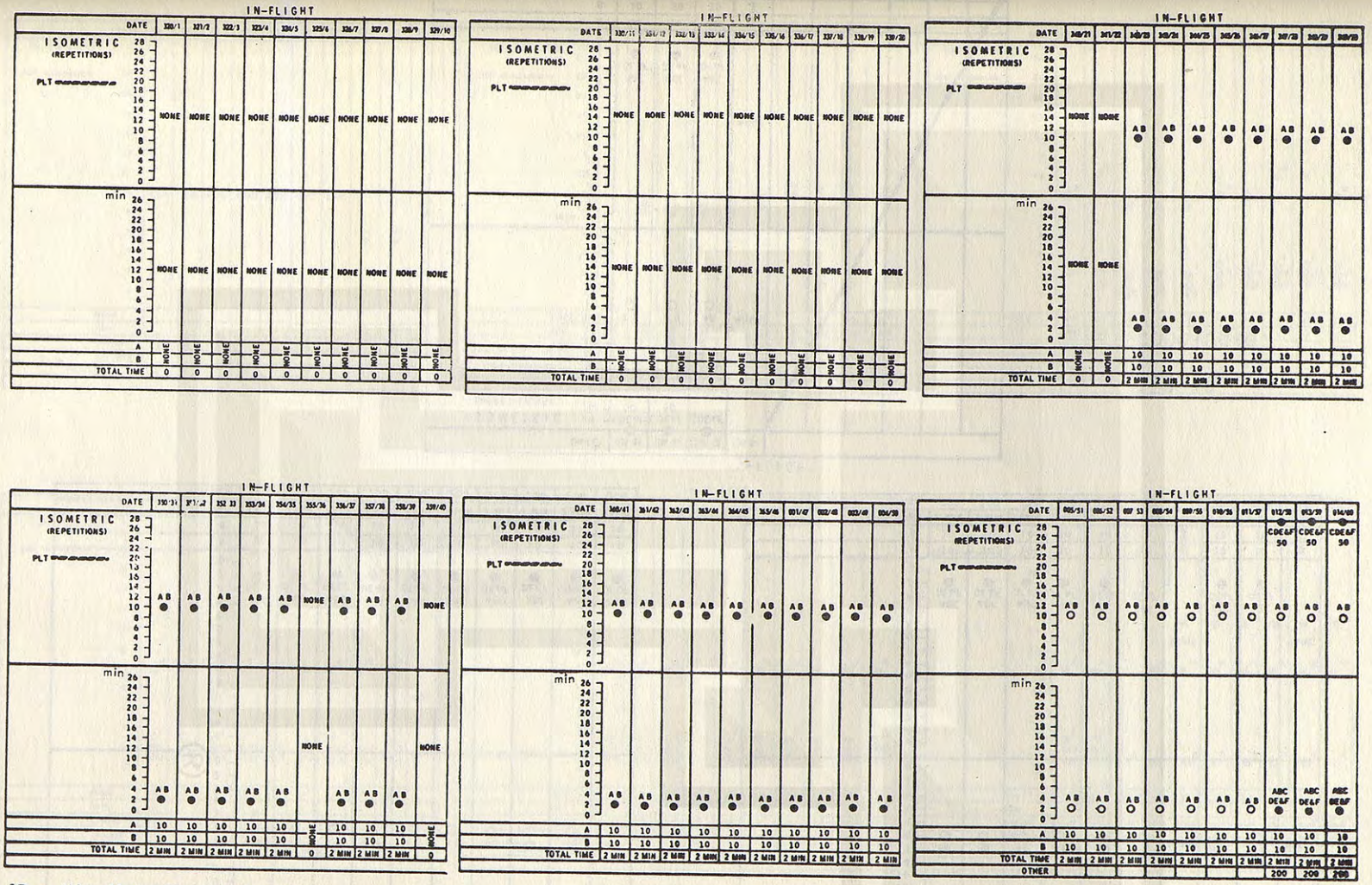
IN-FLIGHT

DATE	035 81	036 82	037 83	038 84
ISOMETRIC (REPETITIONS) SPT	NONE	NONE	NONE	NONE
min	NONE	NONE	NONE	NONE
A	NONE	NONE	NONE	NONE
B				
TOTAL TIME	0	0	0	0
OTHER				

AB = Hip Abduction/Adduction
CD = Neck Anterior/Posterior (Flex/Extend)



AB = Hip Abduction/Adduction
CD = Neck Anterior/Posterior (Flex/Extend)



AB = Hip Abduction/Adduction
CD = Neck Anterior/Posterior (Flex/Extend)
EF = Neck Left Lateral/Right Lateral

Figure 1.2-19. - cont.

IN-FLIGHT

DATE	015/61	016/62	017/63	018/64	019/65	020/66	021/67	022/68	023/69	024/70
ISOMETRIC (REPETITIONS)	CDE&F 50	CDE&F 50	CDE&F 50	CDE&F 50	CDE&F 50	CDE&F 50	CDE&F 50	CDE&F 50	CDE&F 50	CDE&F 50
PLT ▬▬▬	A B	A B	A B	A B	A B	A B	AB	AB	AB	AB
min	ABC DE&F	ABC DE&F	ABC DE&F	ABC DE&F	ABC DE&F	ABC DE&F	ABC DE&F	ABC DE&F	ABC DE&F	ABC DE&F
A	10	10	10	10	10	10	10	10	10	10
B	10	10	10	10	10	10	10	10	10	10
TOTAL TIME	2 MIN	2 MIN	2 MIN	2 MIN	2 MIN	2 MIN	2 MIN	2 MIN	2 MIN	2 MIN
OTHER	200	200	200	200	200	200	200	200	200	200

IN-FLIGHT

DATE	025 71	026 72	027 73	028 74	029 75	030 76	031 77	032 78	033 79	034 80
ISOMETRIC (REPETITIONS)	CDE&F 50	CDE&F 50	CDE&F 50	CEDaF 50	CDE&F 50	CDE&F 50		CDE&F 50	CDE&F 50	
PLT ▬▬▬	AB	AB	AB	AB	AB	AB	NONE	AB	AB	NONE
min	ABC DE&F	ABC DE&F	ABC DE&F	ABC DE&F	ABC DE&F	ABC DE&F	NONE	ABC DE&F	ABC DE&F	NONE
A	10	10	10	10	10	10	NONE	10	10	NONE
B	10	10	10	10	10	10		10	10	
TOTAL TIME	2 MIN	2 MIN	2 MIN	2 MIN	2 MIN	2 MIN	0	2 MIN	2 MIN	0
OTHER	200	200	200	200	200	200		200	200	

IN-FLIGHT

DATE	035 81	036 82	037 83	038 84
ISOMETRIC (REPETITIONS)	CDE&F 50	CDE&F 50	CDE&F	
PLT ▬▬▬	A B	A B	AB	NONE
min	ABC	ABC	ABC	NONE

Figure 1.2-19. - concluded.

IN-FLIGHT

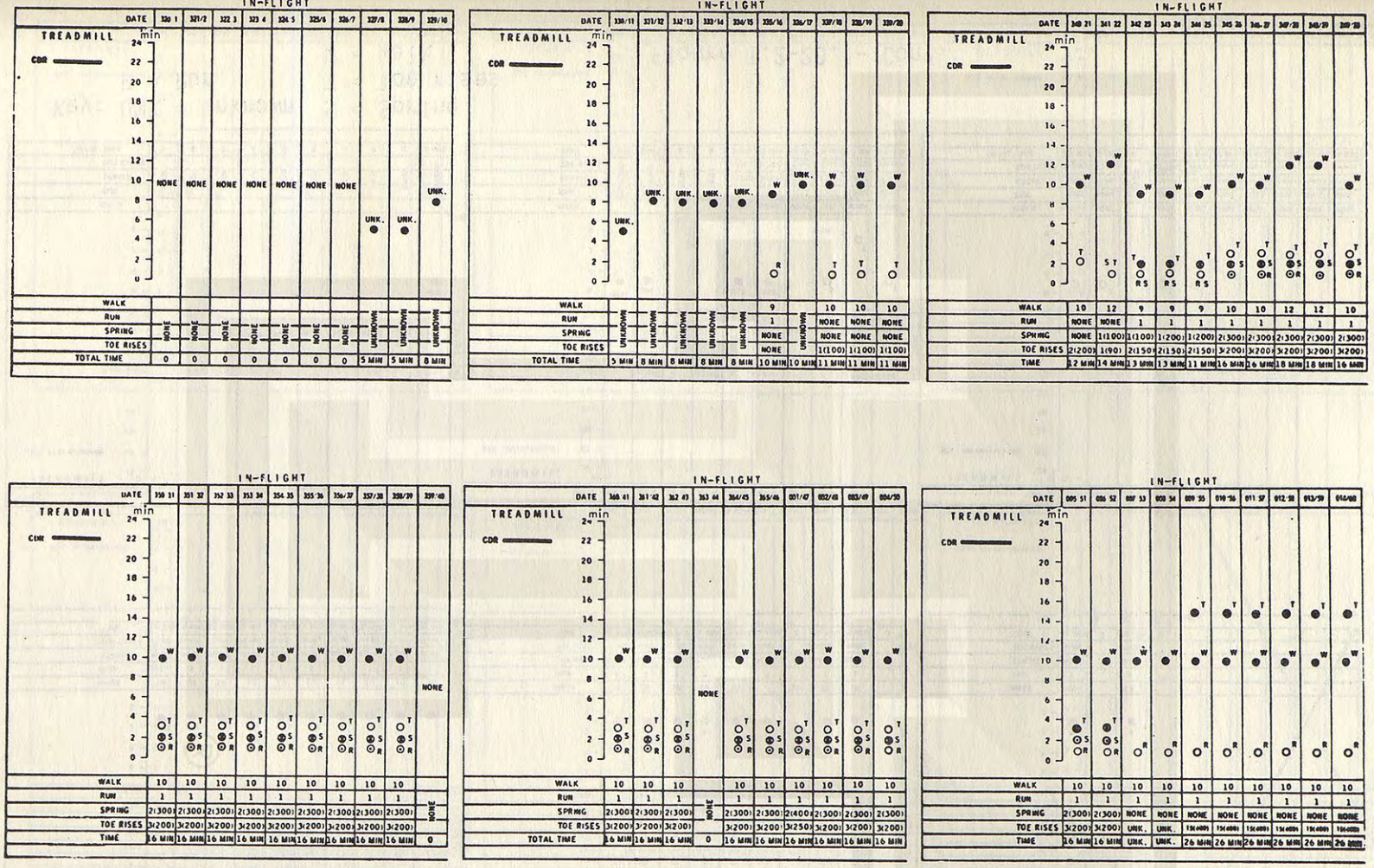
DATE	320 1	321/2	322 3	323 4	324 5	325/6	326/7	327/8	328/9	329/10
TREADMILL min										

IN-FLIGHT

DATE	330/11	331/12	332/13	333/14	334/15	335/16	336/17	337/18	338/19	339/20
TREADMILL min										

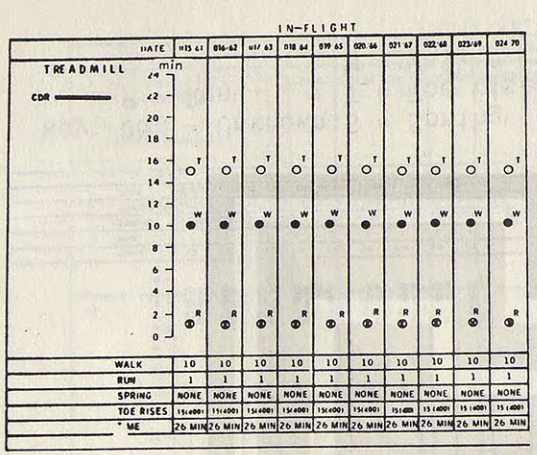
IN-FLIGHT

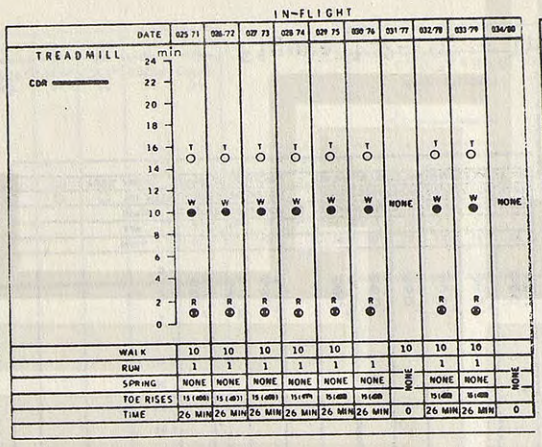
DATE	340 21	341 22	342 23	343 24	344 25	345 26	346 27	347/28	348/29	349/30
TREADMILL min										

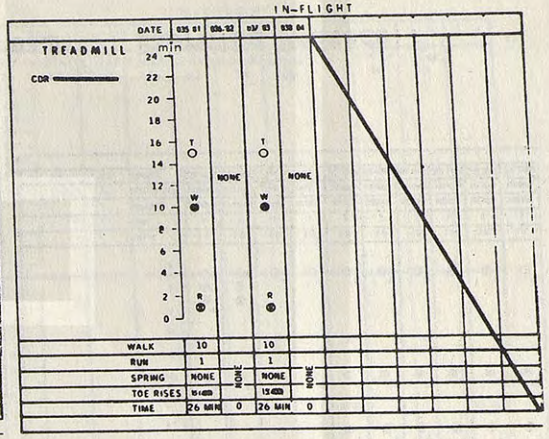


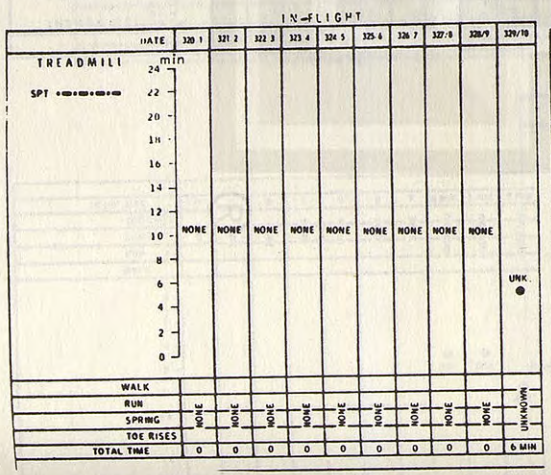
Key: UNK = Unknown S = Spring
R = Run T = Toe rises
W = Walk

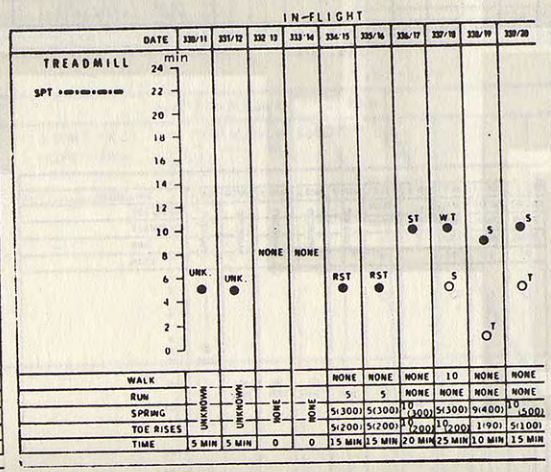
Figure 1.2-20. - Treadmill Exercise Protocol.

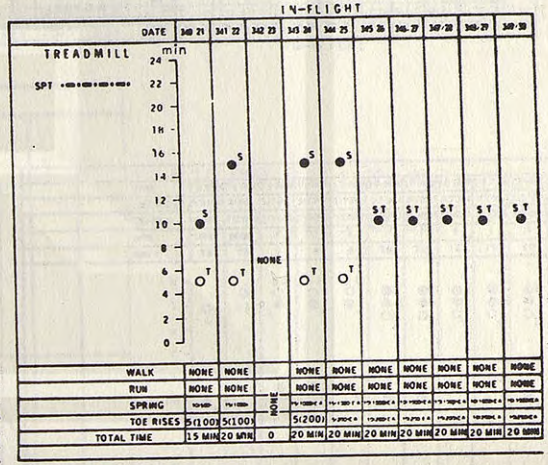






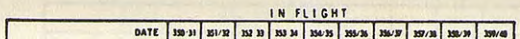


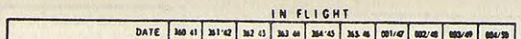


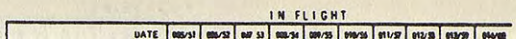


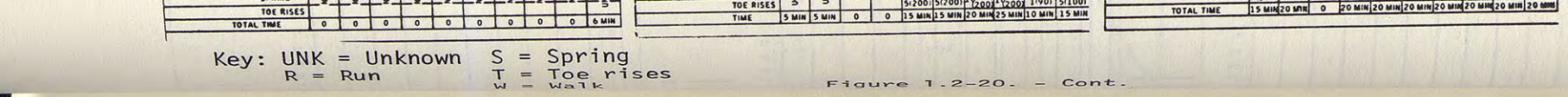
Key: UNK = Unknown S = Spring
R = Run T = Toe rises
W = Walk

Figure 1.2-20. - Cont.



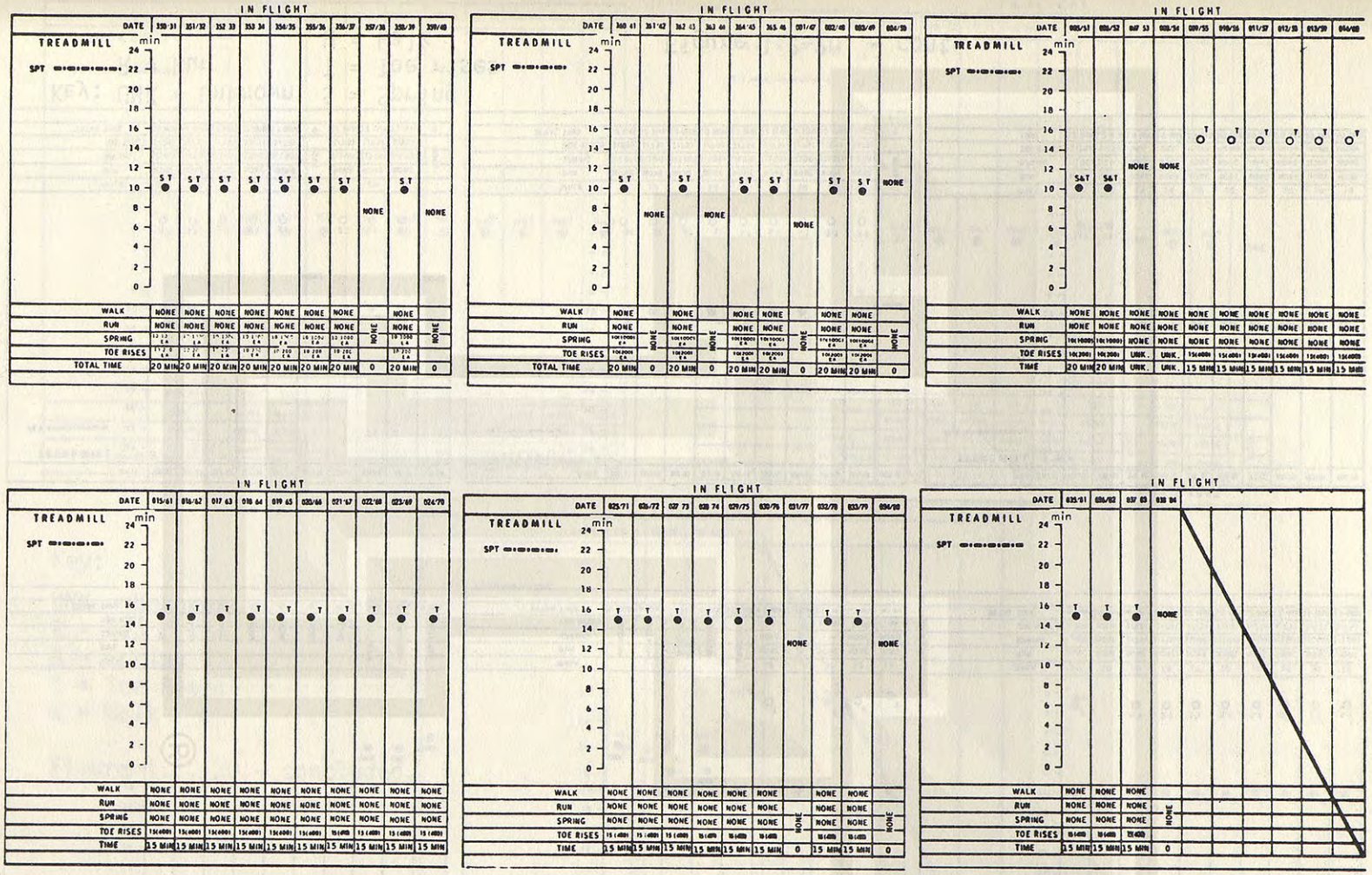






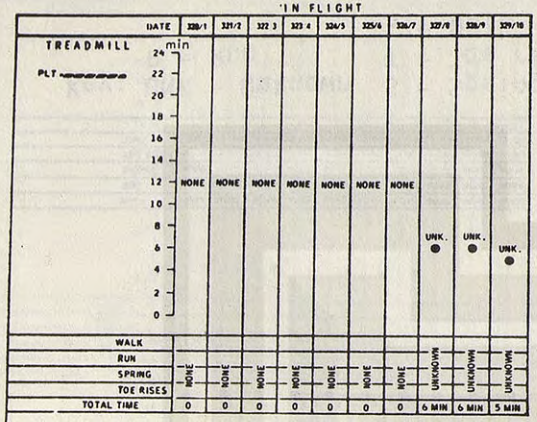
Key: UNK = Unknown S = Spring
R = Run T = Toe rises
W = Walk

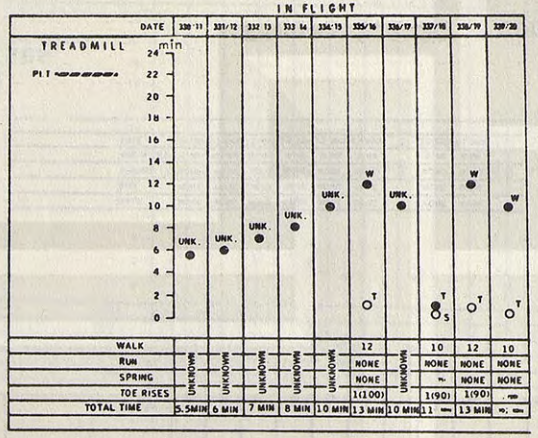
Figure 1.2-20. - Cont.

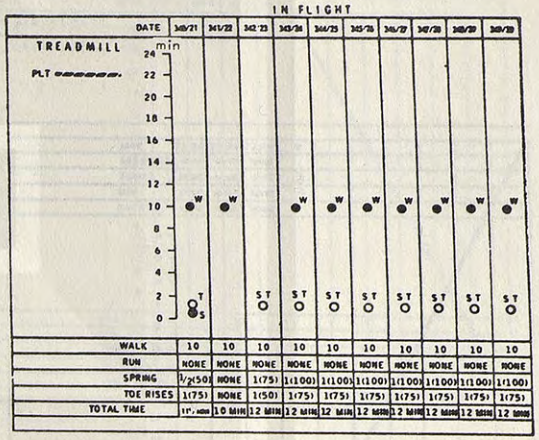


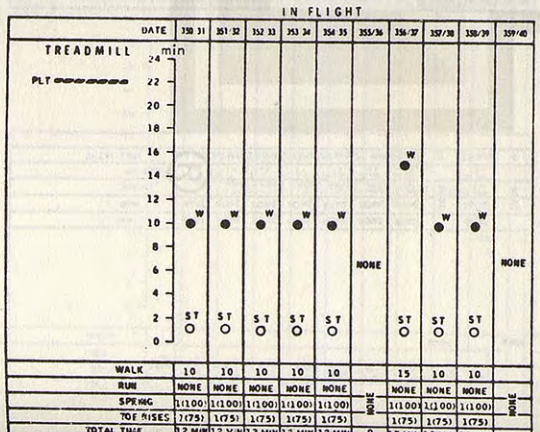
Key: UNK = Unknown S = Spring
R = Run T = Toe rises
W = Walk

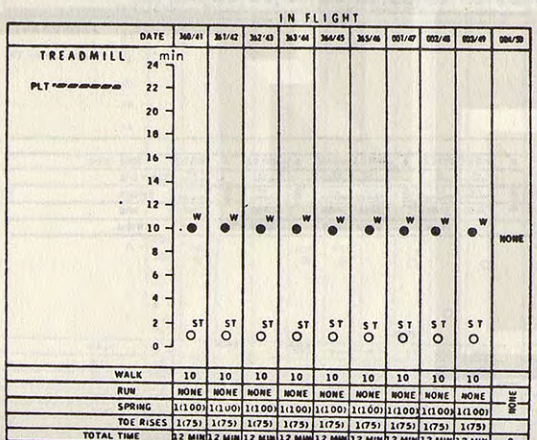
Figure 1.2-20 - cont.

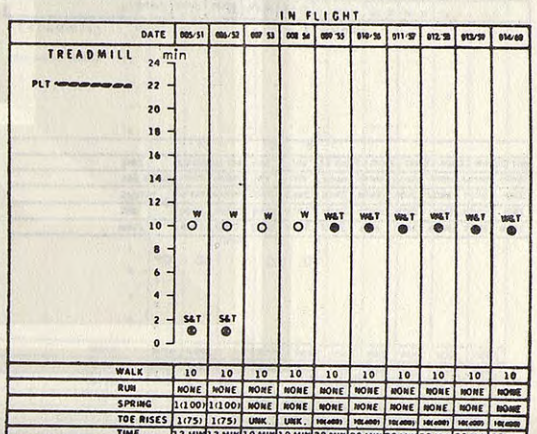






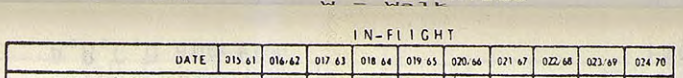


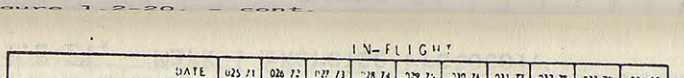


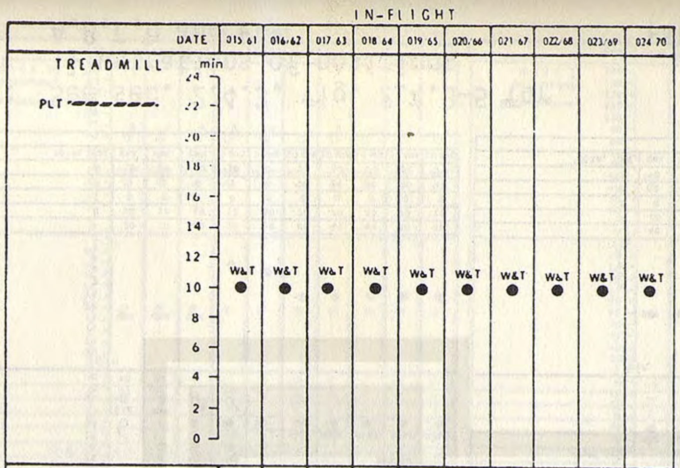


Key: UNK = Unknown S = Spring
R = Run T = Toe rises
W = Walk

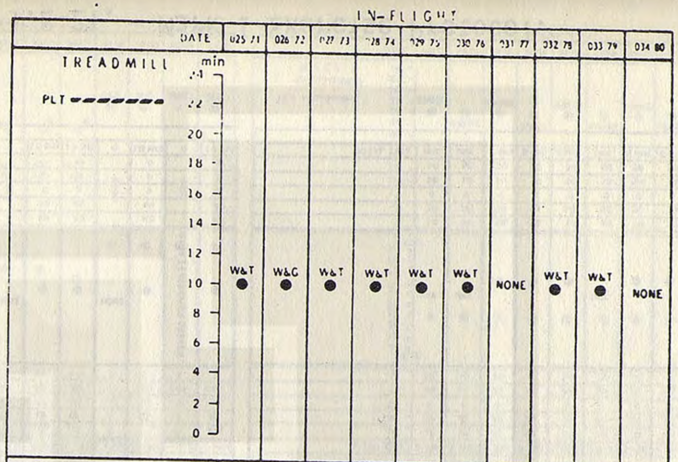
Figure 1-2-20. - cont.



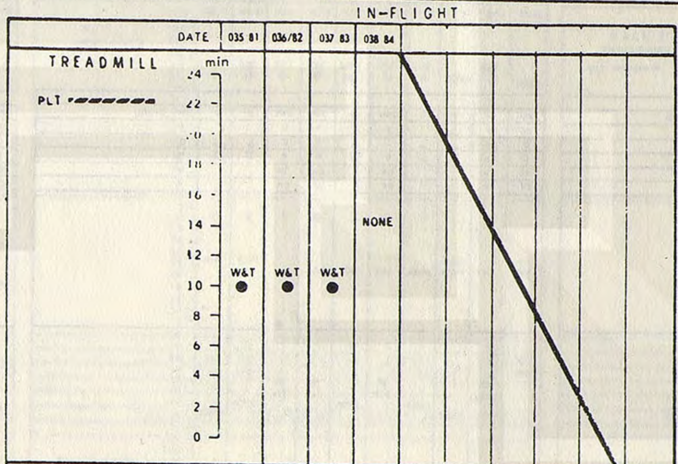




DATE	015 61	016 62	017 63	018 64	019 65	020 66	021 67	022 68	023 69	024 70
WALK	10	10	10	10	10	10	10	10	10	10
RUN	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
SPRING	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
TOE RISES	10(400)	10(400)	10(400)	10(400)	10(400)	10(400)	10(400)	10(400)	10(400)	10(400)
TIME	20 MIN	20 MIN	20 MIN	20 MIN	20 MIN	20 MIN	20 MIN	20 MIN	20 MIN	20 MIN



DATE	025 71	026 72	027 73	028 74	029 75	030 76	031 77	032 78	033 79	034 80
WALK	10	10	10	10	10	10		10	10	
RUN	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
SPRING	NONE	NONE	NONE	NONE	NONE	NONE		NONE	NONE	
TOE RISES	10(400)	10(400)	10(400)	10(400)	10(400)	10(400)		10(400)	10(400)	
TIME	20 MIN	20 MIN	20 MIN	20 MIN	20 MIN	20 MIN	0	20 MIN	20 MIN	0



DATE	035 81	036 82	037 83	038 84
WALK	10	10	10	
RUN	NONE	NONE	NONE	NONE
SPRING	NONE	NONE	NONE	
TOE RISES	10(400)	10(400)	10(400)	
TIME	20 MIN	20 MIN	20 MIN	0

Key:

UNK = Unknown
R = Run
S = Spring
T = Toe Rises
W = Walk

Figure 1.2.-20 - concluded.

IN-FLIGHT

DATE	320/1	321/2	322/3	323/4	324/5	325/6	326/7	327/8	328/9	329/10
MARK I (REPETITIONS) CDR	NONE	NONE	A&B	AB&E	AB&E	NONE		A, B	AB&E	A, E, B
min	NONE	NONE	●	UNK.	UNK.	NONE	NONE	UNK.	UNK.	UNK.
A			25	10	10			20	10	25
B			25	10	10			10	10	10
C	NONE	NONE	0	0	0	NONE	NONE	0	0	0
D			0	0	0			0	0	0
E			0	10	10			0	10	30
TOTAL TIME	0	0	UNK.	UNK.	UNK.	0	0	UNK.	UNK.	UNK.

IN-FLIGHT

DATE	320/1	321/2	322/3	323/4	324/5	325/6	326/7	327/8	328/9	329/10
MARK I (REPETITIONS) SPT	NONE	NONE	A&B	A&B	NONE	A&B	NONE	NONE	ARCD&E	A&B
min	NONE	NONE	●	UNK.	NONE	UNK.	NONE	NONE	UNK.	UNK.
A			40	40		40			40	20
B			40	40		40			40	20
C	NONE	NONE	0	0	NONE	0	NONE	NONE	40	0
D			0	0		0			40	0
E			0	0		0			40	20
TOTAL TIME	0	0	UNK.	UNK	0	UNK.	0	0	UNK.	UNK.

IN-FLIGHT

DATE	320/1	321/2	322/3	323/4	324/5	325/6	326/7	327/8	328/9	329/10
MARK I (REPETITIONS) PLT	NONE	NONE	NONE	A	NONE	NONE	NONE	NONE	ABD&E	ABD&E
min	NONE	NONE	NONE	UNK.	NONE	NONE	NONE	NONE	UNK.	UNK.
A				10					50	50
B				0					50	50
C	NONE	NONE	NONE	0	NONE	NONE	NONE	NONE	0	0
D				0					50	0
E				0					50	50
TOTAL TIME	0	0	0	UNK.	0	0	0	0	0	0

IN-FLIGHT

DATE	330/11	331/12	332/13	333/14	334/15	335/16	336/17	337/18	338/19	339/20
MARK I (REPETITIONS) CDR	A, B&E	A, B&E	A, E, A, B	E, A, B	B, A	A	A	A	A	A
						BD&E	BD&E	BD&E	BD&E	BD&E
min	UNK.	UNK.	UNK.	●	●	●	●	●	●	●
A	20	30	20	20	20	40	40	40	40	40
B	10	10	10	10	30	20	20	20	20	20
C	0	0	0	0	0	0	0	0	0	0
D	0	0	0	0	0	20	20	20	20	20
E	10	10	30	30	0	20	20	20	20	20
TOTAL TIME	UNK.	UNK.	UNK.	5 MIN	6 MIN	10 MIN	10 MIN	10 MIN	10 MIN	10 MIN

IN-FLIGHT

DATE	330/11	331/12	332/13	333/14	334/15	335/16	336/17	337/18	338/19	339/20
MARK I (REPETITIONS) SPT	A&B	A&B	CURLS	NONE	A&B	A, B	NONE	A, B	NONE	A B
min	UNK.	UNK	●	NONE	●	●	NONE	●	MARK I EXERCISER BROKEN	●
A	40	40	0		40	40		80		40
B	40	40	0		40	80		40		40
C	0	0	100	NONE	0	0	NONE	0	NONE	0
D	0	0	0		0	0		0		0
E	0	0	0		0	0		0		0
TOTAL TIME	UNK.	UNK.	15 MIN	0	10 MIN	10 MIN	0	10 MIN	0	10 MIN

IN-FLIGHT

DATE	330/11	331/12	332/13	333/14	334/15	335/16	336/17	337/18	338/19	339/20
MARK I (REPETITIONS) PLT	ABD&E	ABD&E	ABD&E	ABD&E	ABD&E	ABD&E	ABD&E	ABD&E	NONE	NONE
min	UNK	UNK.	●	●	●	UNK.	●	●	NONE	NONE
A	50	50	50	50	50	50	50	50		
B	50	50	50	50	50	50	50	50		
C	0	0	0	0	0	0	0	0	NONE	NONE
D	50	50	50	50	50	50	50	50		
E	50	50	50	50	50	50	50	50		
TOTAL TIME	UNK.	UNK.	8 MIN	8 MIN	8 MIN	UNK.	8 MIN	8 MIN	0	0

Key: See sec. 2.4.3, fig. 2.4.3-5 for

IN-FLIGHT

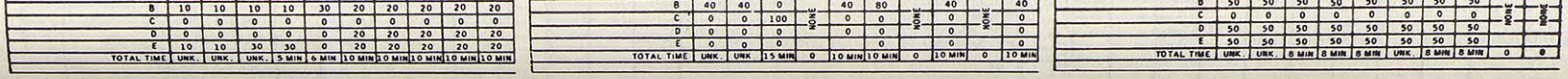
DATE	340/21	341/22	342/23	343/24	344/25	345/26	346/27	347/28	348/29	349/30
MARK I (REPETITIONS) CDR										
min										
A										
B										
C										
D										
E										
TOTAL TIME										

IN-FLIGHT

DATE	340/21	341/22	342/23	343/24	344/25	345/26	346/27	347/28	348/29	349/30
MARK I (REPETITIONS) SPT										
min										
A										
B										
C										
D										
E										
TOTAL TIME										

IN-FLIGHT

DATE	340/21	341/22	342/23	343/24	344/25	345/26	346/27	347/28	348/29	349/30
MARK I (REPETITIONS) PLT										
min										
A										
B										
C										
D										
E										
TOTAL TIME										



	DATE	340/21	341/22	342/23	343/24	344/25	345/26	346/27	347/28	348/29	349/30
	MARK I (REPETITIONS)										
	CDR	A	A	A	A	A	A	A	A	A	A
		BD&E	BD&E	BD&E	BD&E	B&DE	BD&E	BD&E	BD&E	BD&E	BD&E
	min										
A		40	40	40	40	40	40	40	40	40	40
B		20	20	20	20	20	20	20	20	20	20
C		0	0	0	0	0	0	0	0	0	0
D		20	20	20	20	20	20	20	20	20	20
E		20	20	20	20	20	20	20	20	20	20
TOTAL TIME		10 MIN	10 MIN	10 MIN	10 MIN	10 MIN	10 MIN	10 MIN	10 MIN	10 MIN	10 MIN

IN-FLIGHT

	DATE	340/21	341/22	342/23	343/24	344/25	345/26	346/27	347/28	348/29	349/30
	MARK I (REPETITIONS)										
	SPT	A&B	B A C	B A&C	B A&C	B A&C	B A&C	B&C	B&C	B&C	B&C
	min										
A		40	40	40	40	40	40	0	0	0	0
B		40	60	80	80	80	80	100	100	100	100
C		0	20	40	40	40	100	100	100	100	100
D		0	0	0	0	0	0	0	0	0	0
E		0	0	0	0	0	0	0	0	0	0
TOTAL TIME		10 MIN	10 MIN	16 MIN	16 MIN	16 MIN	15 MIN	20 MIN	20 MIN	20 MIN	20 MIN

IN-FLIGHT

	DATE	340/21	341/22	342/23	343/24	344/25	345/26	346/27	347/28	348/29	349/30
	MARK I (REPETITIONS)										
	PLT	ABD&E	ABD&E	ABD&E	ABD&E	ABD&E	ABD&E	ABD&E	ABD&E	ABD&E	
	min										
A		50	50	50	50	50	50	50	50	50	50
B		50	50	50	50	50	50	50	50	50	50
C		0	0	0	0	0	0	0	0	0	0
D		50	50	50	50	50	50	50	50	50	50
E		50	50	50	50	50	50	50	50	50	50
TOTAL TIME		8 MIN	8 MIN	8 MIN	8 MIN	8 MIN	8 MIN	8 MIN	8 MIN	8 MIN	8 MIN

IN-FLIGHT

	DATE	350/31	351/32	352/33	353/34	354/35	355/36	356/37	357/38	358/39	359/40
	MARK I (REPETITIONS)										
	CDR	A	A	A	A	A	A	A	A	A	NONE
		BD&E	BD&E	BD&E	BD&E	BD&E	BD&E	BD&E	BD&E	BD&E	
	min										NONE
A		40	40	40	40	40	40	40	40	40	
B		20	20	20	20	20	20	20	20	20	
C		0	0	0	0	0	0	0	0	0	NONE
D		20	20	20	20	20	20	20	20	20	
E		20	20	20	20	20	20	20	20	20	
TOTAL TIME		10 MIN	10 MIN	10 MIN	10 MIN	10 MIN	10 MIN	10 MIN	10 MIN	10 MIN	0

IN-FLIGHT

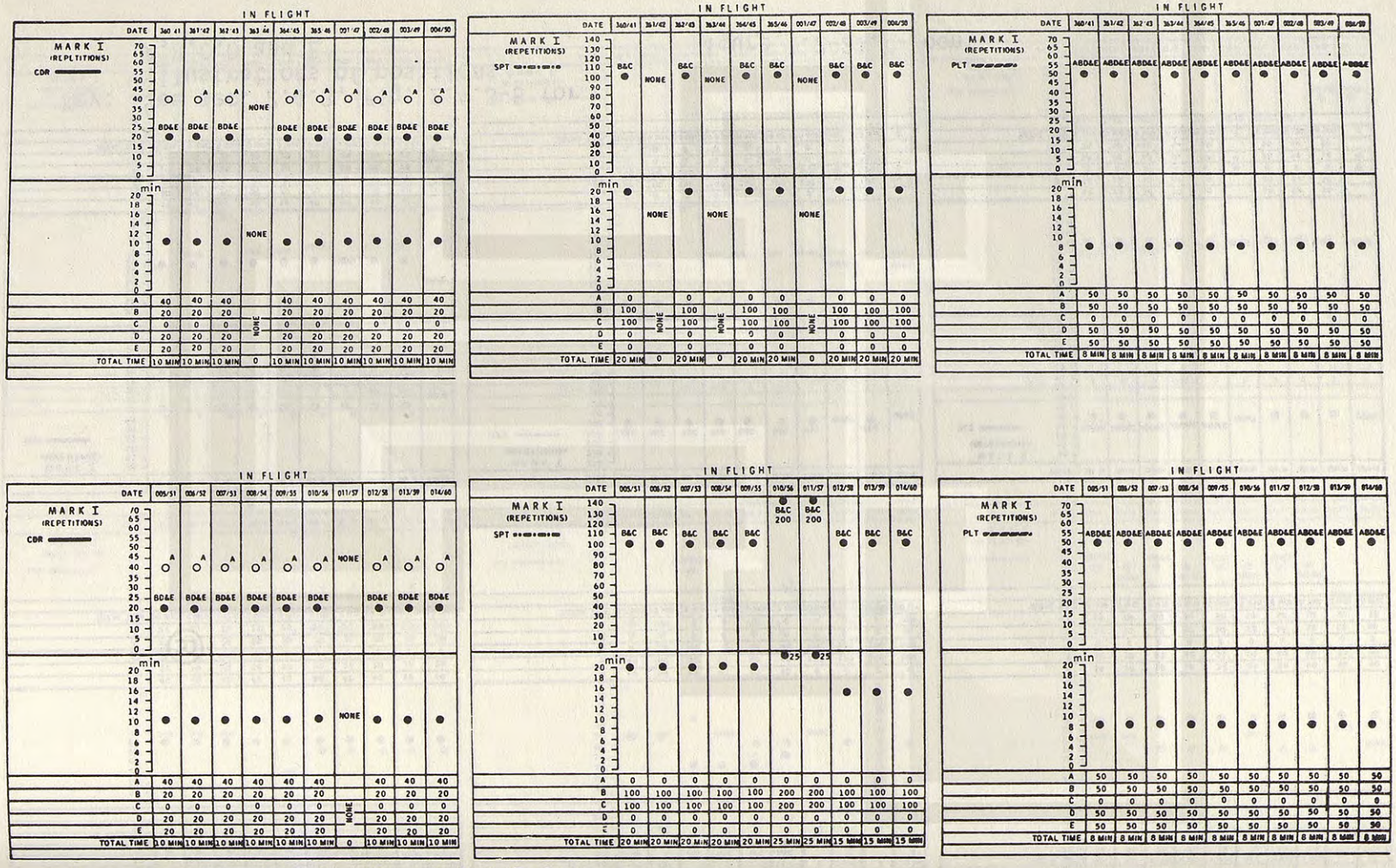
	DATE	350/31	351/32	352/33	353/34	354/35	355/36	356/37	357/38	358/39	359/40
	MARK I (REPETITIONS)										
	SPT	B&C	B&C	B&C	B&C	B&C	B&C	B&C	NONE	B&C	NONE
	min								NONE		NONE
A		0	0	0	0	0	0	0		0	
B		100	100	100	100	100	100	100	NONE	100	NONE
C		100	100	100	100	100	100	100		100	
D		0	0	0	0	0	0	0		0	
E		0	0	0	0	0	0	0		0	
TOTAL TIME		20 MIN	20 MIN	20 MIN	20 MIN	20 MIN	20 MIN	20 MIN	0	20 MIN	0

IN-FLIGHT

	DATE	350/31	351/32	352/33	353/34	354/35	355/36	356/37	357/38	358/39	359/40
	MARK I (REPETITIONS)										
	PLT	ABD&E	ABD&E	ABD&E	ABD&E	ABD&E	NONE				NONE
	min						NONE				NONE
A		50	50	50	50	50		50	50	50	
B		50	50	50	50	50		50	50	50	
C		0	0	0	0	0	NONE	0	0	0	NONE
D		50	50	50	50	50		50	50	50	
E		50	50	50	50	50		50	50	50	
TOTAL TIME		8 MIN	8 MIN	8 MIN	8 MIN	8 MIN	0	8 MIN	8 MIN	8 MIN	0

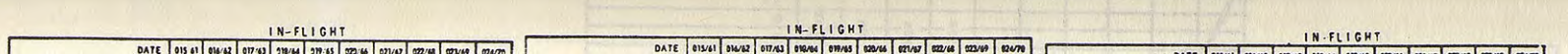
Key: See sec. 2.4.3, fig. 2.4.3-5 for illustrations of positions A,B,C,D and E

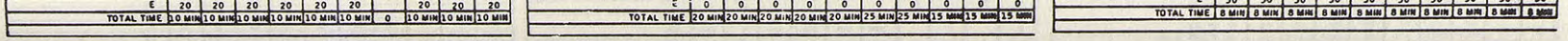
Figure 1.2-21. - cont.



Key: See.sec. 2.4.3, fig. 2.4.3-5 for illustrations of positions A-B-C-D and E

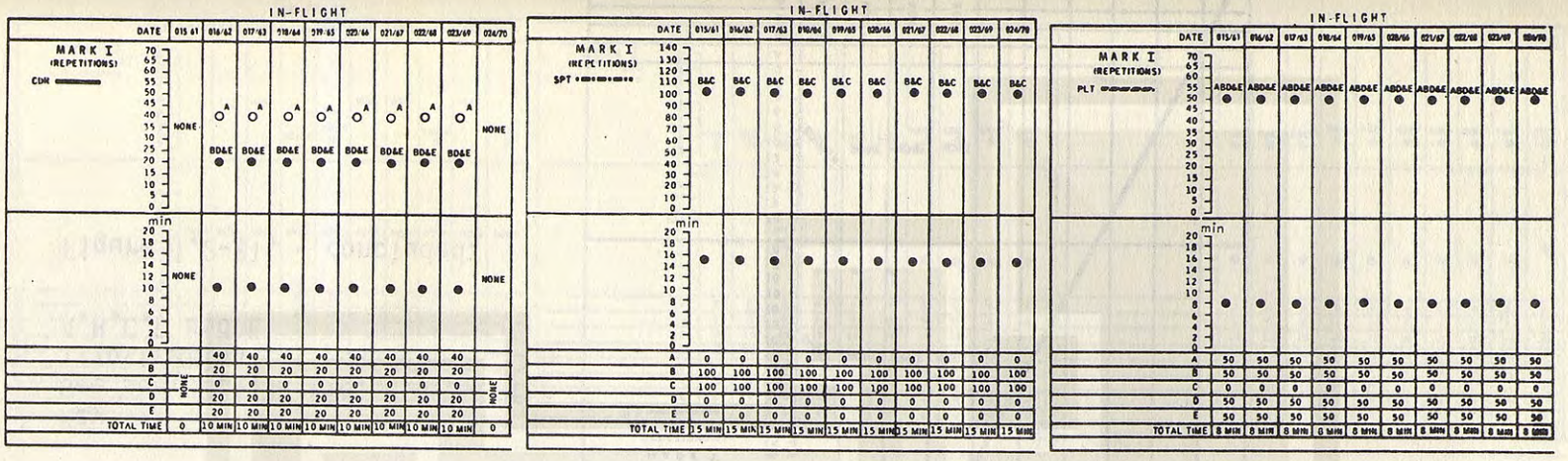
Figure 1.2-21. - cont.

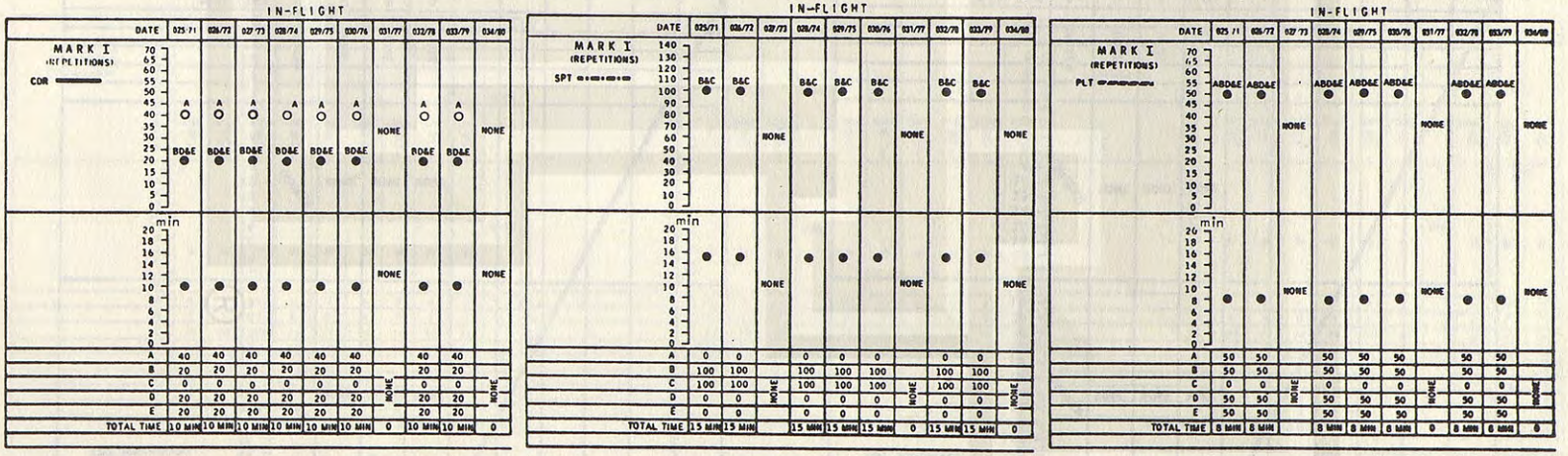




Key: See.sec. 2.4.3, fig. 2.4.3-5 for illustrations of positions A,B,C,D and E

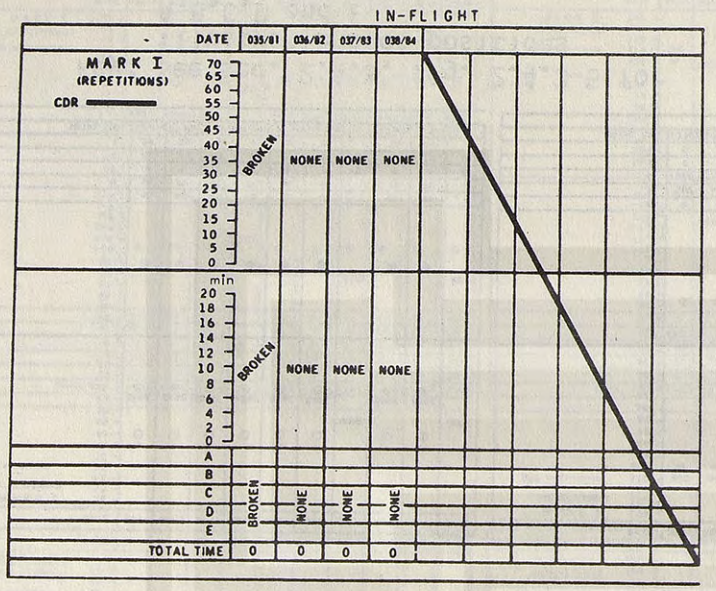
Figure 1.2-21. - cont.

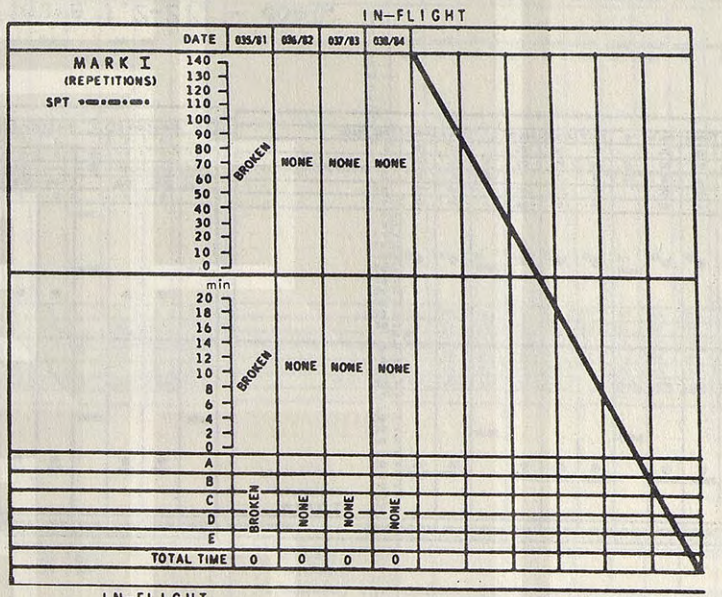


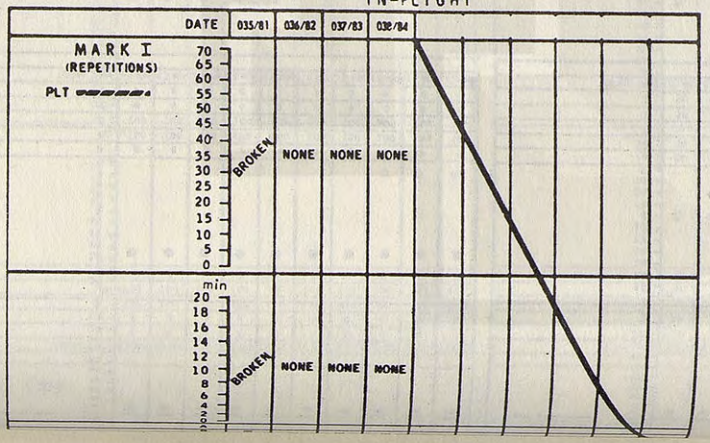


Key: See sec. 2.4.3, fig. 2.4.3-5 for illustrations of positions A,B,C,D and E

Figure 1.2-21. - cont.

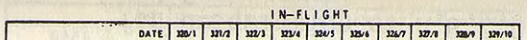


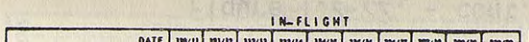


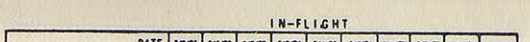


Key:
See sec. 2.4.3, fig. 2.4.3-5 for illustrations of positions A,B,C,D and E

Figure 1.2-21. - concluded.







IN-FLIGHT

MARK II (REPETITIONS) CDR	DATE	320/1	321/2	322/3	323/4	324/5	325/6	326/7	327/8	328/9	329/10
BEEPER SOUNDS				NONE	BCD&E	BC&D	NONE	NONE	BDE&F	NONE	CD&F
min 18 16 14 12 10 8 6 4 2 0		NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
A					0	0			0		0
B					5	10			10		0
C					5	10			0		10
D	NONE		NONE		5	10	NONE		10	NONE	10
E		NONE		NONE	5	0		NONE	10		0
F					0	0			10		10
G					0	0			0		0
H					0	0			0		0
TOTAL TIME	0	0	0	UNK.	UNK.	0	0	UNK.	0	UNK.	

IN-FLIGHT

MARK II (REPETITIONS) CDR	DATE	330/11	331/12	332/13	333/14	334/15	335/16	336/17	337/18	338/19	339/20
BEEPER SOUNDS		CD&F	CD&F	CD&F	CD&F	CD&F	CD&F	CD&F	CD&F	CD&F	CD&F
min 18 16 14 12 10 8 6 4 2 0		NONE	NONE	NONE	●	●	●	●	●	●	●
A		0	0	0	0	0	0	0	0	0	0
B		0	0	0	0	0	0	0	0	0	0
C		10	10	10	10	10	10	15	15	15	15
D		10	10	10	10	10	10	15	15	15	15
E		0	0	0	0	0	0	0	0	0	0
F		10	10	10	10	10	10	15	15	15	15
G		0	0	0	0	0	0	0	0	0	0
H		0	0	0	0	0	0	0	0	0	0
TOTAL TIME		UNK.	UNK.	UNK.	4 MIN	4 MIN	6 MIN	6 MIN	6 MIN	6 MIN	6 MIN

IN-FLIGHT

MARK II (REPETITIONS) CDR	DATE	340/21	341/22	342/23	343/24	344/25	345/26	346/27	347/28	348/29	349/30
BEEPER SOUNDS		CD&F	CD&F	CD&F	CD&F	CD&F	CD&F	CD&F	CD&F	CD&F	CD&F E
min 18 16 14 12 10 8 6 4 2 0		●	●	●	●	●	●	●	●	●	●
A		0	0	0	0	0	0	0	0	0	0
B		0	0	0	0	0	0	0	0	0	0
C		15	15	15	20	20	20	20	20	20	20
D		15	15	15	20	20	20	20	20	20	20
E		0	0	0	0	0	0	0	0	0	10
F		15	15	15	20	20	20	20	20	20	20
G		0	0	0	0	0	0	0	0	0	0
H		0	0	0	0	0	0	0	0	0	0
TOTAL TIME		6 MIN	6 MIN	6 MIN	6 MIN	6 MIN	6 MIN	6 MIN	6 MIN	6 MIN	8 MIN

IN-FLIGHT

MARK II (REPETITIONS) CDR	DATE	350/31	351/32	352/33	353/34	354/35	355/36	356/37	357/38	358/39	359/40
BEEPER SOUNDS		CD&F E	CD&F E	CD&F E	CD&F E	CD&F E	CD&F E	CD&F E	CD&F E	CD&F E	NONE
min 18 16 14 12 10 8 6 4 2 0		●	●	●	●	●	●	●	●	●	NONE
A		0	0	0	0	0	0	0	0	0	
B		0	0	0	0	0	0	0	0	0	
C		20	20	20	20	20	20	20	20	20	
D		20	20	20	20	20	20	20	20	20	NONE
E		10	10	10	10	10	10	10	10	10	
F		20	20	20	20	20	20	20	20	20	
G		0	0	0	0	0	0	0	0	0	
H		0	0	0	0	0	0	0	0	0	
TOTAL TIME		6 MIN	6 MIN	6 MIN	6 MIN	6 MIN	6 MIN	6 MIN	6 MIN	6 MIN	0

IN-FLIGHT

MARK II (REPETITIONS) CDR	DATE	360/41	361/42	362/43	363/44	364/45	365/46	001/47	002/48	003/49	004/50
BEEPER SOUNDS		CD&F E	CD&F E	CD&F E	NONE	CD&F E	CD&F E	CD&F E	CD&F E	CD&F E	CD&F E
min 18 16 14 12 10 8 6 4 2 0		●	●	●	NONE	●	●	●	●	●	●
A		0	0	0		0	0	0	0	0	0
B		0	0	0		0	0	0	0	0	0
C		20	20	20		20	20	20	20	20	20
D		20	20	20	NONE	20	20	20	20	20	20
E		10	10	10		10	10	15	15	15	15
F		20	20	20		20	20	20	20	20	20
G		0	0	0		0	0	0	0	0	0
H		0	0	0		0	0	0	0	0	0
TOTAL TIME		6 MIN	6 MIN	6 MIN	0	6 MIN	6 MIN	6 MIN	6 MIN	6 MIN	6 MIN

IN-FLIGHT

MARK II (REPETITIONS) CDR	DATE	005/51	006/52	007/53	008/54	009/55	010/56	011/57	012/58	013/59	014/60
BEEPER SOUNDS		CD&F E	CD&F E	CD&F E	CD&F E	CD&F E	CD&F E	NONE	CD&F E	CD&F E	CD&F E
min 18 16 14 12 10 8 6 4 2 0		●	●	●	●	●	●	NONE	●	●	●
A		0	0	0	0	0	0		0	0	0
B		0	0	0	0	0	0		0	0	0
C		20	20	20	20	20	20		20	20	20
D		20	20	20	20	20	20	NONE	20	20	20
E		15	15	15	15	15	15		15	15	15
F		20	20	20	20	20	20		20	20	20
G		0	0	0	0	0	0		0	0	0
H		0	0	0	0	0	0		0	0	0
TOTAL TIME		8 MIN	8 MIN	8 MIN	8 MIN	8 MIN	8 MIN	0	8 MIN	8 MIN	8 MIN

Key: See sec. 2.4.3, fig. 2.4.3-6 for description of A,B,C,D,E and F.

Figure 1.2-22. - Mark II Exercise Protocol

IN-FLIGHT

DATE	015/61	016/62	017/63	018/64	019/65	020/66	021/67	022/68	023/69	024/70
MARK II (REPETITIONS) CDR ———	NONE	CD&F E	CD&F E	CD&F E	CD&F E	CD&F E	CD&F E	CD&F E	CD&F E	NONE
min	NONE	●	●	●	●	●	●	●	●	NONE
A		0	0	0	0	0	0	0	0	
B		0	0	0	0	0	0	0	0	
C		20	20	20	20	20	20	20	20	
D		20	20	20	20	20	20	20	20	
E	NONE	15	15	15	15	15	15	15	15	NONE
F		20	20	20	20	20	20	20	20	
G		0	0	0	0	0	0	0	0	
H		0	0	0	0	0	0	0	0	
TOTAL TIME	0	8 MIN	8 MIN	8 MIN	8 MIN	8 MIN	8 MIN	8 MIN	8 MIN	0

IN-FLIGHT

DATE	025/71	026/72	027/73	028/74	029/75	030/76	031/77	032/78	033/79	034/80
MARK II (REPETITIONS) CDR ———	CD&F E	CD&F E	CD&F E	CD&F E	CD&F E	CD&F E	NONE	CD&F E	CD&F E	NONE
min	●	●	●	●	●	●	NONE	●	●	NONE
A	0	0	0	0	0	0		0	0	
B	0	0	0	0	0	0		0	0	
C	20	20	20	20	20	20		20	20	
D	20	20	20	20	20	20		20	20	
E	15	15	15	15	15	15	NONE	15	15	NONE
F	20	20	20	20	20	20		20	20	
G	0	0	0	0	0	0		0	0	
H	0	0	0	0	0	0		0	0	
TOTAL TIME	8 MIN	8 MIN	8 MIN	8 MIN	8 MIN	8 MIN	0	8 MIN	8 MIN	0

IN-FLIGHT

DATE	035/81	036/82	037/83	038/84
MARK II (REPETITIONS) CDR ———	CD&F E	NONE	CD&F E	NONE
min	●	NONE	●	NONE
A	0		0	
B	0		0	
C	20		20	
D	20	NONE	20	NONE
E	15		15	
F	20		20	
G	0		0	
H	0		0	
TOTAL TIME	8 MIN	0	8 MIN	0

IN-FLIGHT

DATE	320/1	321/2	322/3	323/4	324/5	325/6	326/7	327/8	328/9	329/10
MARK II (REPETITIONS) SPT ▪▬▪▬▪	NONE	NONE	NONE	NONE	F ●	NONE	NONE	NONE	NONE	NONE
min	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
A					0					
B					0					
C					0					
D	NONE	NONE	NONE	NONE	0	NONE	NONE	NONE	NONE	NONE
E					0					
F					40					
G					0					
H					0					
TOTAL TIME	0	0	0	0	UNK.	0	0	0	0	0

IN-FLIGHT

DATE	330/11	331/12	332/13	333/14	334/15	335/16	336/17	337/18	338/19	339/20
MARK II (REPETITIONS) SPT ▪▬▪▬▪	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
min	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
A										
B										
C										
D										
E	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
F										
G										
H										
TOTAL TIME	0	0	0	0	0	0	0	0	0	0

IN-FLIGHT

DATE	340/21	341/22	342/23	343/24	344/25	345/26	346/27	347/28	348/29	349/30
MARK II (REPETITIONS) SPT ▪▬▪▬▪	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
min	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
A										
B										
C										
D										
E	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
F										
G										
H										
TOTAL TIME	0	0	0	0	0	0	0	0	0	0

Key: See sec. 2.4.3. fig. 2.4.3-6.

IN-FLIGHT

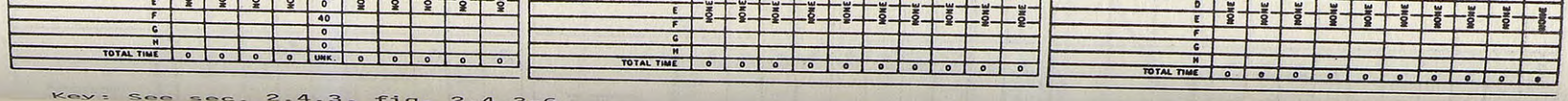
DATE	350/31	351/32	352/33	353/34	354/35	355/36	356/37	357/38	358/39	359/40
MARK II (REPETITIONS) SPT ▪▬▪▬▪	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
min	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
A										
B										
C										
D										
E	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
F										
G										
H										
TOTAL TIME	0	0	0	0	0	0	0	0	0	0

IN-FLIGHT

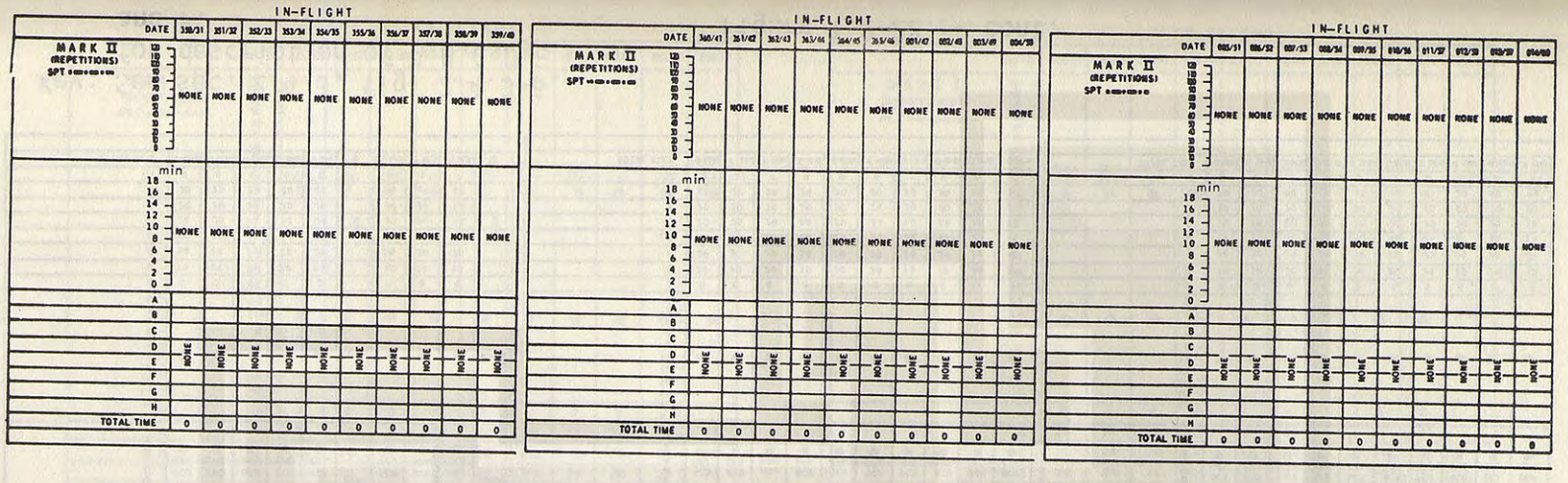
DATE	360/41	361/42	362/43	363/44	364/45	365/46	001/47	002/48	003/49	004/50
MARK II (REPETITIONS) SPT ▪▬▪▬▪	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
min	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
A										
B										
C										
D										
E	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
F										
G										
H										
TOTAL TIME	0	0	0	0	0	0	0	0	0	0

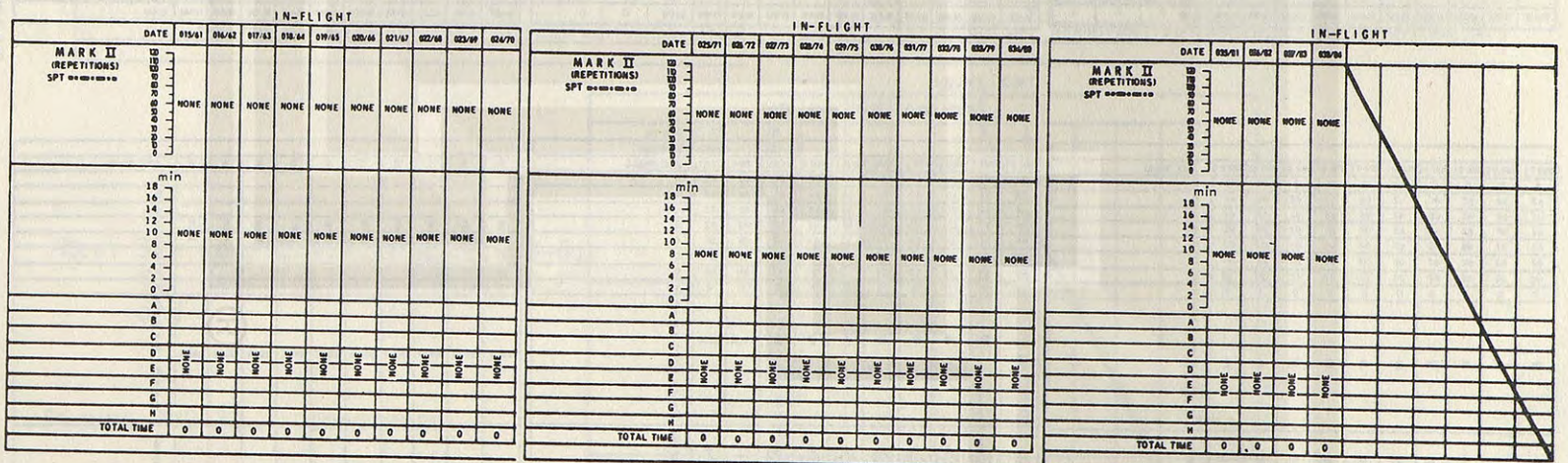
IN-FLIGHT

DATE	005/51	006/52	007/53	008/54	009/55	010/56	011/57	012/58	013/59	014/60
MARK II (REPETITIONS) SPT ▪▬▪▬▪	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
min	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
A										
B										
C										
D										
E	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
F										
G										
H										
TOTAL TIME	0	0	0	0	0	0	0	0	0	0



Key: See sec. 2.4.3, fig. 2.4.3-6.





Key: See sec. 2.4.3, fig. 2.4.3-6, for description of A,B,C,D,E and F.

Figure 1.2-22. - cont.

IN-FLIGHT

DATE	320/1	321/2	322/3	323/4	324/5	325/6	326/7	327/8	328/9	329/10
MARK II (REPETITIONS) PLT ----	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
min	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
A										
B										
C										
D	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
E										
F										
G										
H										
TOTAL TIME	0	0	0	0	0	0	0	0	0	0

IN-FLIGHT

DATE	330/11	331/12	332/13	333/14	334/15	335/16	336/17	337/18	338/19	339/20
MARK II (REPETITIONS) PLT ----	BCD EFGH	BCD EFGH	BCD EFGH	BCD EFGH	BCD EFGH	BCD EFG	BCD EFGH	BCD EFGH	BCD EFGH	BCD EFGH
min	NONE	NONE	●	●	●	●	●	●	●	●
A	0	0	0	0	0	0	0	0	0	0
B	15	50	15	15	15	15	15	15	15	20
C	15	50	15	15	15	15	15	15	15	20
D	15	50	15	15	15	15	15	15	15	20
E	15	50	15	15	15	15	15	15	15	20
F	15	50	15	15	15	15	15	15	15	20
G	15	50	15	15	15	15	15	15	15	20
H	15	50	15	15	15	0	15	15	15	20
TOTAL TIME	UNK.	UNK.	7 MIN	7 MIN	7 MIN	7MIN	7 MIN	7 MIN	7 MIN	10 MIN

IN-FLIGHT

DATE	340/21	341/22	342/23	343/24	344/25	345/26	346/27	347/28	348/29	349/30
MARK II (REPETITIONS) PLT ----	BCD EFGH	BCD EFGH	BCD EFG	BCD EFG	BCD EFG	BCD EFG	BCD EFG	BCD EFG	BCD EFG	BCD EFG
min	●	●	●	●	●	●	●	●	●	●
A	0	0	0	0	0	0	0	0	0	0
B	20	20	20	20	20	20	20	20	20	20
C	20	20	20	20	20	20	20	20	20	20
D	20	20	20	20	20	20	20	20	20	20
E	20	20	20	20	20	20	20	20	20	20
F	20	20	20	20	20	20	20	20	20	20
G	20	20	20	20	20	20	20	20	20	20
H	20	20	0	0	0	0	0	0	0	0
TOTAL TIME	10 MIN	10 MIN	10 MIN	10 MIN	10 MIN	10 MIN	10 MIN	10 MIN	10 MIN	10 MIN

IN-FLIGHT

DATE	350/31	351/32	352/33	353/34	354/35	355/36	356/37	357/38	358/39	359/40
MARK II (REPETITIONS) PLT ----	BCD EFG	BCD EFG	BCD EFG	BCD EFG	BCD EFG	NONE	BCD EFG	BCD EFG	BCD EFG	NONE
min	●	●	●	●	●	NONE	●	●	●	NONE
A	0	0	0	0	0		0	0	0	
B	20	20	20	20	20		20	20	20	
C	20	20	20	20	20		20	20	20	
D	20	20	20	20	20	NONE	20	20	20	NONE
E	20	20	20	20	20		20	20	20	
F	20	20	20	20	20		20	20	20	
G	20	20	20	20	20		20	20	20	
H	0	0	0	0	0		0	0	0	
TOTAL TIME	10 MIN	10 MIN	10 MIN	10 MIN	10 MIN	0	10 MIN	10 MIN	10 MIN	0

IN-FLIGHT

DATE	360/41	361/42	362/43	363/44	364/45	365/46	001/47	002/48	003/49	004/50
MARK II (REPETITIONS) PLT ----	BCD EFG	BCD EFG	BCD EFG	BCD EFG	BCD EFG	BCD EFG	BCD EFG	BCD EFG	BCD EFG	BCD EFG
min	●	●	●	●	●	●	●	●	●	●
A	0	0	0	0	0	0	0	0	0	0
B	20	20	20	20	20	20	20	20	20	20
C	20	20	20	20	20	20	20	20	20	20
D	20	20	20	20	20	20	20	20	20	20
E	20	20	20	20	20	20	20	20	20	20
F	20	20	20	20	20	20	20	20	20	20
G	20	20	20	20	20	20	20	20	20	20
H	0	0	0	0	0	0	0	0	0	0
TOTAL TIME	10 MIN	10 MIN	10 MIN	10 MIN	10 MIN	10 MIN	10 MIN	10 MIN	10 MIN	10 MIN

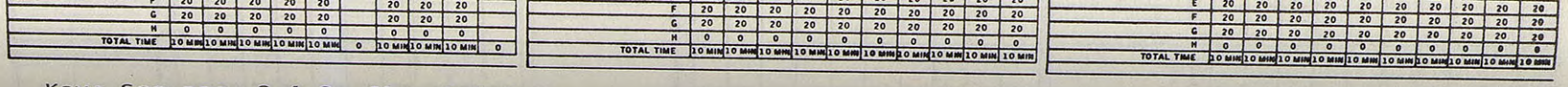
IN-FLIGHT

DATE	005/51	006/52	007/53	008/54	009/55	010/56	011/57	012/58	013/59	014/60
MARK II (REPETITIONS) PLT ----	BCD EFG	BCD EFG	BCD EFG	BCD EFG	BCD EFG	BCD EFG	BCD EFG	BCD EFG	BCD EFG	BCD EFG
min	●	●	●	●	●	●	●	●	●	●
A	0	0	0	0	0	0	0	0	0	0
B	20	20	20	20	20	20	20	20	20	20
C	20	20	20	20	20	20	20	20	20	20
D	20	20	20	20	20	20	20	20	20	20
E	20	20	20	20	20	20	20	20	20	20
F	20	20	20	20	20	20	20	20	20	20
G	20	20	20	20	20	20	20	20	20	20
H	0	0	0	0	0	0	0	0	0	0
TOTAL TIME	10 MIN	10 MIN	10 MIN	10 MIN	10 MIN	10 MIN	10 MIN	10 MIN	10 MIN	10 MIN

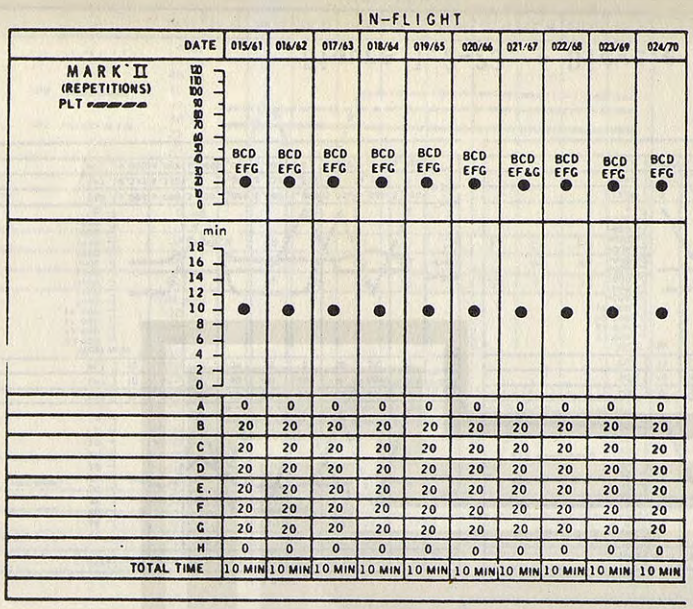
Key: See sec. 2.4.3, fig. 2.4.3-6.

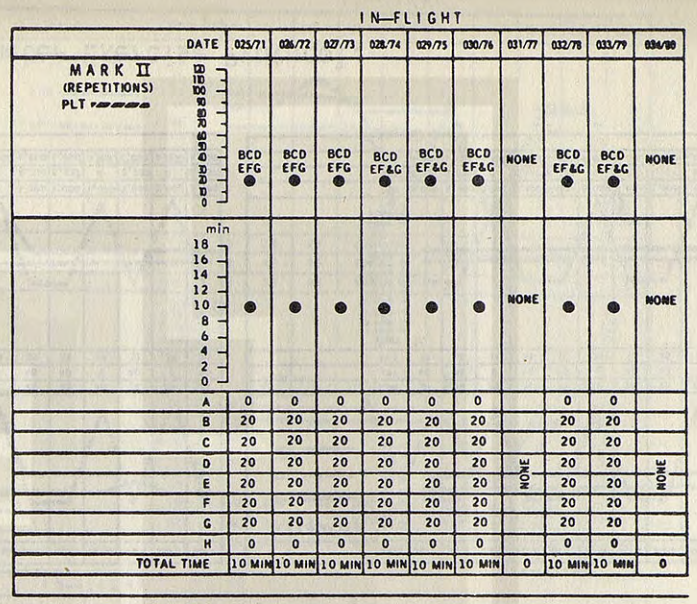
IN-FLIGHT

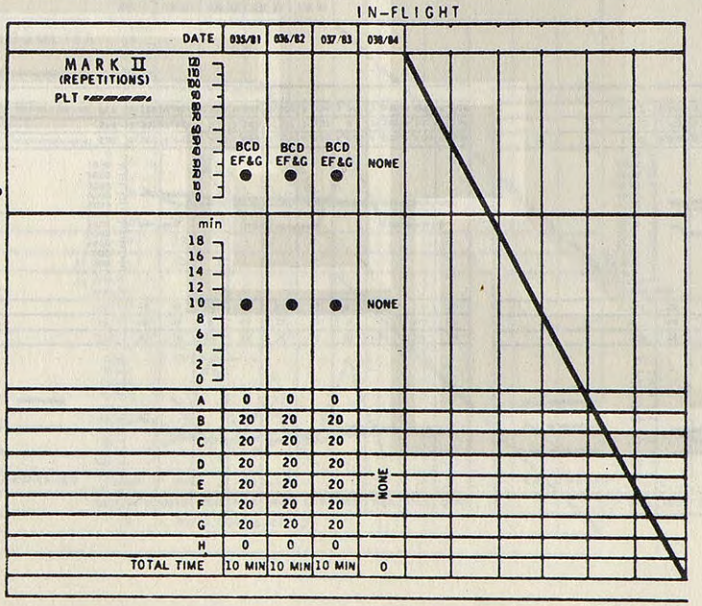
IN-FLIGHT



Key: See sec. 2.4.3, fig. 2.4.3-6.







Key: See sec. 2.4.3, fig. 2.4.3-6, for description of A,B,C,D,E and F.

Figure 1.2-22. - concluded.

IN-FLIGHT

DATE	320/1	321/2	322/3	323/4	324/5	325/6	326/7	327/8	328/9	329/10
CDR	0	0	0	25	30	15	30	25	30	30
SPT	0	0	0	35	25	30	0	50	80	35
PLT	0	0	0	15	30	15	0	15	15	17
CDR	0	0	2,000	3,000	4,110	2,000	4,000	4,000	4,000	4,000
SPT	0	0	5,137	7,010	4,038	5,000	0	10,137	16,737	7,337
PLT	0	0	2,250	2,240	4,650	2,250	0	2,500	2,450	2,900

IN-FLIGHT

DATE	330/11	331/12	332/13	333/14	334/15	335/16	336/17	337/18	338/19	339/20
CDR	25	30	35	35	30	35	31	30	29	30
SPT	40	35	0	40	35	35	0	40	40	40
PLT	22	35	35	35	32	32	28.5	30	29	30
CDR	4,000	4,000	4,400	4,400	4,200	4,400	4,600	4,600	4,600	4,800
SPT	7,337	7,337	0	7,000	7,337	7,337	0	7,337	7,337	7,337
PLT	3,520	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000

IN-FLIGHT

DATE	340/21	341/22	342/23	343/24	344/25	345/26	346/27	347/28	348/29	349/30
CDR	30	29	29	30	No Data	29	28	30	29	27
SPT	40	40	40	0	No Data	40	40	40	40	40
PLT	30	36	35	35	No Data	37	35	35	35	35
CDR	4,800	4,800	4,800	5,100	5,000	5,000	5,000	5,000	5,000	5,000
SPT	7,337	8,338	8,339	0	8,340	8,341	8,337	8,337	8,337	8,337
PLT	5,000	5,700	6,000	5,300	6,000	6,000	6,000	6,000	6,000	6,000

IN-FLIGHT

DATE	350/31	351/32	352/33	353/34	354/35	355/36	356/37	357/38	358/39	359/40
CDR	26	28	18	28	30	28	28	25	28	Not Done (Eva)
SPT	40	40	0	40	40	40	0	40	0	
PLT	35	35	35	35	35	0	30	35	35	
CDR	5,000	5,000	3,000	5,000	5,000	5,000	5,000	4,000	5,000	Not Done (Eva)
SPT	8,337	8,337	0	8,337	8,337	8,337	0	8,337	0	
PLT	6,000	6,000	6,000	6,000	6,000	0	6,000	6,000	6,000	

IN-FLIGHT

DATE	360/41	361/42	362/43	363/44	364/45	365/46	001/47	002/48	003/49	004/50
CDR	0	28	28	0	28	28	28	28	28	28
SPT	40	40	0	0	40	40	0	40	0	40
PLT	35	35	35	35	35	35	35	31	35	35
CDR	0	5,000	5,000	0	5,000	5,000	5,000	5,000	5,000	5,000
SPT	8,337	8,337	0	0	8,337	8,337	0	8,337	0	8,337
PLT	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000

IN-FLIGHT

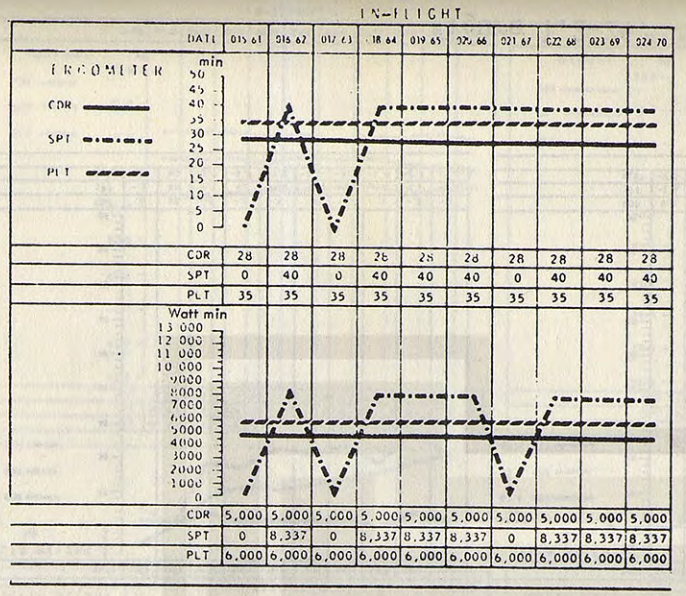
DATE	005/51	006/52	009/53	008/54	009/55	010/56	011/57	012/58	013/59	014/60
CDR	29	28	28	28	28	28	28	28	28	28
SPT	40	40	0	40	40	0	40	40	0	40
PLT	35	35	35	35	35	35	35	35	35	35
CDR	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000
SPT	8,337	8,337	0	8,337	8,337	0	8,337	8,337	0	8,337
PLT	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000

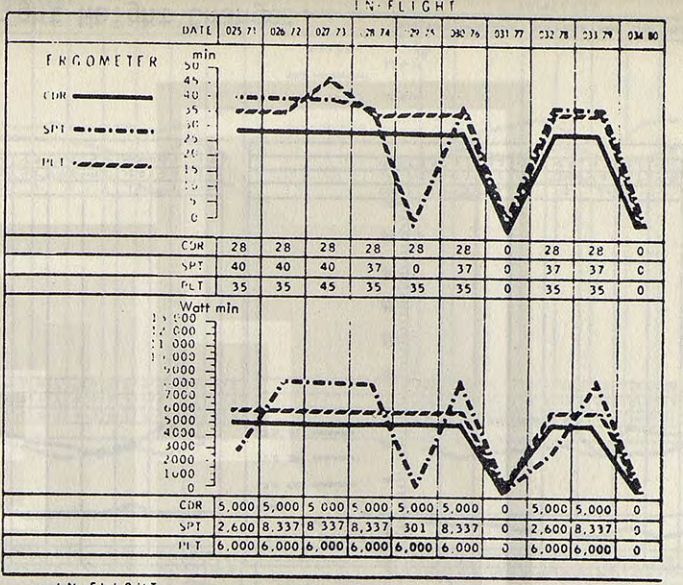
IN-FLIGHT

DATE	015/61	016/62	017/63	18/64	019/65	020/66	021/67	022/68	023/69	024/70
CDR	30	30	30	30	30	30	30	30	30	30
SPT	40	40	40	40	40	40	40	40	40	40
PLT	35	35	35	35	35	35	35	35	35	35
CDR	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000
SPT	8,337	8,337	8,337	8,337	8,337	8,337	8,337	8,337	8,337	8,337
PLT	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000

IN-FLIGHT

DATE	025/71	026/72	027/73	028/74	029/75	030/76	031/77	032/78	033/79	034/80
CDR	30	30	30	30	30	30	30	30	30	30
SPT	40	40	40	40	40	40	40	40	40	40
PLT	35	35	35	35	35	35	35	35	35	35
CDR	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000
SPT	8,337	8,337	8,337	8,337	8,337	8,337	8,337	8,337	8,337	8,337
PLT	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000





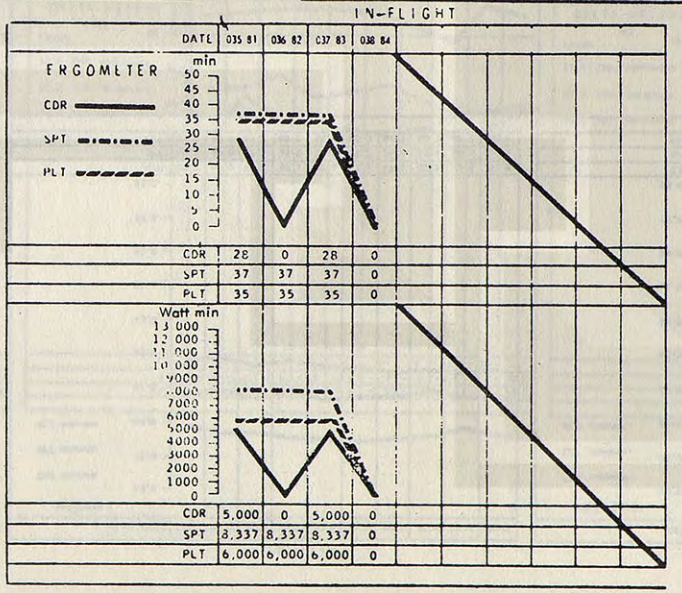
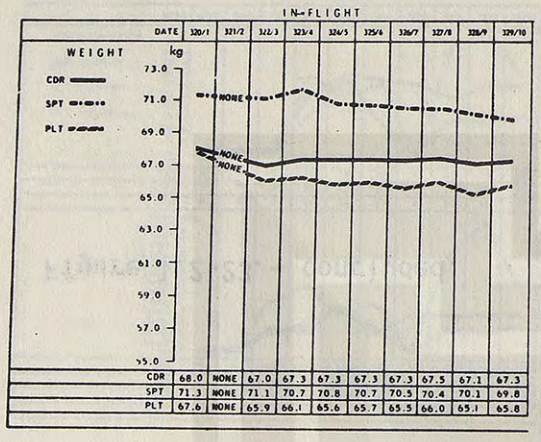


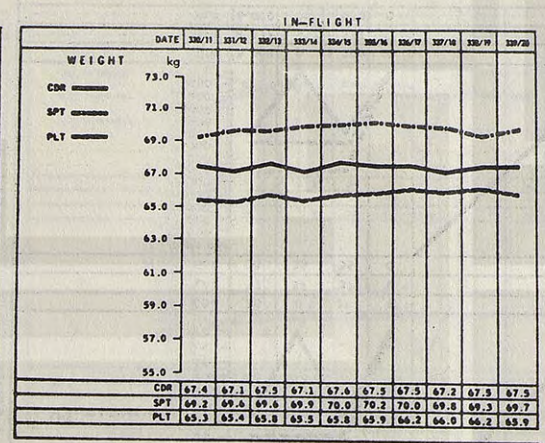
Figure 1.2-23.- concluded.

IN-FLIGHT



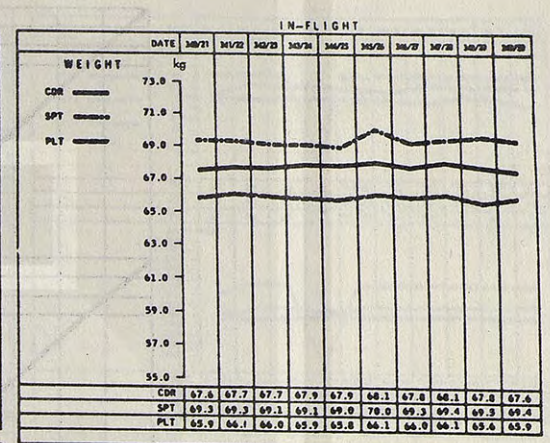
DATE	320/1	321/2	322/3	323/4	324/5	325/6	326/7	327/8	328/9	329/10
CDR	68.0	NONE	67.0	67.3	67.3	67.3	67.3	67.5	67.1	67.3
SPT	71.3	NONE	71.1	70.7	70.8	70.7	70.5	70.4	70.1	69.8
PLT	67.6	NONE	65.9	66.1	65.6	65.7	65.5	66.0	65.1	65.8

IN-FLIGHT



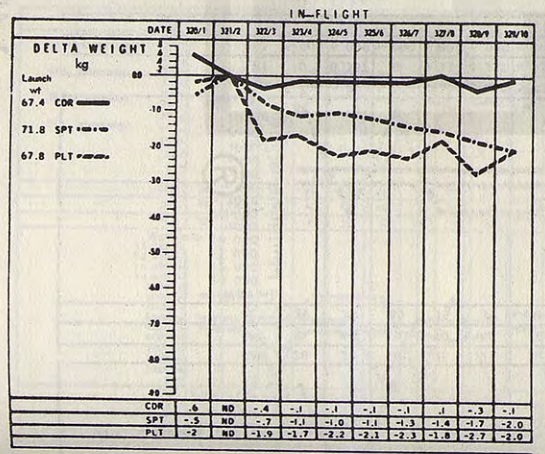
DATE	330/11	331/12	332/13	333/14	334/15	335/16	336/17	337/18	338/19	339/20
CDR	67.4	67.1	67.5	67.1	67.6	67.5	67.5	67.2	67.5	67.5
SPT	69.2	69.6	69.6	69.9	70.0	70.2	70.0	69.8	69.3	69.7
PLT	65.3	65.4	65.8	65.5	65.8	65.9	66.2	66.0	66.2	65.9

IN-FLIGHT



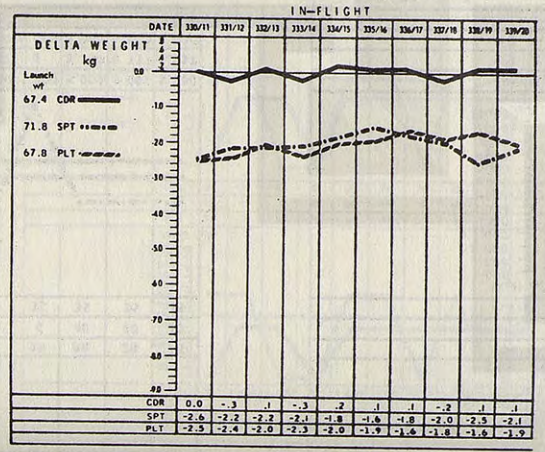
DATE	340/21	341/22	342/23	343/24	344/25	345/26	346/27	347/28	348/29	349/30
CDR	67.6	67.7	67.7	67.9	67.9	68.1	67.8	68.1	67.8	67.6
SPT	69.3	69.3	69.1	69.1	69.0	70.0	69.3	69.4	69.5	69.4
PLT	65.9	66.1	66.0	65.9	65.8	66.1	66.0	66.1	65.6	65.9

IN-FLIGHT



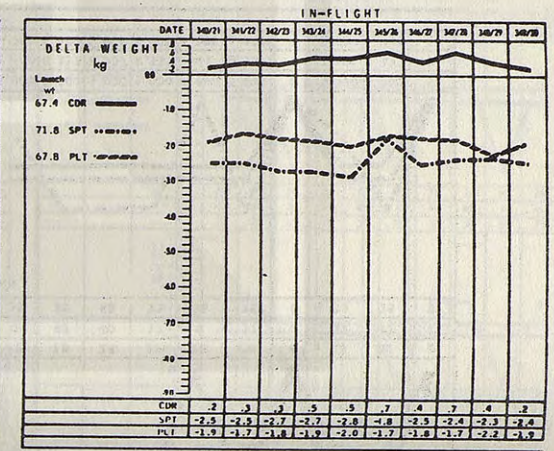
DATE	320/1	321/2	322/3	323/4	324/5	325/6	326/7	327/8	328/9	329/10
CDR	.6	ND	-.4	-.1	-.1	-.1	-.1	.1	-.3	-.1
SPT	-.5	ND	-.7	-1.1	-1.0	-1.1	-1.3	-1.4	-1.7	-2.0
PLT	-2	ND	-1.9	-1.7	-2.2	-2.1	-2.3	-1.8	-2.7	-2.0

IN-FLIGHT



DATE	330/11	331/12	332/13	333/14	334/15	335/16	336/17	337/18	338/19	339/20
CDR	0.0	-.3	.1	-.3	.2	.1	.1	-.2	.1	.1
SPT	-2.6	-2.2	-2.2	-2.1	-1.8	-1.6	-1.8	-2.0	-2.5	-2.1
PLT	-2.5	-2.4	-2.0	-2.3	-2.0	-1.9	-1.6	-1.8	-1.6	-1.9

IN-FLIGHT



DATE	340/21	341/22	342/23	343/24	344/25	345/26	346/27	347/28	348/29	349/30
CDR	.2	.3	.2	.5	.5	.7	.4	.7	.4	.2
SPT	-2.5	-2.5	-2.7	-2.7	-2.8	-1.8	-2.5	-2.4	-2.3	-2.4
PLT	-1.9	-1.7	-1.8	-1.9	-2.0	-1.7	-1.8	-1.7	-2.2	-1.9

IN-FLIGHT

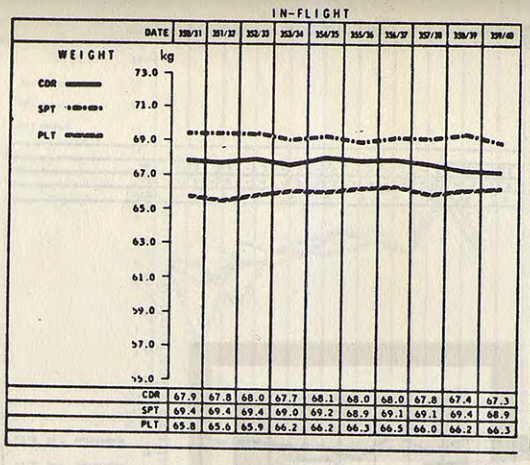
DATE	350/31	351/32	352/33	353/34	354/35	355/36	356/37	357/38	358/39	359/40
WEIGHT kg										
CDR										
SPT										
PLT										

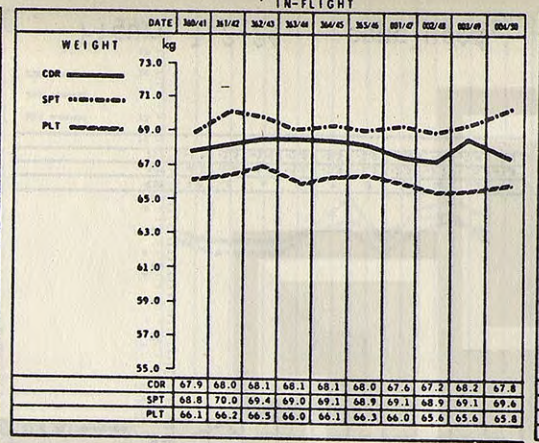
IN-FLIGHT

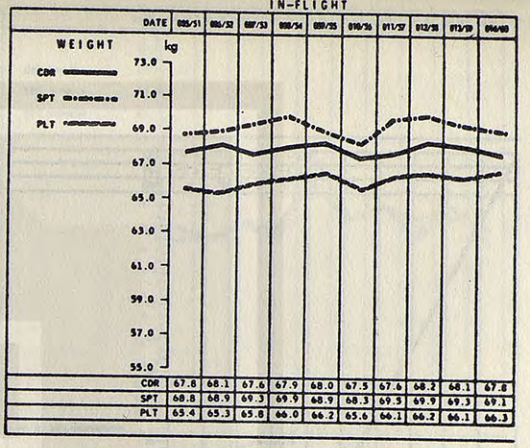
DATE	360/41	361/42	362/43	363/44	364/45	365/46	001/47	002/48	003/49	004/50
WEIGHT kg										
CDR										
SPT										
PLT										

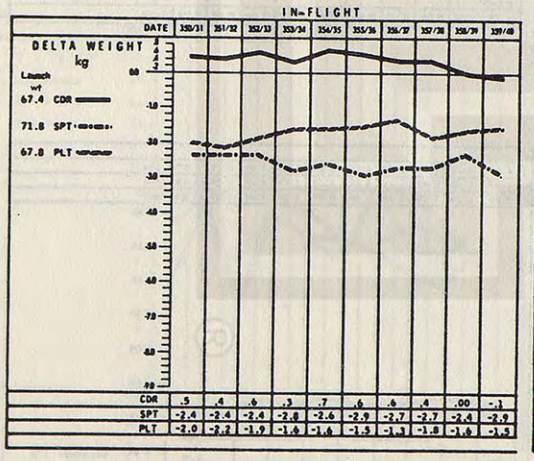
IN-FLIGHT

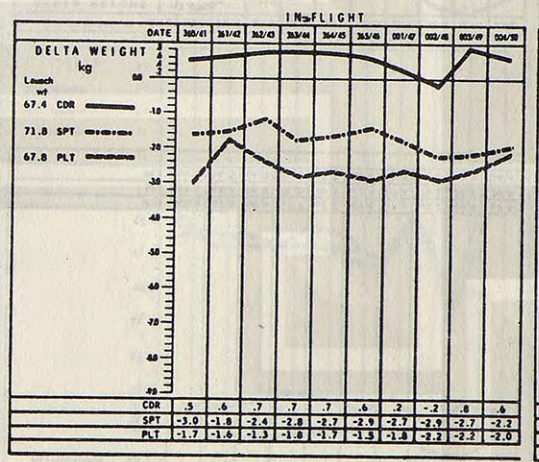
DATE	005/51	006/52	007/53	008/54	009/55	010/56	011/57	012/58	013/59	014/60
WEIGHT kg										
CDR										
SPT										
PLT										











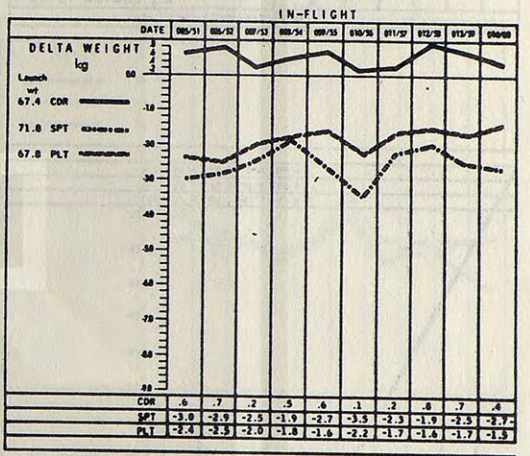
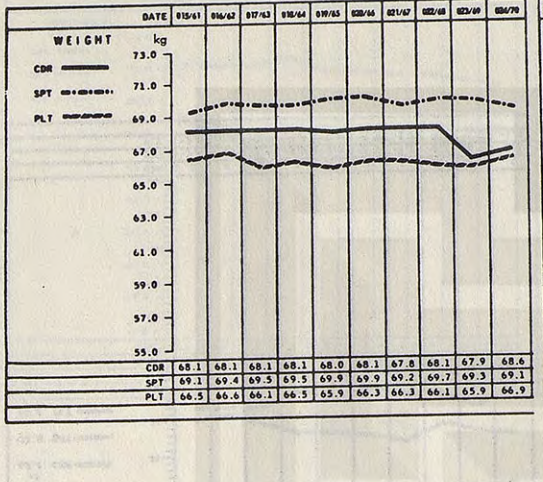


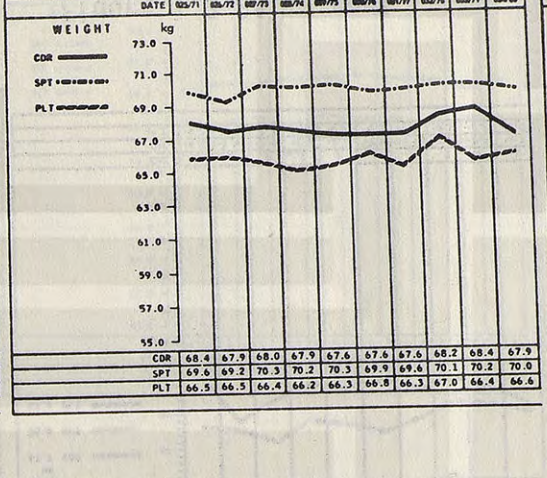
Figure 1.2-24. - cont.

IN-FLIGHT



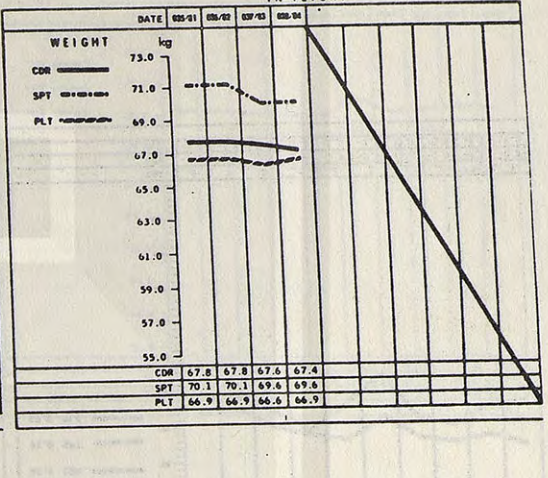
DATE	015/61	016/62	017/63	018/64	019/65	020/66	021/67	022/68	023/69	024/70
CDR	68.1	68.1	68.1	68.1	68.0	68.1	67.8	68.1	67.9	68.6
SPT	69.1	69.4	69.5	69.5	69.9	69.9	69.2	69.7	69.3	69.1
PLT	66.5	66.6	66.1	66.5	65.9	66.3	66.3	66.1	65.9	66.9

IN-FLIGHT



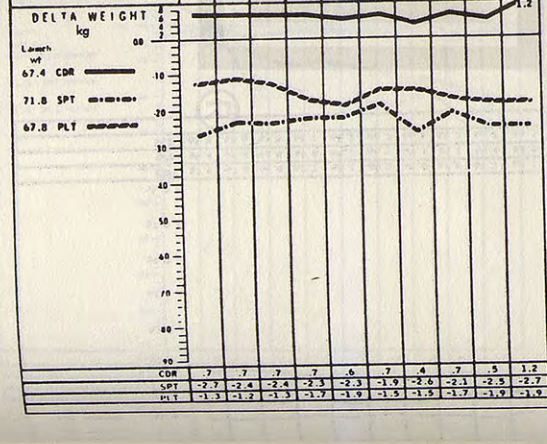
DATE	025/71	026/72	027/73	028/74	029/75	030/76	031/77	032/78	033/79	034/80
CDR	68.4	67.9	68.0	67.9	67.6	67.6	67.6	68.2	68.4	67.9
SPT	69.6	69.2	70.3	70.2	70.3	69.9	69.6	70.1	70.2	70.0
PLT	66.5	66.5	66.4	66.2	66.3	66.8	66.3	67.0	66.4	66.6

IN-FLIGHT



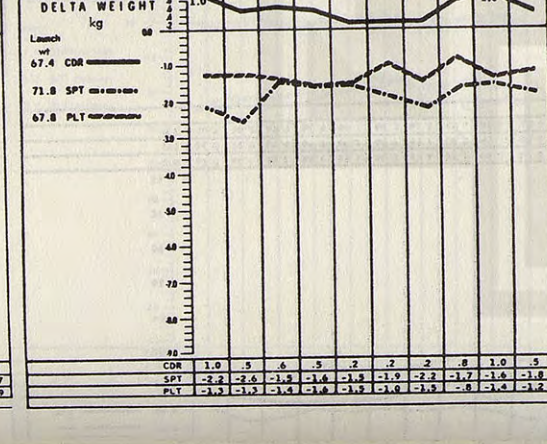
DATE	035/81	036/82	037/83	038/84
CDR	67.8	67.8	67.6	67.4
SPT	70.1	70.1	69.6	69.8
PLT	66.9	66.9	66.6	66.9

IN-FLIGHT



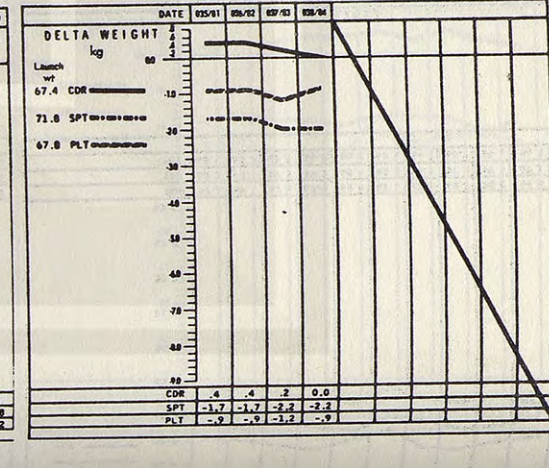
DATE	015/61	016/62	017/63	018/64	019/65	020/66	021/67	022/68	023/69	024/70
CDR	.7	.7	.7	.7	.6	.7	.4	.7	.5	1.2
SPT	-2.7	-2.4	-2.4	-2.3	-2.3	-1.9	-2.6	-2.3	-2.5	-2.7
PLT	-1.3	-1.2	-1.3	-1.7	-1.9	-1.5	-1.5	-1.7	-1.9	-1.9

IN-FLIGHT



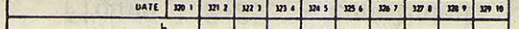
DATE	025/71	026/72	027/73	028/74	029/75	030/76	031/77	032/78	033/79	034/80
CDR	1.0	.5	.6	.5	.2	.2	.2	.8	1.0	.5
SPT	-2.2	-2.6	-1.5	-1.6	-1.8	-1.9	-2.2	-1.7	-1.6	-1.8
PLT	-1.3	-1.3	-1.4	-1.8	-1.9	-1.0	-1.5	-.8	-1.4	-1.2

IN-FLIGHT

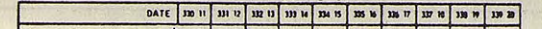


DATE	035/81	036/82	037/83	038/84
CDR	.4	.4	.2	0.0
SPT	-1.7	-1.7	-2.2	-2.2
PLT	-.9	-.9	-1.2	-.9

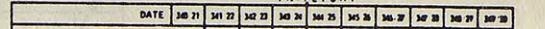
IN-FLIGHT



IN-FLIGHT



IN-FLIGHT



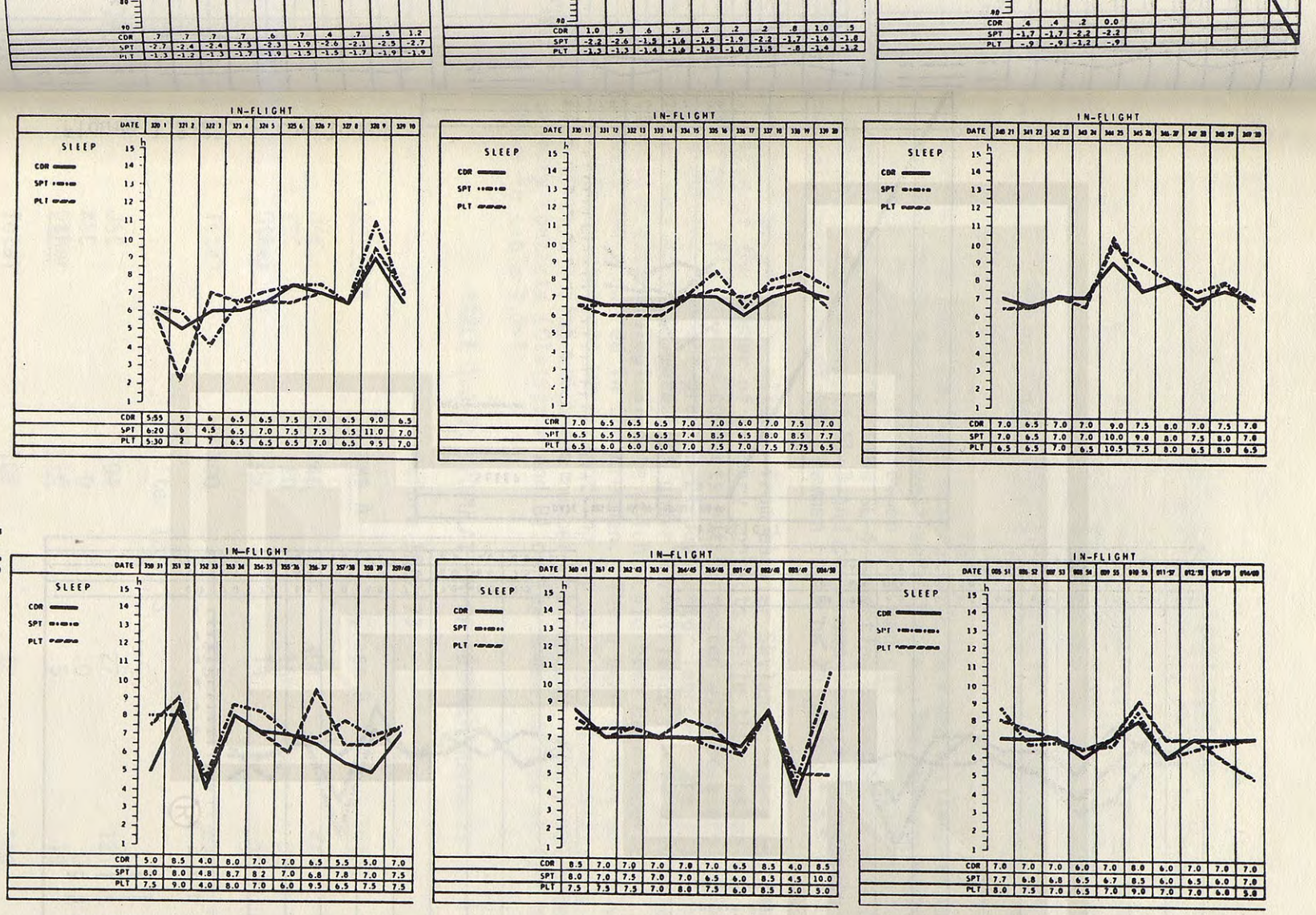


Figure 1.2-25. - In-Flight Sleep Trends.

IN-FLIGHT
SLEEP
CDR
SPT
PLT
h
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
DATE
015 61
016/62
017 63
018 64
019 65
020 66
021 67
022 68
023 69
024 70
CDR 7.0 7.0 6.5 7.0 6.0 7.0 7.0 6.0 7.5 7.0
SPT 6.7 8.0 6.0 10.3 6.0 7.0 6.0 6.0 7.5 6.5
PLT 8.0 7.0 6.5 9.0 5.0 7.0 6.5 7.0 6.0 6.5

IN-FLIGHT
SLEEP
CDR
SPT
PLT
h
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
DATE
025 71
026 72
027 73
028 74
029 75
030 76
031 77
032 78
033 79
034 80
CDR 7.0 6.5 7.0 6.0 6.5 6.5 7.5 5.5 6.5 6.5
SPT 6.5 10.5 7.0 7.0 6.7 7.5 9.0 8.7 7.0 7.0
PLT 6.5 8.5 6.0 6.0 7.0 7.5 8.5 7.0 6.0 6.0

IN-FLIGHT
SLEEP
CDR
SPT
PLT
h
15
14
13
12
11
10
9
8
7
6
DATE
035 81
036 82
037 83
038 84

1.3 Flight Crew Health Stabilization

J. K. Ferguson, Ph.D., G. W. McCollum, M.S., and B. L. Portnoy, M.D.

The Flight Crew Health Stabilization Program for SL-4 was carried out according to the procedures outlined in the document entitled *Skylab Flight Crew Health Stabilization Program*, MSC-07875, Revision C. The goal of the program was to reduce, or eliminate if possible, the probability that a flight crewman would come into contact with a person having an infectious illness.

All primary contacts received instructions to report illnesses they may experience to the Medical Surveillance Office. The primary contacts were not allowed to contact the crewmen if a medical examination found the illness to be infectious. The SL-4 reporting period began on 3 October 1973 as a continuation of SL-3 and continued through 15 February 1974. Preflight isolation of the crewmen began on 20 October 1973.

The SL-4 program was altered from earlier Skylab missions only by reduction of the number of primary contacts while the mission was in progress. All primary contacts not connected with recovery operations were deleted from the program 21 days after launch. The total number of primary contacts were kept under surveillance for 21 days after launch to obtain epidemiological data which would have been beneficial if an illness had occurred in the crewmen. There were 65 days during which all primary contacts were reporting (up to 7 December 1973), and there were 69 days during which the number was reduced. The population of primary contacts (Classes A and B) during these periods of time is shown in table 1.3-I.

TABLE 1.3-I. POPULATION OF PRIMARY CONTACTS

Location	Class A	Class B	Total
Before 12/7/73			
JSC	246	304	550
KSC	20	15	35
Other	34	14	48
Total	300	333	633
After 12/7/73			
JSC	94	27	121
KSC	0	0	0
Other	14	5	19
Total	108	32	140

Active surveillance was accomplished by stationing a nurse at the entrance to primary work areas of the crew beginning at F-27 days. Oral temperatures and throat examinations were given. Daily examinations were given to the Class A primary contacts who were required to be in those areas where crewmen were working. Examination data on these primary contacts are as follows:

	JSC	KSC	Total
Class A exams	1106	149	1255
Examining days	23	6	29
Average examinations/day	48	25	73
Referrals to clinic	15	4	19

Primary contact illnesses were recorded on an illness event form and coded by signs and symptoms. An analysis of these data is shown be

a. Total illnesses reported:

Before 12/7/73	37
After 12/7/73	9
Total	46

b. Location of illnesses reported:

	JSC	KSC	Other	Total
Before 12/7/73	36	1	0	37
After 12/7/73	9	0	0	9
Total	45	1	0	46

c. Class of Primary Contact illness:

	Class A	Class B
Before 12/7/73	23	14
After 12/7/73	4	5
Total	27	19

d. Rates of illnesses (number illnesses/1000 population per week)

	Overall	JSC	KSC	Class A	Class B
Before 12/7/73	6.7	7.5	3.3*	8.8	4.8
After 12/7/73	6.2	7.1	0	3.6*	15.0*

*Based on 5 or less illness events

e. Types of illness:

Note: One event may include more than one symptom and is given as per cent of total illness events.

Illness	Number	% of Illness
URI	37	80
Bronchitis	2	4
Pneumonia	0	0
Upper Enteric	4	9
Lower Enteric	2	4
Fever	5	11
Headache	1	2
Skin Infection	1	2
Other	0	0

Discussion

The rate of illness reported by primary contacts on SL-4 is considered to be low. The average rate for overall reporting was only 61 per 1000 population. During the summer months of SL-3 the average rate for overall reporting was 104 per 1000 population.

As on other Skylab missions, the illness most frequently reported was the upper respiratory infection. This indicates that wearing face masks and staying at protective distances are important control measures in the isolation of astronauts from exposure to common pathogens.

The SL-4 program was generally carried out much more smoothly and efficiently than earlier efforts. The primary contact list was made available at the appropriate time which made it possible to complete the medical examinations and vaccinations on schedule.

The coverage provided by the FCHSP is believed to have contributed greatly to the prevention of illness in the crewmen of Skylab.

2.0 CREW HEALTH

2.0 CREW HEALTH

Jerry R. Hordinsky, M.D.

2.1 Introduction

The events reported in this section highlight the relative medical stability of the SL-4 crewmen during their 84-day voyage and also indicate problems to be solved for future space missions.

2.2 Crew Health Summaries

2.2.1 Preflight Medical Evaluation

Clinical evaluation of astronauts has many facets. One of the earliest of the crew evaluations included a full pressure suit donning and, while exposed to vacuum, doing controlled amounts of work by timed stepping onto and off of a step. The CDR and PLT executed successful checkouts at 1200 Btu per hour (352 watts), 1600 Btu per hour (469 watts), and 2000 Btu per hour (586 watts), respectively, on 27 June 1973; the SPT repeated this sequence on 28 June 1973.

The prime crew performed a full day checkout of the Command Service Module (CSM) 118 in August 1973. This test had the astronauts in hard pressure suits with the environment varying between zero and 5 psia (34×10^3 N/m^2). These tests were conducted with the astronauts fully instrumented; comments about arrhythmias follow later. The tests were operationally successful.

More traditional evaluations included review of medical histories. Pertinent excerpts from them are as follows:

Commander Carr - Jerry Carr was given his astronaut selection medical evaluations in January 1966 at Brooks Air Force Base (SAM). A mild perennial allergic rhinitis and infectious mononucleosis were noted in the history, and an astigmatism (compound, myopic, O.U., but with 20/20 near and far uncorrected vision) was noted in the physical. The cardiovascular stress tests (Double Masters, carotid massage, tilt table, treadmill) were passed without any difficulty at the time of astronaut selection. Since his selection, a first time positive PPD skin test was followed up with INH for one year spanning 1968-1969. Low back pain and posterior upper left leg tenderness were noted in September 1973, but an orthopedic evaluation showed no permanent pathology and the diagnosis was lumbosacral and muscular strain. In the chemistry, Carr tends to run a high cholesterol (approximately 300). Triglycerides and lipoproteins are nominal, however. Carr is not a smoker.

Scientist-Pilot Gibson - Ed Gibson was evaluated at SAM in May and his history revealed an osteomyelitis at ages 2, 4, and 8, well as three laparotomies (age 9 for an abdominal infection, age 11 for an appendectomy, age 24 for a right inguinal hernia His physical showed hypermetropia (farsightedness) (O.S.) and vealed a statistically uncommon (but not pathological) EEG pat- tern. Miscellaneous responses to cardiovascular stress tests will be commented on later. Since SAM, Ed Gibson has remained good health. In September 1973, a steroid cream was utilized quickly resolve a presumed Xerotic eczema (dry inflammatory co tion of the skin) on the right forearm. All medical problems been minor and transient. Although retaining 20/20 near and f uncorrected vision, glasses are worn for prolonged reading. Ed Gibson is not a smoker. He is the youngest of the three as nauts and was the most regular in physical training preflight.

Pilot Pogue - Bill Pogue was given his astronaut selection medi evaluation in January and February 1966. His history at that revealed that his blood pressure tended to be at the high side the normal range (intermittently noted since 1952). Also relev historically were the episodes of nasal congestion, "sinusitis" and post O_2 ear block. His physical examination revealed moder nasal septal deviation, bilateral asymptomatic tympanosclerosis hypermetropia (simple, O.D.), astigmatism (compound hypermetrop C.S.), and retinal arteriolar narrowing and angulation but with out any degeneration. He was a vascular hyperreactor by the Hi criteria but was otherwise not demonstrative of any significant changes in the cardiovascular stress tests. Since SAM, Bill Po has been in good health. There has been no change in the blood pressure status. The episodes of nasal congestion, "sinusitis" and post O_2 ear block were scattered in occurrence and there wa no evidence of chronicity or permanent operational impairment. A routine physical X-ray in January 1972 revealed an area of sclerotic change about the apophyseal joints at lumbar 5-sacral (L5-S1) on the left, but there has been no associated symptomati ogy. Near vision is 20/30 O.D. and 20/40 O.S. and requires cor- rective lenses. A special monocle lens was cut preflight.

Of the three, high frequency loss revealed by audiometry testin is most noted in Bill Pogue, especially on the right. Bill Pog is also not a cigarette smoker.

All three crewmen had mandatory one-hour psychiatrically oriented di cussions preflight. Postflight, an early and a late psychiatric evaluation was also required.

A summary of preflight arrhythmia history follows. The annual ECG examination reports taken from the crew medical records do not show any abnormal rhythms. The unique response of each crewman to various preflight test situations are as follows.

Commander Carr:

° From SAM (1966) we have the following summary.

Cardiovascular history: All cardiovascular tests - Electrocardiogram, Centrifuge, Double Masters, Carotid Massage, Treadmill, *et cetera*, negative.

° Work in hard suit exposed to vacuum in June 1973: no premature arterial contractions (PAC) or premature ventricular contractions (PVC).

° Full day test of CSM-118 in vacuum in August 1973: no noted PAC or PVC.

° Dr. Owen's cardiopulmonary laboratory evaluations, utilizing experiment M171 (sec. 3.15) or maximum effort response, show the following data:

1972:	1 Sep - No PAC's or PVC's
	16 Oct - No PAC's or PVC's
1973	12 Oct - One ectopic in recovery
	6 Nov - No PAC's or PVC's

Scientist Pilot Gibson:

° From SAM (May 1965) we have the following summary.

Centrifuge Test: $+G_z$ acceleration; "Sporadic atrial premature contractions throughout, superimposed with marked sinus arrhythmias." (Lamb)

Centrifuge 10.5-g run; "Occasional atrial premature contractions before and after the run are noted as well as frequent atrial prematurities during exposure at transverse-g. Some of the prematurities seem to be paired in a successive fashion." (Lamb)

Orthostatic Test: "During 7-minutes orthostasis one lower atrial premature contraction; another at the end of 12 minutes. During breath-holding an occasional lower PAC is noted. Occasional PC after hyperventilation and breath holding." (Lamb)

Double Masters: After exercise one lower atrial PC with aberrant conduction; in V5 either a short burst of atrial tachycardia or an interpolated prematurity followed by a second prematurity after a normal beat is noted.

Treadmill - PAC at 4 min, at 11 min, and sporadically thereafter.

- Work in hard suit exposed to vacuum June 1973: no PAC or PVC doing work; one isolated PAC prior starting work.

- Aug. 1973, full day test of CSM-118 in vacuum: three isolated PAC's, one definite PVC, two questionable PVC's.

- Dr. Owen's cardiopulmonary laboratory evaluations, utilizing an experiment M171 (sec. 3.15) or maximum effort response, show the following data:

  1972: 16 Oct - No PAC's or PVC's

  1973: 2 Feb - No PAC's or PVC's
  12 Oct - No PAC's or PVC's
  6 Nov - One PVC in recovery

Pilot Pogue:

- History of sensation of irregular heart action after rapid decompression (1963).

- From SAM (1966) we have the following summary.

  Masters Test, ECG and all other tests negative.

- Work in hard suit exposed to vacuum June 1973; no PAC or PVC.

- Full day test of CSM-118 in vacuum Aug. 1973; three PAC; two PVC.

- Dr. Owen's cardiopulmonary laboratory evaluations, utilizing an experiment M171 (sec. 3.15) or maximum effort response, show the following data:

  1973: 11 Jan - Three PAC's during exercise
  12 Oct - One ectopic at 100 watts and one variant at 200 watts
  6 Nov - No PAC's or PVC's

The histories and physicals of the backup crew, made up of Vance Brand, Bill Lenoir, and Don Lind, were evaluated in similar fashion. Since the backup crewmen were also the backups for SL-3, they did not integrate into detailed SL-4 evaluation schemes until F-60 days.

The detailed crew health evaluations began with the 60-day preflight microbiology and dental requirements. Since the SL-4 launch was slated for as early a date as 24 September, one day before official termination of SL-3, it was necessary to plan for this early date with a proposed scheme of testing. A copy of this scheme, dated 16 August 1973, as it appears in the records, is shown as exhibit A. At that time, the SL-4 prime crew was in highly accelerated training, the SL-4 backups were involved with Skylab Rescue (SL-R) training, and the SML's were shortly to become unavailable because they were to be moved out to the Recovery Ship one month before the planned SL-3 termination on 25 September 1973. About 21 days prior to the proposed launch date (24 September) when the FCHSP was to have been initiated, the date for launch was tentatively reset for 11 November and subsequently moved back to 10 November; therefore, the FCHSP was put into effect on 20 October 1973.

Baseline microbiology was obtained on the prime crew on 21 August. The backup crew sampling was not repeated as SL-3 data still served as a baseline. Baseline dental examinations were completed on the 14th and 17th of September for the prime and backup crews, respectively.

The first medical comprehensive evaluations were to meet the 30-day preflight requirements with the prime crew on 12 October, and with the backup crew preceding it on 10 October. A copy of that schedule is shown in figure 2.2.1-1. A summary of the reported results is as follows. All tests scheduled (fig. 2.2.1-1) were accomplished with the following additions or deletions:

- As part of the blood drawing, part of which represented the original requirements for the 21-day preflight requirement, venous pressure was determined.
- M171 included tilt ergometry.
- Skin fold measurements were omitted as the equipment was unavailable.
- Electromyography was deleted for procedural reasons.

Each crewman had a complete general physical examination. Preliminary evaluation of the data on the Backup CDR, Vance Brand, showed him to be in good health and clearable for flight. Preliminary evaluation of the Backup SPT, Bill Lenoir, showed him clearable for flight. This

16 August 1973 (F-39 days) given the proposed launch date of 24 September

Prime crew availability poor due to accelerated training; backups still committed to SL-R training.

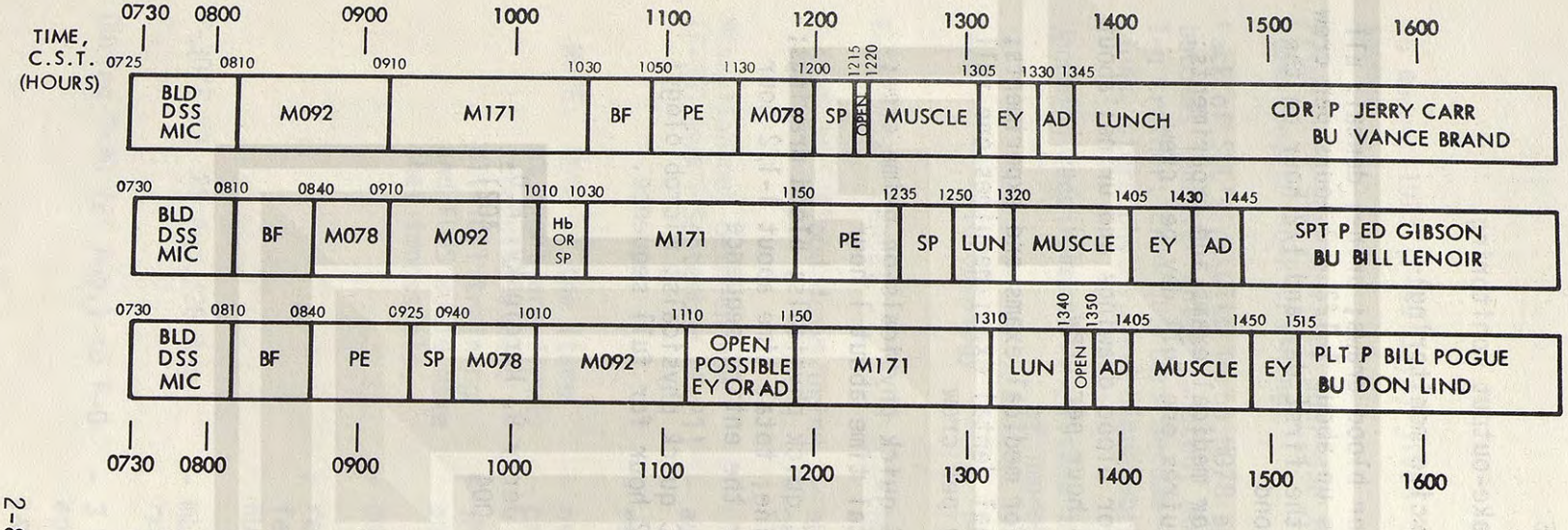
Lack of SML's results in no M078 apparatus; visual testing apparatus becomes inconveniently located; M092/M171 are mandatorily done in the 1-g trainer; crew quarters become location point for general examinations, stereophotos, and blood work.

Upcoming requirements --- listed to determine LSD commitment in light of improbable actual launch on 24 September

F-60	Microbiology	- being done 21 August on prime crew (F-34)
F-56/F-55	Dental	- not scheduled; impact of hour per c
F-45/F-44	Blood draws/Urine	- not scheduled; impact of 1-1/2 hour per crew; controls?
Miscellaneous between now (F-39) and 3 September (F-21)		- audiometry (1/2 - 3/4 hour per crew
		- refraction (1/2 - 3/4 hour per crew
NOTE: None of the items at right are firmly scheduled except clinical training and FCHS would make that impossible.		- psychiatric interviews (3 hours per crew)
		- IMSS clinical training in 1-g train and hospital (3 days)
		- heel x-rays in new foot molds?
		- requested crew briefings with, thus far, M092, M171 personnel and also Russian data with Berry.
F-30/F-29, 25 Aug./26 Aug.		- major medical exams and experiments requiring one day per crew
During F-30 (25 Aug.) to F-0		- 3 M093 runs per crewman (about 3 da apart)

During F-21 (3 Sept.) to F-0 (24 Sept.)	- FCHS
	- intake-output monitoring
(During F-30 to F-0 also -------	exercise monitoring)
F-21/F-20 (3 Sept./4 Sept.) Prime F-20/F-19 (4 Sept./5 Sept.) Backup	- major blood draws; urine; dental; all ties up about 1-1/2 - 2 hours per crew on the first day and 1/2 hour on the second
F-15/F-14 (9 Sept./10 Sept.)	- major medical exams and experiments; requires one full day per crew
F-7 Prime and Backup	- major blood drawings and urine; about 3/4 hour per crew
F-4/F-3 (20 Sept./21 Sept.)	- major medical exams and experiments; final dental exam; requires one full day per crew
F-2 (22 Sept.)	- KSC quick physicals on prime crew; total time about 1 hour
F-1 (23 Sept.)	- KSC quick physicals; blood drawings; urine; total time about 1-1/2 hour for the entire sequence
F-0 (24 Sept.)	- KSC quick physicals; microbiology; 1/2 hour for full sequence.

Jerry R. Hordinsky, M.D.
DD4 -4021



PRE-REPORT REQUIREMENTS: DO NOT EAT, DRINK, BATHE, USE A DEODORANT, OR BRUSH YOUR TEETH THE DAY OF THE PHYSICAL.

INITIAL REPORT LOCATION: SML'S (BEHIND BLDG. 36) AT 0730 HOURS (BU ON 10/P ON 12 OCT) EXCEPT CDR AT 0725 HOURS

SUBSEQUENT LOCATIONS: ALL IN SML'S EXCEPT AUDIOMETRY IN ROOM 312 BLDG 7A
STEREO PHOTOS IN BLDG 41
REFRACTION IN BLDG. 7A (Rm 323) AND
MUSCLE TESTING IN BLDG. 7A (CARDIOVASCULAR LAB)

CODES:
BLD = BLOOD DRAWING
DSS = DENTAL SALIVARY SAMPLES
MIC = MICROBIOLOGY
SP = STEREOPHOTOS + SKIN FOLD MEAS.
PE = PHYSICAL EXAM
PX = PERS. EXERCISE
EY = REFRACTION
LUN = LUNCH
M092 = LOWER BODY NEG. PRESS. + LEG MEASUREMENT + CLOSEUP PHOTOS
M171 = BICYCLE ERGOMETER + ARM/TRUNK MEASUREMENT + TILT ERGOMETER
M078 = BONE DENSITOMETRY
BF = BREAKFAST
AD = AUDIOMETRY
MUSCLE=STRENGTH TESTING/ELECTROMYOGRAPHY/INTEGRATE ANTHROPOMETRIC/ CENTER OF GRAVITY MEASUREMENTS/

NOTE: NO HEAVY EXERCISE IN LUNCH PERIOD PRECEDING MUSCLE TESTING.

NOTE: Hb = HEMOGLOBIN/SPECIFIC GRAVITY PRACTICE

astronaut had several instances of PVC's in earlier testing. Review of the earlier data did not indicate pathology. The physical on 10 October as well as preliminary reports of M092 and M171, did not indicate any cardiovascular pathology. As part of this workup, he also did some maximum effort running while carrying a portable ECG recorder. Preliminary quick review of the data likewise showed no significant arrhythmia. It should be noted, however, that in the M171 session, approximately 15 PVC's, all scattered, were noted in real time. The Backup PLT, Don Lind, was essentially clearable for flight. In the last few days he had a mild flareup of a hayfever condition. The symptoms were sneezing and watering of the eyes, which were relieved with Dimetapp®.

The Prime Crew CDR, Jerry Carr, was clearable for flight. He also had a very minimal flareup of his hayfever in the past three weeks. In his case, this presented with early morning sneezing and with intermittent postnasal drip during the day. Because he gave a history of intermittent low back pain, an orthopedic evaluation was made in September; no significant back pathology was demonstrated and x-rays of the back were read as normal. The patient stated that doing back exercises reduced the incidence of the back pain. In regard to the M171, the CDR ran a much higher heart rate at 75% max $\dot{V}O_2$ as compared to previous baseline runs. This probably reflected the increased traveling and training of the preceding week. The Prime Crew SPT, Edward Gibson, was likewise essentially clearable for flight. On examination, a small area of injection at the upper aspect of the left tympanic membrane was noted. This was asymptomatic but probably reflected some failure of pressure equilibration during recent flying of the previous week. In the M092, a single premature atrial contraction was noted approximately three minutes into recovery, and the M171 demonstrated the same elevated heart rate for 75% max $\dot{V}O_2$ as compared to other preflight baselines. Prime Crew PLT, Bill Pogue, was likewise clearable for flight.

In the interim between examinations the PLT (prime) used Ornade® b.i.d. from 22 to 24 October for post flying congestion secondary to the use of oxygen.

The next sequential comprehensive examinations were to meet the 15-day preflight requirements, with the prime crew on 26-27 October, and with the backup crew on 29-30 October. A schedule of these examinations is depicted in figure 2.2.1-2. During these examinations the crew participated as operators of the M092-M171 packages to gain learning experience. The requirements for the 15-day preflight schedule were extremely long and the prime crew chose, at the last minute, to shift the M131 components to 27 October. A summary of the reported results is as follows:

NOTE: NO HEAVY EXERCISE IN LUNCH PERIOD PRECEDING MUSCLE TESTING.
CENTER OF GRAVITY MEASUREMENTS/
NOTE: Hb = HEMOGLOBIN/SPECIFIC GRAVITY PRACTICE

Figure 2.2.1-2. - Fifteen-Day Preflight Examination Schedule: SL-4.

For the Prime Crew, the day began with basic microbiology, dental salivary sampling, and extensive blood protocol involving isotopes. Peripheral venous pressure was completed; however, circulation time had not been performed because of an apparent belief that the procedure had not been well tested. The electronystagmography was omitted because of lack of support from primary contacts due to illness. Tagged to the M092 sequence were arm and leg measurements, arm and leg blood pressure measurements, lower body negative pressure standard protocol and leg blood-flow experiments. Finally electromyography was done after the LBNP procedures and then M171 together with vital capacity were run. Stereophotos and infrared photographs were taken and the first skin fold measurements were actually completed at the time of these particular photographs. The baseline for M078 was reconfirmed, and Dr. Thornton did his various muscle testing experiments. A general physical was completed on each of the crewmembers. Toward the end of the day, spatial localization (M131-2) and oculogyral illusion and motion sensitivity (M131-1) were to be performed, but the bulk of the M131 work was transferred to the next day as previously stated.

The preliminary review of the data showed the CDR, Jerry Carr, and PLT, Bill Pogue, to be in good health. SPT Ed Gibson was also qualified for flight, but the area of the eardrum that was thought to represent some barotrauma and which had been noted in very minimal form during the 30-day preflight examination, now seemed more prominent. The SPT was told to halt any further exposures to situations resulting in quick valsalva and to hold for examination by the ENT consultant. The consultant confirmed the barotrauma and reported all damage to be present in the drum itself, with no damage or bleeding behind the drum. He was of the opinion that if the SPT had to fly during that immediate period, he could, and that this was a condition that should spontaneously heal. This conclusion was reached after substantiating the clinical impression with a microscope examination of the ear and impedance testing of both ear drums. The M092, M171 and miscellaneous testing preliminary average heart rate and blood pressure data seemed reasonable, although the heart rates did seem a bit elevated at the third step of the M171. In the M131 experiment, a very high natural resistance to motion sickness was noted in all three crewmen and the only parameter that seemed to be responsible was the increased aerobatic flying. All the crewmembers were able to perform 150 head movements without the protection of any drug. Carr was at 20 rpm, Gibson at 20 rpm, and Pogue at 25 rpm.

The entire 15-day preflight protocol for the Backup Crew was completed on 29 October. The exceptions were that no stereophotos were taken as enough baseline data had been accumulated. Electronystagmography and circulation time were deleted, and the leg blood-flow was carried out.

Figure 2.2.1-2. - Fifteen-Day Preflight Examination Schedule - SL-4

EMG M092 ELECTROMYGRAPHY INCLUDES LEG MEASUREMENT AND FACIAL PHOTOS

LUN SUP SNK

LUNCH SUPPER SNACK

Infrared photographs were taken in the one-g trainer to determine th camera settings necessary for flight. Quick look of the M092 and M data did not indicate any problems although the wave form data was actively monitored during this component of the test. At the M171 level, the Backup Crew revealed a lower heart rate than that charac istically seen in the Prime Crew. The M131 sequence data for the Ba Crew also showed a much higher toleration to motion sickness. CDR and SPT Lenoir both went 150 head movements at their allotted rpm, PLT Lind made several head movements above what was normally his ex head movement cutoff point. Brand was at 15 rpm, Lenoir at 10 rpm, Lind at 10 rpm.

No flight restrictions were placed on any member of the Backup Crew.

The day after the major physical examinations of the Prime and Back Crews, a repeat blood drawing was performed and training of the SPT in hemoglobin (Hb) techniques was conducted. Blood tests at the 15- preflight examination included part of original 21-day preflight re

The five-day preflight examination was the next and final comprehens evaluation, with the Prime Crew scheduled on 6 November and Backup scheduled on 5 November. The schedule for this examination is depic in figure 2.2.1-3. The Prime Crew was cleared for flight. The SPT left ear showed no acute process. A yellowish hue was noted in the former injected area. Shortly after the F-5 day examination was co pleted, a hold was put on the launch because cracks were discovered the SL-4 rocket. What was going to have been a convenient late morn launch on 10 November was delayed until at least 15 November. A sec five-day preflight examination was performed on the Prime and Backu Crews on 10 November 1973; this schedule is attached as figure 2.2.

The Prime Crew was cleared for flight again. The T-38 flight to the Cape for suit fit about that time caused a slight injection of the left superior ear drum of the CDR as well as reinjection of the left ear drum of the SPT.

During the regular Flight Crew Health Stabilization period (and in w proved to be a six-day extension above the basic 21 days), the Crew Surgeon and his deputy made daily visits to the astronauts to clarif medical points, provide a feedback on medical examinations, and to d quick history and physical reviews. These regular visits served to establish better understanding and personal relationships with the c with whom further communications would be by long distance for 84 da

It was during the Flight Crew Health Stabilization period that a mot home was rented and used as a portable office. The motor home prove uniquely useful in keeping the crewmen sequestered and at the same t providing transportation, especially when the question of evaluation

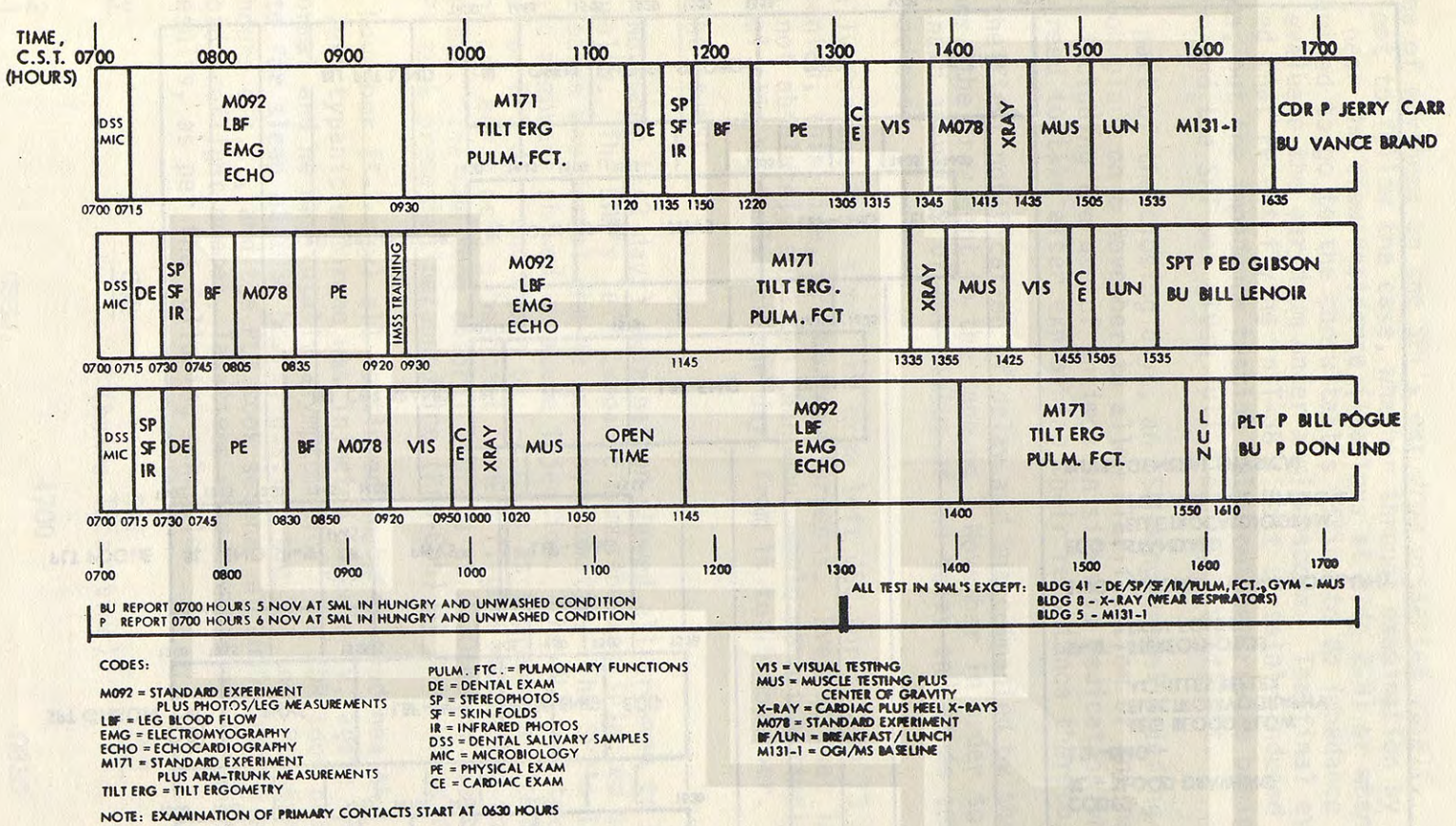


Figure 2.2.1-3. - Five-Day Preflight Examination Schedule (First), SL-4.

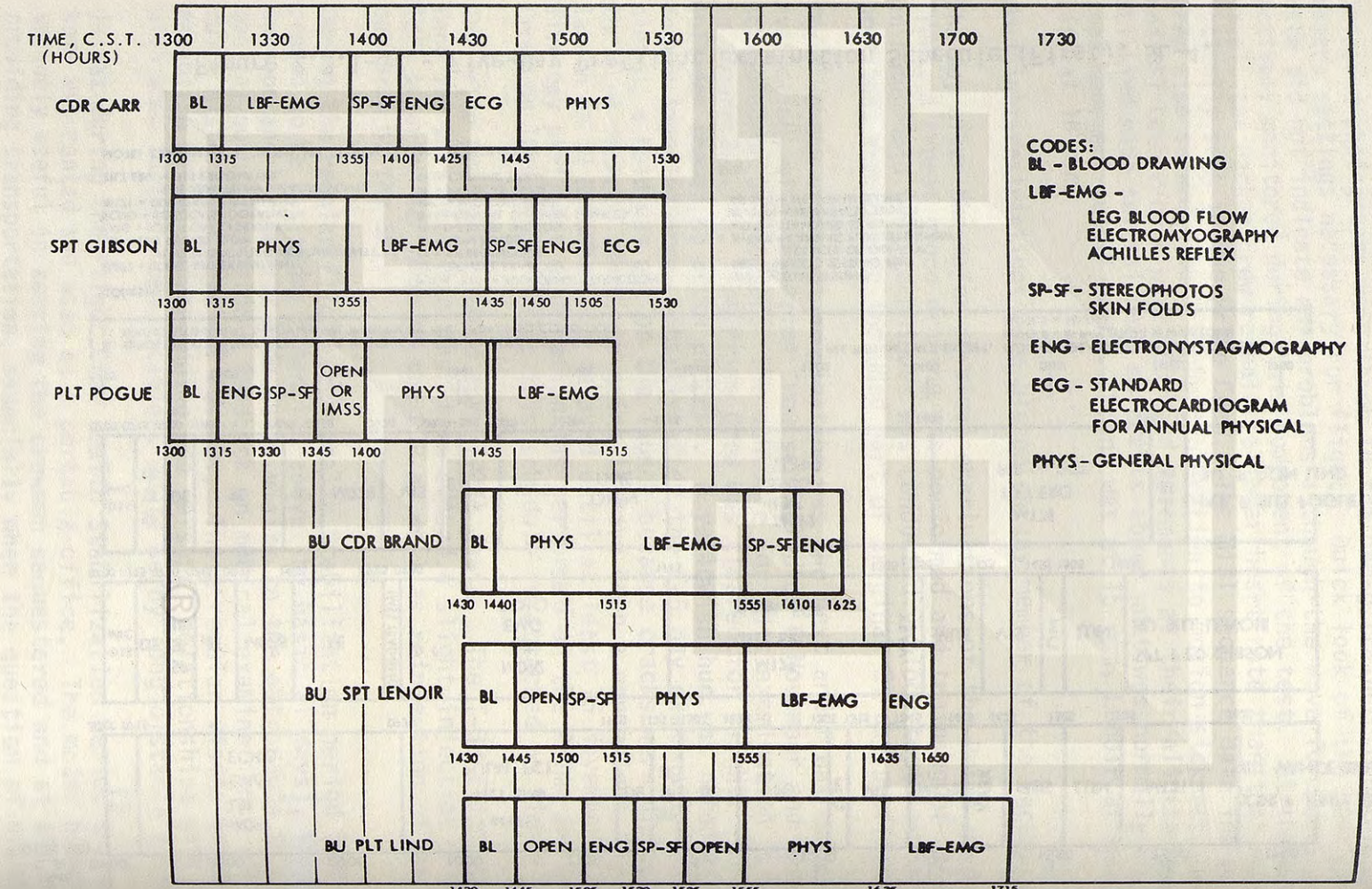


Figure 2-2-1-4. - Five-Day Postflight Examination Schedule (Second), Sl-4.

the area of erythema on the SPT's ear drum presented itself. It was convenient to follow the case, whether through examination by the consultant near the crew residence (Trailers at Bldg 228) or when a trip was required to go to the consultant's office to do impedance testings and to evaluate the ear drum under a microscope. The final evaluation indicated that recent flying in T-38's most certainly induced the erythema, but the impedance testing ruled out hemorrhage behind the ear drum and the SPT was given full clearance for flight.

Also as part of the closing days, an LSD Mangagement Briefing to the crew took place on 6 November to allow clarification of any major issues, including the use of antimotion sickness medication which the crew agreed to take after explaining their reluctance thereto.

After the first notification of delay and unaccompanied by the Crew Surgeons, the crew went to the Cape on 7 November in order to make a firsthand appraisal of the status of the delay and to do some equipment checkout.

Hopefully for the last time, the crew left JSC for KSC on 13 November accompanied, this time, by the Crew Surgeons. Even at that late date, it was not absolutely sure fin changeout would permit a timely launch. The final slip was only for one day, from 15 to 16 November.

Preflight at KSC

The 14 November (F-2 days) examination showed all crewmen to be in good health. The CDR's left tympanic membrane was injected superiorly but valsalva was normal and he was asymptomatic. The SPT's left tympanic membrane showed no acute injection. The PLT had taken one Ornade® on F-3 days and again on F-2 days as a prophylactic measure to prevent any ear blocks subsequent to the flights occurring in that time frame. The CDR took chloral hydrate at 2130 hours e.s.t., and the SPT took promethazine/ephedrine (Pro-Eph) at 1500 hours for sleep.

On 15 November (F-1 day) all continued to be in good health. The CDR's left typanic membrane was injected superiorly, again valsalva was normal and he was totally asymptomatic. The CDR took chloral hydrate for sleep at 2030 hours, e.s.t., the SPT took Pro-Eph at 1430 hours e.s.t., and the PLT took seconal at 2000 hours e.s.t. To avoid preflight enemas, laxatives were administered with successful results, as per the following schedule:

Day	CDR	SPT (hours local time)	PLT
F-2		1700	
F-1	0830		0830
	1800		

Also on 15 November, final isotope blood work was performed.

On 16 November, the final microbiological sampling was completed. The medically important microorganizms recovered are shown in Table 2.2.1-I. The final sleep times preflight were: CDR, 5 hours, 55 minutes; SPT, 6 hours and 20 minutes; and PLT, 5 hours and 30 minutes. The condition of the left tympanic membrane of the CDR was normal on F-0 day. The condition of the left tympanic membrane of the SPT showed slight discoloration but no acute injection at final examination on F-0 day. The last physicals cleared the astronauts for flight.

On 16 November, the crew ate their traditional steak and eggs breakfast and then proceeded to the suit room. As last minute supplements to the board supplies, vials containing scopolamine/dextroamphetamine sulfate (Scop/Dex) and Pro-Eph were placed in each astronaut's suit, as well as 10 chloral hydrate capsules for the CDR and 5 Ornade® capsules for the PLT.

The crew began the oxgen prebreathe at 0537 hours e.s.t. Despite the concern over cracks in the rocket, the launch was highly successful. Maximum heart rates (bpm) noted were:

CDR	SPT	PLT
125	118	125

JSC, with their independent readings, noted the maximums as:

115	118	116

2.2.2 In-flight Crew Health Status

To recapitulate, there were several items in the medical histories and physicals which dictated attention for the upcoming flight:

CDR: Low back pain (lumbosacral strain) experienced in the preflight period and the effect of this on return to one-g.

SPT: Injected left eardrum, which is chronic and variable but not thought to be limiting for flight *per se*.

Multiple prior laparotomies and the presence of adhesions.

Lability of blood pressure which was less than PLT, however.

TABLE 2.2.1-I. MEDICALLY IMPORTANT MICROORGANISMS FROM SOURCE MATERIAL OF SL-4 PRIME CREWMEMBERS

F-0 Days, 16 Nov. 1973 (30 Nov. 1973 Report)		SCALP	EAR	AXILLA	HAND	NAVEL	GROIN	TOES	NASAL	GARGLE	URINE	FECES
Enterobacter aerogenes	CDR					-	-		-			
	SPT					-	-		-			
	PLT					+	+		+			
Escherichia coli	CDR					-	-					
	SPT					-	+					
	PLT					+	-					
Haemophilus parahaemolyticus	CDR									+		
	SPT									+		
	PLT									-		
Haemophilus parainfluenzae	CDR									+		
	SPT									+		
	PLT									+		
Klebsiella pneumoniae	CDR					-						
	SPT					-						
	PLT					+						
Ova and Parasites	CDR											-
	SPT											-
	PLT											-

PLT: History of recurrent nasal congestion, "sinusitis", nasal septal deviation.

High normal blood pressure, lability of blood pressure.

Once in flight the crew had no formal scheduled medical examinations. Data from experiments and "as necessary" medical evaluations were to provide the necessary monitoring of health status.

Although the basic M092-M171/93 experiment package came on three or four day centers, there was always a mission rule which required a heart rate and blood pressure stress evaluation at least every four days for clinical reasons if for some reason the experiments were not able to be run or if they were deleted.

The absence of any major illness or injury was indeed a statistically fortunate event.

There were numerous symptomatic events, however, that required variabl amounts of medication. The medication charts (fig. 2.2.2-1) graphical demonstrate the utilized medication.

For the CDR the initial utilization of medication involved the prescri antimotion sickness medication (Scop/Dex) on MD 1; this is described in detail in section 2.2.2.2. The second major and recurrent use of medication was lip balm on MD 14, and Alpha Keri® cream throughout the mission, as required, to prevent drying of the skin. A sedative was utilized on MD 39 and then was not utilized again until the last two sleeping periods on mission days 83 and 84. Sudafed® was utilized on MD 40 after the EVA. Transient nasal congestion was treated with Sudafed® on mission days 49, 54, 65, and 77, and was utilized again as a decongestant both before and after the last EVA on MD 80. The Afri was used to enhance the effect of Sudafed on MD 80. Afrin® was used prophylactically prior to deorbit on MD 85.

The SPT likewise initiated his medication for motion sickness (Scop/D on MD 1. Sleeping medications were utilized on the following mission days: 8, 33, and 82 (Pro-Eph) and on mission days 37, 49, 59, 63, 71, 75 and finally for the last two sleep periods on mission days 83 and 84 (Dalmane®). Transient headaches required aspirin on mission days 17 and 67. Throughout the mission Alpha Keri® cream was utilized to control dry skin; lip balm was initiated on MD 14 for control of dry lips and used as necessary. Transient nasal congestion required Sudafed® on MD 60 and Afrin® on mission days 62, 74, 75, and 80 (this being an EVA day). Afrin® was used prophylactically on MD 85. A minimal papular rash was noted on mission days 75 through 79 on the left neck and ear area. No medications were used. Wet packs were

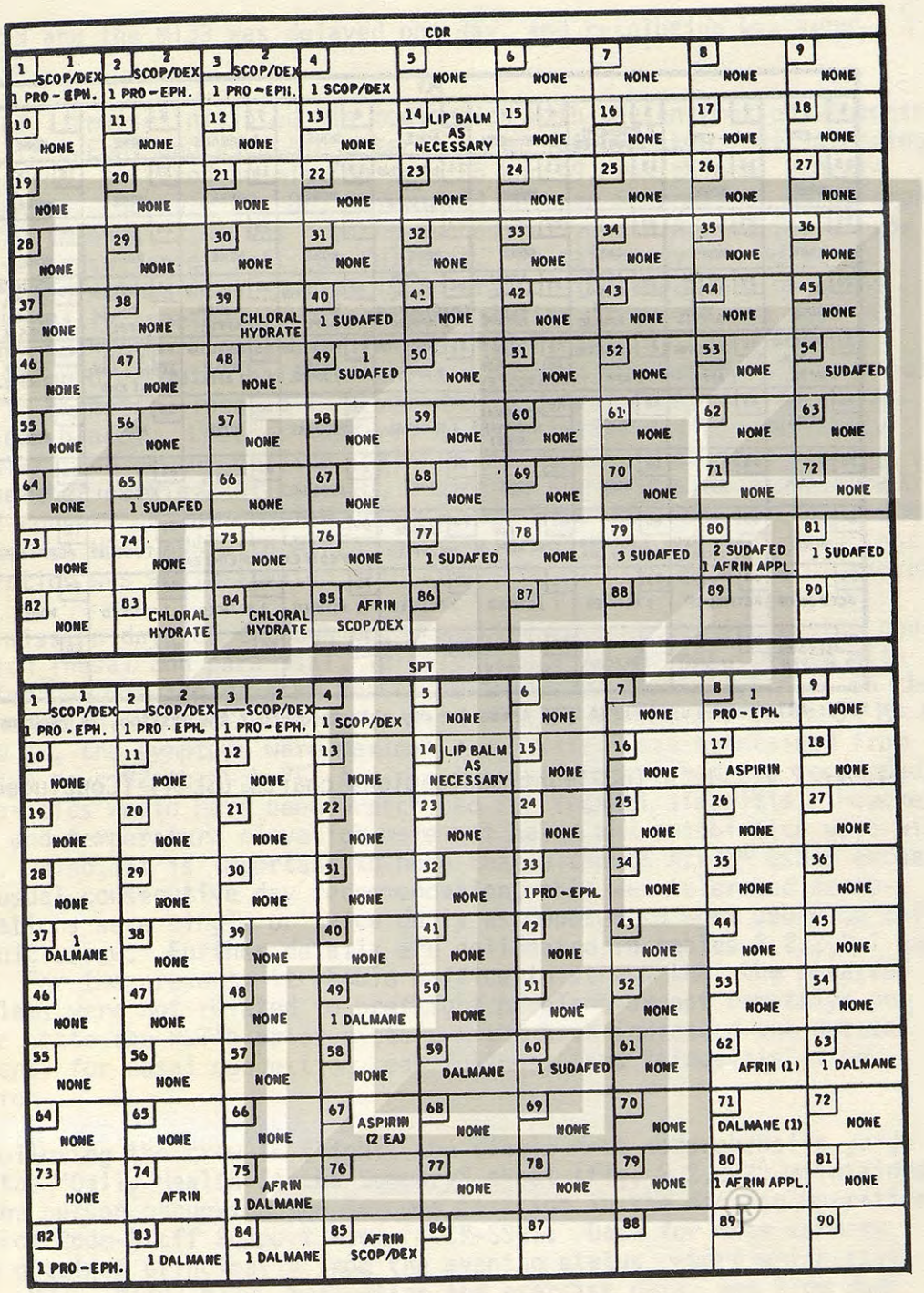


Figure 2.2.2-1. - In-Flight Medications Chart (SL-4).

PLT								
1 3 PRO-EPH.	2 2 PRO-EPH.	3 2 PRO-EPH. 1 SUDAFED	4 2 PRO-EPH.	5 NONE	6 NONE	7 1 ORNADE	8 NONE	9 NONE
10 NONE	11 NONE	12	13 NONE	14 LIP BALM AS NECESSARY	15 NONE	16 NONE	17 NONE	18 NONE
19 NONE	20 NONE	21 NONE	22 NONE	23 NONE	24 NONE	25 NONE	26 NONE	27 NONE
28 NONE	29 AFRIN NASAL DRS 1 APPLIC	30 AFRIN NASAL DPS. 3 APPLIC	31 AFRIN NASAL DPS. 2 APPLIC	32 AFRIN 3 APPL. TINACTIN SOLN 1 APPLIC	33 TINACTIN SOLN. 2 APPL.	34 TINACTIN SOLN. 2 APPL.	35 TINACTIN SOLN. 2 APPL.	36 TINACTIN 2 APPL. 1 CHLORAL HYDRATE
37 TINACTIN SOLN. 2 APPL.	38 TINACTIN SOLN. 2 APPL.	39 TINACTIN SOLN. 2 APPL.	40 TINACTIN SOLN. 3 APL; AFRIN PRE & POST EVA	41 TINACTIN SOLN. 2 APPL.	42 TINACTIN SOLN. 2 APPL.	43 TINACTIN SOLN. 2 APPL.	44 TINACTIN 2 APPL. AFRIN 1 APPL POST EVA	45 TINACTIN SOLN. 2 APPL.
46 NONE	47 NONE	48 NONE	49 CHLORAL HYDRATE (ONE)	50 1 SECONAL	51 1 SECONAL	52 NONE	53 NONE	54 NONE
55 AFRIN	56 NONE	57 NONE	58 NONE	59 NONE	60 1 SECONAL	61 AFRIN (TWICE)	62 AFRIN (1)	63 NONE
64 NONE	65 1 SUDAFED AFRIN 1	66 1 SUDAFED AFRIN (2 APP.)	67 AFRIN (ONE APPL.)	68 AFRIN (2 APPLI.)	69 AFRIN (2 APPLI.) ACTIFED (1 EA)	70 AFRIN (1 APPLI.) ACTIFED (1 EA)	71 ACTIFED (1)	72 ACTIFED (3)
73 ACTIFED (3)	74 ACTIFED (3)	75 3 ACTIFED	76 1 ACTIFED	77 2 ACTIFED	78 1 ACTIFED	79 1 ACTIFED	80 1 ACTIFED	81 NONE
82 SECONAL 1 ACTIFED	83 SECONAL	84 1 SECONAL	85 SCOP/DEX	86	87	88	89	90

NOTE: All crewmen used ALPHA KERI cream for dry skin throughout the mission, as required

Figure 2.2.2-1. - In-Flight medications charts (SL-4) (Concluded).

applied and the M133 was delayed one day, and resolution was spontaneous.

The PLT likewise initiated his medication with the antimotion sickness pills (Pro-Eph) and used Alpha Keri® cream for dry skin. His sleeping medication, utilized on mission days 36 and 49, was chloral hydrate. On mission days 50, 51, 60, 82, 83, and 84 he used Seconal®. On mission days 29 through 32 he was treated successfully with Afrin® for a subjective sensation of left ear fullness. No pathology was noted on objective examination. A rash in an area of the upper mid back was conditionally treated with Tinactin® solution, from mission days 32 through 45, with resolution. The rash was initially described as consisting of about a half dozen areas between a quarter-inch to a half-inch in diameter, located in a vertically linear fashion between the shoulder blades. Lesions appeared to be slightly raised, basically circular, red on the outside, pale in the center, with some scaling, and neither itching, blistering, draining, nor pain were experienced. Nasal congestion was treated on MD 3 with Sudafed®, and on EVA days with Ornade® on MD 7 and with Afrin® on mission days 40 and 44. Transient congestion was again treated with Afrin® on mission days 55, 61 and 62.

From mission days 65 through 80, the PLT complained of increasing congestion (nasal and paranasal, largely frontal). He was treated with Sudafed® on mission days 65 and 66, with Afrin® on mission days 65 through 70, and with Actifed® on mission days 69 through 80, and again on MD 82. On MD 72, the symptoms were maximal and Actifed® was maintained from mission days 72 through 75, t.i.d. If the symptoms had not responded, antibiotics would have been prescribed for frontal sinusitis. However, pain and temperature elevation were not noted and antibiotics were withheld. Also, it is important to note that although Afrin® usage exceeds the usual consecutive day recommendation, this was tolerated as applications were single or twice daily as opposed to what could be called chronic usage. Further details are delineated in tables 2.2.2.2-I and -II. For the present, it should suffice to stress that the observed problems were not related to preflight problems except remotely; one could state the PLT's prior history might have indicated the greater tendency for nasal congestion, ear fullness, and "sinusitis"-like symptoms.

In following the crew in flight, the single most comprehensive guide was the "Daily Health Status Summary" sheet (fig. 2.2.2-2) maintained by the person occupying the Aeromed position in the Mission Operations Control Room-Staff Support Room (MOCR-SSR). Data for this summary were obtained principally from the evening status report which gave M071, M073, M172, M133, medication and exercise data, and from dump tapes and the private medical conference which gave subjective and objective crew observations of their responses to the stressor tests such as M092 and M171 as well as to the general status of living in

DOY 023 MD 69

SL-4

ACTIVITY	MD 68	CDR	MD 69	MD 68	SPT	MD 69	MD 68	PLT	MD 69
Launch Weight (lb)		149.75			157			149	
Daily Weight (lb)	$149.9^{+0.4}$		$149.8^{-0.1}$	$153.6^{+1.0}$		$152.6^{-1.0}$	$145.6^{-0.7}$		$145.2^{-0.4}$
Caloric Intake (Kcal)	3019		3859	2995		3272	3308		3327
Protein g/kg Body Weight	1.508		1.845	1.546		1.526	2.230		1.962
Minimum Minerals		690			750			800	
CA/mg	673(1)		881	817		914	972		922
Minimum P/mg		1450			1500			1450	
	1783		1574	1838		1481(1)	1901		1663
Minimum NA/mg		4000			4100			4200	
	4968		5142	5111		5273	5671		5743
Minimum K/mg		3500			3100			3500	
	3964		3670	3764		2758(2)	3634		3947
H_2O Intake (cc)	2907		MD 67 2448	2862		MD 67 2712	3495		MD 67 4049
Urine Output (cc)	Not Reported		MD 67 2650 (36 h)	Not Reported		MD 67 4000 (36 h)	Not Reported		MD 67 3829 (36 h)
Urine sp. gr.	NOT DONE			NOT DONE			NOT DONE		
Hemoglobin	NOT DONE			NOT DONE			NOT DONE		
Illness or Injury Yes/No	No			No			No		
Medications	None			None			Afrin (2 applications) Actifed (1 each)		
Hours Sleep/Quality	7.5 (6.5 Heavy 1.0 Light			7.5 (6.0 Heavy 1.5 Light			6.0 (4.0 Heavy 2.0 Light		

(Continuation Sheet) DAILY HEALTH STATUS SUMMARY Page 2 of 2

DOY 023 MD 69 SL-4

Yes/No	No	No	No
Medications	None	None	Afrin (2 applications) Actifed (1 each)
Hours Sleep/Quality	7.5 (6.5 Heavy 1.0 Light	7.5 (6.0 Heavy 1.5 Light	6.0 (4.0 Heavy 2.0 Light

DOY 023 MD 69 SL-4

ACTIVITY	CODE	CDR	SPT	PLT
M093 Yes/No	16	Yes	No	No
M171 Yes/No	17	No	No	No
Ergometer:	18	Leg: 28 minutes	Leg: 40 minutes	Leg: 35 minutes
Type/Min/Wt.Min	A	5000 watt minutes	8337 watt minutes	6000 watt minutes
Mark I: Min	19	10 minutes A B C D E	15 minutes A B C D E	08 minutes A B C D E
Type/Rept.	B	40 20 20 20	100 100	50 50 50 50
Mark II: Min	20	08 minutes A B C D E F G H	A B C D E F G H	10 minutes A B C D E F G H
Type/Rept.	C	20 20 15 20		20 20 20 20 20 20
Mark III: Min	21	A B C D E	A B C D E	A B C D E
Type/Rept.	D			
Isometric: Leg Min/Type/ Rept. Neck	22 E	03 minutes A: 10 B: 10 C: 10 D: 10 E: 10 F: 10	A: B: C: D: E: F:	02 minutes A: 10 B: 10 C: 50 D: 50 E: 50 F: 50
Treadmill: Type/Min/Rept.	23 F	W S 10 minutes R T 01 minute 15 min/400 ea	W S R T 15 min/400 ea	W S 10 minutes R T 10 min/400 ea
SYMPTOMS & SIGNS		- Comments only if applicable - Include time of occurrence in G.M.T. - Symptoms & signs noted do not necessarily indicate illness or injury		
General	24			
Skin	25			
Head,Face,Neck	26			
EENT	27			Slight nasal congestion persists
Chest	28			
Abdomen	29			
Back	30			
Extremities	31			
GU/Rectal	32			
Neurological	33			

Figure 2.2.2-2. - Daily Health Status Summary. (concluded)

zero-g. Where appropriate, comments from these sources will be included in upcoming sections of this report.

The only consultation with our Houston based Inflight Medical Support System (IMSS) consultants was during the prolonged nasal and paranasal congestion encountered by the PLT. The weekly Principal Investigator (PI) meetings, initiated from the beginning of the mission, could be looked upon as consultation opportunities for the Crew Surgeons. The inputs of the personnel conducting experiment M093, Vectorcardiogram (sec. 3.6), became especially valuable as the PLT began demonstrating ST changes in the Delta 50 of the M092 around MD 57 and later ST/T changes in the M171 around MD 78. However, these changes, though not fully explained, were not felt to be directly associated with organic cardiac change. The level of detail in the real time reports is clearly demonstrated in exhibit B.

On MD 54 a major review of medical data was carried out to provide Headquarters with useful information for making their go/no-go decision for additional mission extension.

The private air-to-ground medical conference between the crew and the Crew Surgeon allowed the traditional systematic review of body systems and clarifications of crew comments and problems. The private medical conference was inadvertently taped for public distribution on at least three occasions.

The Crew Surgeon conducted the majority of the "comms" up to MD 70; the Deputy Crew Surgeon actively participated in the "comms" prior to MD 70 also. After MD 70, the Surgeon and Deputy left for the PRS, *New Orleans*, and the "comm" was variably conducted by Dr. Ross (Crew Surgeon of SL 1/2) and Dr. Buchanan (Crew Surgeon of SL-3).

MEDICAL DATA PACK FOR EXPERIMENTERS ATTCH #1

VCG

Report Period 0730 MD 58 0730 MD 59

M092: - CDR ___ SPT ___ (PLT) ___ RT (PB) MD 57 DOY 11 TIME: FR. 20/24/58 TO: 20/51/17

REMARKS: VCG playback confirms definite ST segment flattening in Y lead & increase in QX/QT ratio from .4 → .6 at -40 ΔP. During -50 Δp, 0.5mm ST segment depression occured & further increase in QX/QT to .67. When LBNP released ST segment rapidly returned to isoelectric level. Coexistant & Y lead ST depression was a Z lead ST depression, but without straightening. No ectopic beats noted, but junctional

P.I. SIG. _____

~~M093: - CDR ___ SPT ___ PLT ___ RT PB MD TIME: FR. / / TO: / /~~

REMARKS: rhythm (intermittant) again noted during early recovery.

The ST segment changes have not been seen previously, and represent a definite quantitative & qualetative repolarization change. Correlation with exercise tracings is required -

K C Stanton MD

P.I. SIG. _____

M171: - CDR ___ SPT (PLT) ___ RT (PB) MD 57 DOY 11 TIME: FR. 21/06/43 TO. 21/31/40

REMARKS: Not very good technically. Lost both X & Z leads for part of Rest & most of exercise I due to poor electrode contact & amplifier saturation. Y lead unfortunately noisy during exercise, but no significant ST changes noted. In recovery, J point depression & positive (up slope) ST segment noted - this has occured on all previous runs & is normal response. Thus doubt that

P.I. SIG. _____

ST seg change noted in m092 is significant.

K C Stanton MD.

MEDICAL DATA PACK FOR EXPERIMENTERS ATTCH #1

VCG

Report Period 0730 MD 63 0730 MD 64

M092: - CDR__ SPT__ PLT__ RT-PB MD 63-017 TIME: FR. 13 1x/1x3 TO: 14 1x/1x3

REMARKS: Erratic Y axis prior to protocol (loose electrode?) Front end Hi Cal not seen on Y. (Good End Cal however.) Otherwise a very nice run & clean data. No ectopic beats noted. Sinus arrhythmia during recovery phase. Max heart rate = 84 during -50 Δ P. No ST Seg anomalies this run. VCG grossly normal.

P.I. SIG. KC Stanton

[redacted] - CDR__ SPT__ PLT__ RT-PB MD 63-017 TIME: FR. 14 144/10 TO. 5 111/23

Instrumented Exercise

REMARKS: 27 min Exercise - Max HR = 186.

No ST segment anomalies post exercise

HR at termination = 110

P.I. SIG.

M171: - CDR__ SPT__ PLT__ RT-PB MD 63-017 TIME: FR. 14 114/23 TO. 14 143/23

REMARKS: Nominal run - No ectopic beats noted. Sinus arrhythmia in recovery. Max HR = 136. No ST seg anomalies

P.I. SIG. KC Stanton

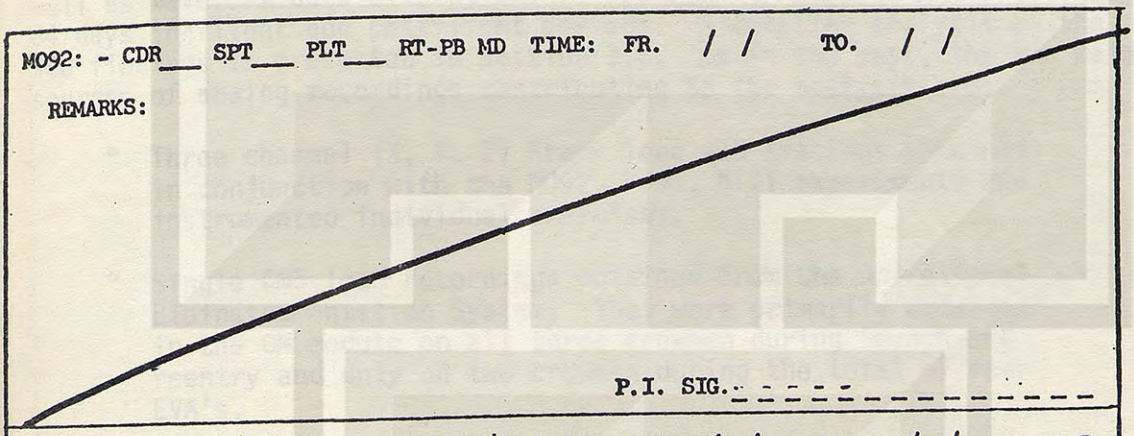
MEDICAL DATA PACK FOR EXPERIMENTERS ATTCH #1

VCG

Report Period 0730 MD 80 0730 MD 81

M092: - CDR___ SPT___ PLT___ RT-PB MD TIME: FR. / / TO. / /

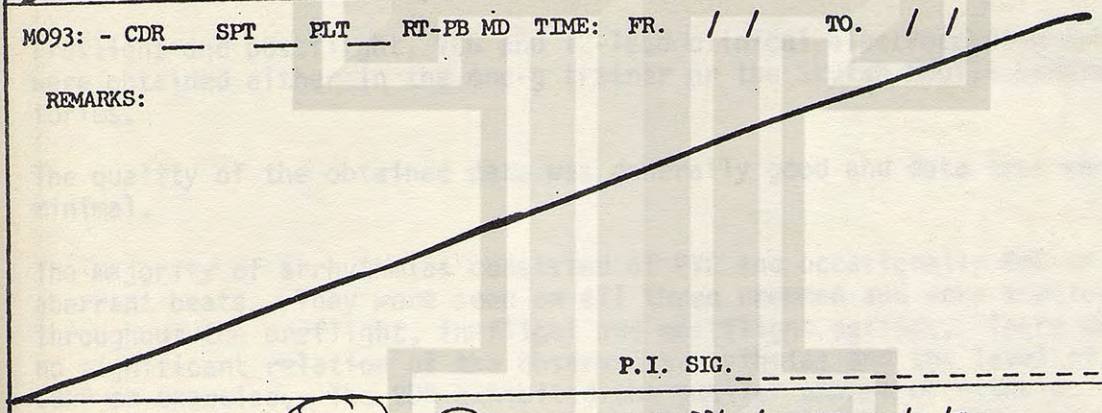
REMARKS:



P.I. SIG._____

M093: - CDR___ SPT___ PLT___ RT-PB MD TIME: FR. / / TO. / /

REMARKS:



P.I. SIG._____

M171: - CDR___ SPT___ (PLT) RT-(PB) MD TIME: FR. 032/22/02 TO. 032/22/30

REMARKS: Several isolated, essentially uniform appearing PVC's noted, primarily in Exercise III which are of little concern. Non-Specific ST flattening and T-Inversion in Exercise III and first 25-30 Secs of recovery are noted but clinical significance is not apparent as yet.

P.I. SIG. D. Riley 13 Feb 74

2.2.2.1 Analysis of cardiac arrhythmias in-flight

A. Nicogossian, M.D.; G. W. Hoffler, M.D.; R. L. Johnson, M.D. and M. M. Jackson, M.S.

This section of the Bioinstrumentation and EVA metabolic assessment will specifically deal with the description of the cardiac rhythm changes as well as waveform data alterations as observed throughout the preflight, 84 days in-flight and postflight periods. A detailed analysis of the VCG findings is presented in section 3.6. As in the past, the two main sources of analog recordings contributing to the analysis are:

- Three channel (X, Y, Z) Frank lead VCG tracings obtained in conjunction with the M092, M093, M171 experiments and instrumented individual exercises.

- Single CM5 lead recordings obtained from the Operational Bioinstrumentation System. They were primarily obtained in the CM module on all three crewmen during launch and reentry and only on two crewmen during the total of four EVA's.

Preflight and postflight, VCG and 12-lead clinical electrocardiography were obtained either in the one-g trainer or the Skylab Mobile Laboratories.

The quality of the obtained data was generally good and data loss was minimal.

The majority of arrhythmias consisted of PVC and occasionally PAC or aberrant beats. They were seen on all three crewmen and were scattered throughout the preflight, in-flight and postflight periods. There was no significant relation of the observed arrhythmias and the level of LBNP or exercise. The CDR exhibited the smaller amount of ectopic beats. Occasional junctional rhythm following release of LBNP was noticed on the PLT. All crewmen exhibited the characteristic response to release of LBNP which consisted of sinus arrhythmia with a heart rate of 40-50 bpm over a 5-10 second period. On several occasions during maximum LBNP and/or third level of exercise nonspecific ST-segment and T-wave changes were exhibited by the PLT.

At the present time the lack of a regular pattern and frequency of occurrence of the observed arrhythmias would speak against an organic lesion.

2.2.2.2 Zero-g adaptation

Jerry R. Hordinsky, M.D.

We will address the initial zero-g adaptation in this section. Each crewman's heart rates at launch or shortly thereafter never exceeded approximately 125 bpm. All remained in good subjective state until docking at which time the PLT had sudden onset of nausea and vomiting. The exact time of docking was achieved at 1602 hours c.s.t. All the crewmen experienced head fullness and headache shortly after insertion; this was fullness one could feel and see. The CDR described it as feeling like a cold; the neck was quite distended. The PLT ate poorly on MD 1; the CDR and SPT were able to eat most of their allotted food, but the time line made eating at the prescribed lunch time impossible. The first antimotion sickness medication was taken after the first phasing adjustment rendezvous maneuver (NC1) by the CDR and at insertion by the SPT and PLT. All three took their second prescribed dose at docking. Because of symptoms, the PLT took a third medication at approximately 2030 hours c.s.t. The SPT did not take one of his mandated medications. The details of the medications used are available in section 3.12, Experiment M131.

Coming at an inopportune time, the crew was inadvertently overheard discussing the withholding of information relating to the PLT's vomitus. Although the crew was initially informed, via the private medical "comm" on MD 2, that withholding this information was ill advised, Dr. Kraft included a short open loop criticism (made by Rear Admiral Alan B. Shepard, Jr.) of the original crew decision. This event, coupled with the early zero-g adaptation symptoms, set the stage for many queries and comments by ground. Fortunately, the crew had saved the vomitus.

On MD 2, the SPT continued to eat everything and had developed no new symptoms. The CDR and the PLT still had "stomach awareness" around mealtime and this resulted in a slightly decreased food intake. On MD 3 the CDR and PLT still had premeal "stomach awareness"; several smaller meals were preferred to three main meals. The head fullness, red face, bloodshot eyes, distended neck veins were present, but decreasing. There was no difficulty in clearing the ears. Exercise was noted to clear some of the above mentioned symptoms.

On MD 4, all the crewmen were free of gastrointestinal symptoms. Subjectively, they felt better as other symptoms also receded. A summary of symptoms and signs beyond this stage is presented in tables 2.2.2.2-I and 2.2.2.2-II.

TABLE 2.2.2.2-I. SUMMARY OF IN-FLIGHT GENERAL MEDICAL REVIEW OF SYSTEMS, THROUGH MD 50

General State: "Expected" problems of adaptation to zero gravity caused the crew to feel pressed early in the mission. They did not want to run at SL-3 level for 84 days, for they felt this might contribute to mistakes. They wanted "winddown" time, and more exercise time. After many inputs to the ground and back-and-forth verbal exchange between ground and crew, a mid-mission request for an operational conference resulted in mutually satisfying results. The crew reported they still felt subjectively "go" for 84 days and intracrew harmony remained good.

	CDR	SPT	PLT
Skin:	Lips, dry. Dandruff. Hands, scaling.	Same as CDR but with perhaps less difficulty with skin on hands.	Basically the same as the CDR. Also fungal type rash on back (MD 32-45).
Head Fullness	Definitely through MD 8 and intermittently noted thereafter. Headache on MD 1.	Definitely through MD 8 and intermittently noted thereafter for several days but definitely denied on MD 44. Headache on MD 1 and on MD 17.	Basically the same pattern as CDR.
Face/Neck:	No symptoms *per se*. Prominent veins and raised cheeks noted.	Same as for CDR.	Same as for CDR.
Eyes:	No changes in vision noted. Eyes injected - MD 1 thru 5.	Same as for CDR. Same as for CDR but injection was most prominent; SPT also commented on sensation of foreign particles on MD 24 and occasionally prior to that.	Same as for CDR. Same as for CDR.
Ears:	Prophylactic usage of decongestant after EVA 2 because of delayed valsalva in early part of EVA. Also increased wax noted on MD 30.	No symptoms were commented on.	Prophylactic decongestant used after EVA 1 and 2. Left ear fullness MD 29-32 without pain, examination negative.
Nose:	Specific comments on sneezing on MD 3, -4, -6. Heightened nasal congestion on MD 49.	No unique nasal congestion except for that present as part of the entire head fullness noted earlier; also some early mission sneezing but	Early mission sneezing. Stuffy and congested enough to take decongestant on MD 4; also used decongestants prophylactically on EVA 1 and 2.

TABLE 2.2.2.2-I. SUMMARY OF IN-FLIGHT GENERAL MEDICAL REVIEW OF SYSTEMS, THROUGH MD 50(concluded)

Nose:	Specific comments on sneezing on MD 3, -4, -6. Heightened nasal congestion on MD 49.	No unique nasal congestion except for that present as part of the entire head fullness noted earlier; also some early mission sneezing but early mission CDR and PLT	Early mission sneezing. Stuffy and congested enough to take decongestant on MD 4; also used decongestants prophylactically on EVA 1 and 2.

TABLE 2.2.2.2-I. SUMMARY OF IN-FLIGHT GENERAL MEDICAL REVIEW OF SYSTEMS, THROUGH MD 50 (concluded)

	CDR	SPT	PLT
Throat:	No soreness experienced. Diminished taste.	Same comments as for CDR.	Same as CDR.
Chest:	No cough. No tightness.	Same as CDR.	Same as CDR.
Abdomen:	Stomach awareness on MD 1, -2, and -3. Sensation of hunger on days of high density food intake. No abdominal pain. Flatus increased.	No zero-g adaptation problems. Rest of sensations correspond to those of the CDR.	Nausea and vomiting one time on MD 1. Stomach awareness on MD 2 and -3. Rest of symptoms correspond to those of the CDR.
Extremities:	No permanent joint or muscle stiffness or soreness. Ground-like stiffness present on starting exercises.	No permanent joint or muscle stiffness or soreness. After toe rises on treadmill, noted calf soreness but build-up of tolerance was good by MD 24.	No permanent joint or muscle stiffness or soreness.
Lymphatic System:	No swellings noted.	Same as for CDR.	Same as for CDR.
Genito-urinary:	No problems. Note ratio of water intake to urine output in last 10 days preflight: 2667/1690 cc, and in MD 41 thru MD 50: 2573/1720 cc.	No problems Note ratio of water intake to urine output in last 10 days 3038/1449 cc, and MD 23 thru MD 32: 3000/1525 cc, and MD 41 thru MD 50: 2982/1775 cc.	No problems. Note ratio of water intake to urine output in last 10 days preflight: 3564/2178 cc, and MD 23 thru MD 32: 3364/2070 cc, and MD 41 thru MD 50: 3172/1810 cc.
Rectal:	No hemorrhoids. No perianal irritation. No diarrhea/constipation.	Same as for CDR.	Same as for CDR.
Neurological:	No paresthesias.	Same as for CDR.	Same as for CDR.
Addendum - Sleep:	Sleeping medication utilized on MD 39. Comparison of sleep: first 10 days of flight, 6.6 hours/sleep period, to last 10 days of flight;* 7.1 hours/sleep period.	Sleeping medication used MD 8, -33, -37, -49. Comparison of sleep: First 10 days of flight, 7 hours/sleep period, to last 10 days of flight,* 7.2 hours/sleep period.	Sleeping medication used on MD 36, -49, -50, -51. Comparison of sleep: First 10 days of flight, 6.4 hours/sleep period, to last 10 days of flight,* 7.0 hours/sleep period.

*Last 10 days in sleep data refers to MD 41-50.

TABLE 2.2.2.2-II. SUMMARY OF IN-FLIGHT GENERAL MEDICAL REVIEW OF SYSTEMS, MD 51-85

General: The crew initiated operational conference proved useful for all; a simple shift to crew control for the hour post sleep and the hour presleep did wonders for their morale.

	CDR	SPT	PLT
(Comments at right are quoted examples, not exclusives)		MD 59: mind wound up. MD 62: tired. MD 71: overtired. MD 63-67: sleep MDA/airlock was too hot.	MD 60: work very taxing mentally.
Skin:	General status of skin good.	General status of skin good. Recurrent scaling of right palm (noted on MD 58). Pressure response medial right toe (MD 54). Neck rash (numerous pimples) (MD 76-79).	General status of skin good. Superficial scratches on hands from cleaning vacuum fans, easily healed (MD 63).
Head/Face/Neck:	Veins filled up. Exercise relieves fullness (noted again on MD 70).	Veins filled up. Generalized headache for 2 hours in a.m. on MD 67, following poor sleep.	Veins filled up. Congestion of forehead noted MD 67. Congestion less on MD 69. Comment, exercise relieves fullness on MD 70. Headache above eyes, noted on MD 70.
Eyes:	Subjectively; near and far vision decreased.	No comment.	Subjectively; near vision down in-flight.
Ears:	Valsalva normal (including EVA).	Valsalva normal (including EVA).	Valsalva normal (including EVA).
Nose:	Nasal congestion with slight headache, MD 54. Nasal congestion on MD 65, and 77 through 81 (EVA on MD 80).	Nasal congestion on MD 60, -62, -74, -75 and -80.	Nasal congestion on MD 55, -61, -62, and -65 through -80 (MD 66 associated with M509 and and on MD 80, with EVA). Associated forehead sensation on MD 67. Head full and slight postnasal drip described on MD 70. Over the hump MD 73. About resolved on MD 73. Lasted 4 d. Actifed taken on

through 81 (EVA on MD 80).

forehead sensation on MD 67.
Head full and slight postnasal drip described on MD 70.
Over the hump MD 73.
About resolved on MD 73.
Last time taken on Actifed

TABLE 2.2.2.2-II. SUMMARY OF IN-FLIGHT GENERAL MEDICAL REVIEW OF SYSTEMS, MD 51-83 (concluded)

	CDR	SPT	PLT
Mouth/Throat:	No difficulty with teeth, comment of MD 58.	No difficulty with teeth, comment of MD 58.	Toothbrush too soft.
Chest:	No pathological symptoms noted by any of the crew.		
Abdomen:	MD 66: No change in food likes. MD 51: Stomach bouncing into chest. MD 63: Hungry; could eat more.	MD 66: No change in food likes. MD 51: Treadmill bounces stomach into chest. MD 63: Hungry; could eat more.	MD 63: Hungry and could eat more.
Back/Extremities:	MD 51: Stiff and then feels good after first couple of exercises.	MD 51: Calves occasionally sore after toe rises	No problems.
Lymphatic System:	No lymphatic problems or swellings for any of the crew.		
Genito-Urinary:	Comment on MD 56: night urination occurred only 2-3 times during the entire mission.	Comment on MD 56: night urination occurred only about once in three weeks.	Same as SPT.
Rectal:	No diarrhea or constipation; only problem was the long time required for defecation and the associated clean up procedures.		
Neurological:	None of the crewmembers developed paresthesia.		
Sleep:	Medication required on MD 83, MD 84.	Medication required on MD 59, -63, -76, -82, -83, -84.	Medication required on MD 51, -60, -82, -83, -84.

2.2.2.3 Activation of Skylab

Additional requirements for implementation into the Activation Checklist were made approximately one month before lift off; this necessitated redrawing of the activation time line and the following priority items were added:

- PT - mandatory to be in the time line every day starting with day 2.
- Biociding - mandatory before activation and living in orbital workshop (OWS).
- Girth measurements and manual blood pressures (BP) are highest priority.
- SWS Food - might delay to obtain some of the higher priority medical data.
- Photos and center of gravity (CG) determination - lowest priority.

Activation tended to remain rushed from the crew's point of view. Mission day 4, which was to have been the crew's day off, was a busy work day. Required medical measurements took a good portion of the time in this early phase. Crew comments revealing their feelings of pressure during this early phase are illustrated in the following extracts taken from the records.

324:20:46:57 SPT "This is the SPT, with a general comment on medical experiments. I think we're gaining speed and will be able to accomplish these things with perhaps a little more accuracy and a little more speed as we gain more familiarity. One factor that is causing us to start off slow is the relatively small amount of training, in some cases no training, that we have had on some of the additional experiments. They're all good things to be doing and we're glad to have them on board, but bear with us because we haven't had any training on some of them, and very little on others; include facial photos, IR (infrared) photos, limb measurement, blood flow and stereo photos. We'll try and keep you posted on how we're carrying these things out."

324:04:49:16 CDR "This is the CDR at 04:49 Zulu. The subject is time utilization. The main addressees for this would be the FAO's (Flight Activities Officer), I think - looking back over the week that stands behind us, the best word I can think to describe it is frantic. I think it's too bad that we have to put ourselves in this kind of a posture where we're just breaking our necks trying to get a lot of stuff done. It would have been a whole lot better, I think, at least for our morale if for nothing else, if what took us a week could have been spread into two weeks, because the biggest time consumers we had were finding things. Because we were not really familiar with - with locating everything."

329:04:50:16 CDR "And I think body positioning was also a time consumer. Getting to where you wanted to go and then anchoring yourself, and then getting what you needed and learning to cope with your new environment just takes a great deal of time. I think you could probably tell from our voices that we were very, very frustrated, and becoming very irritated, out about day 5 or so. Because we just for*** no matter how hard we tried, and how tired we got, we just couldn't catch up with the Flight Plan. And it was a very, very demoralizing thing to have happen to us."

In the actuality of operations, the crew "lost time" was made up at the expense of their eating and exercise time. Enlightenment from this SL-4 experience points up the advisability of easing the schedule by ground personnel when they recognize that the crew is showing signs of being over pressured. All of the Skylab crews have been conscientious and rather compulsive about trying to complete all ground-assigned tasks. We have observed that these essentially "good" traits can only add to feelings of frustration and pressure when adapting to the unique conditions characteristic of null gravity.

2.2.2.4 Environmental profile

There were no environmental problems in maintaining the parameter limits of total pressure, oxygen, and carbon dioxide as delineated in the mission rules. The mission rules provide for the following parameters.

***indicates missing word(s).

The maximum sustained $ppCO_2$ for mission continuation is 7.6 mm Hg. The maximum emergency excursion, not requiring mission termination is 15 mm Hg. This maximum should not be held for more than three hours.

The minimum nominal allowable ppO_2 is 170 mm Hg given a total cabin pressure above the nominal minimum of 248 mm Hg.

The minimum sustained ppO_2 for mission continuation in a contingency is 145 mm Hg given a total cabin pressure above 248 mm Hg.

The minimum emergency excursion not requiring mission abort is a ppO_2 of 128 mm Hg given total cabin pressure above 248 mm Hg. This minimum should not be held for more than three hours.

Total pressure was intentionally increased by pumping up oxygen prior to M509 runs to compensate for the nitrogen generated by the equipment. Plots of oxygen and total pressure are available in section 1.2, figure 1.2-1.

Other parameters as temperature and relative humidity were more flexible and these parameters became of significant concern around MD 60 when high Beta angles resulted in temperatures rising above 80° F (27° C) with onset of concurrent crew discomfort and problems of potential off-gassing from the heated spacecraft wall. The temperature variations in the OWS during the mission are depicted in graphic form in figure 2.2.

The OWS average gas temperature is computed by taking the average of the following four OWS temperature sensors (they appear in Manual Selection Keyboard [MSK] 0537), as given on SWSH dwg. 5.6.

Sensor No.	Name
1. C7032-437	SLP CMPT CEIL T
2. C7123-437	WR CEIL T
3. C7122-437	EXP CMPT CEIL T
4. C7040-437	EXP CMPT CEIL 2T

Medical Mangagement Team considerations relative to just what temperatures would be tolerated are delineated in exhibit C. Operational attachments presented by flight planners to avoid exceeding these thermal stresses are included as exhibit D. It might be added that early in the mission the temperatures were on the warm side also, but it was only in this latter January phase of the mission that temperatures above 80° F were predicted and specific maneuvers were actively planned to abet the rising temperatures.

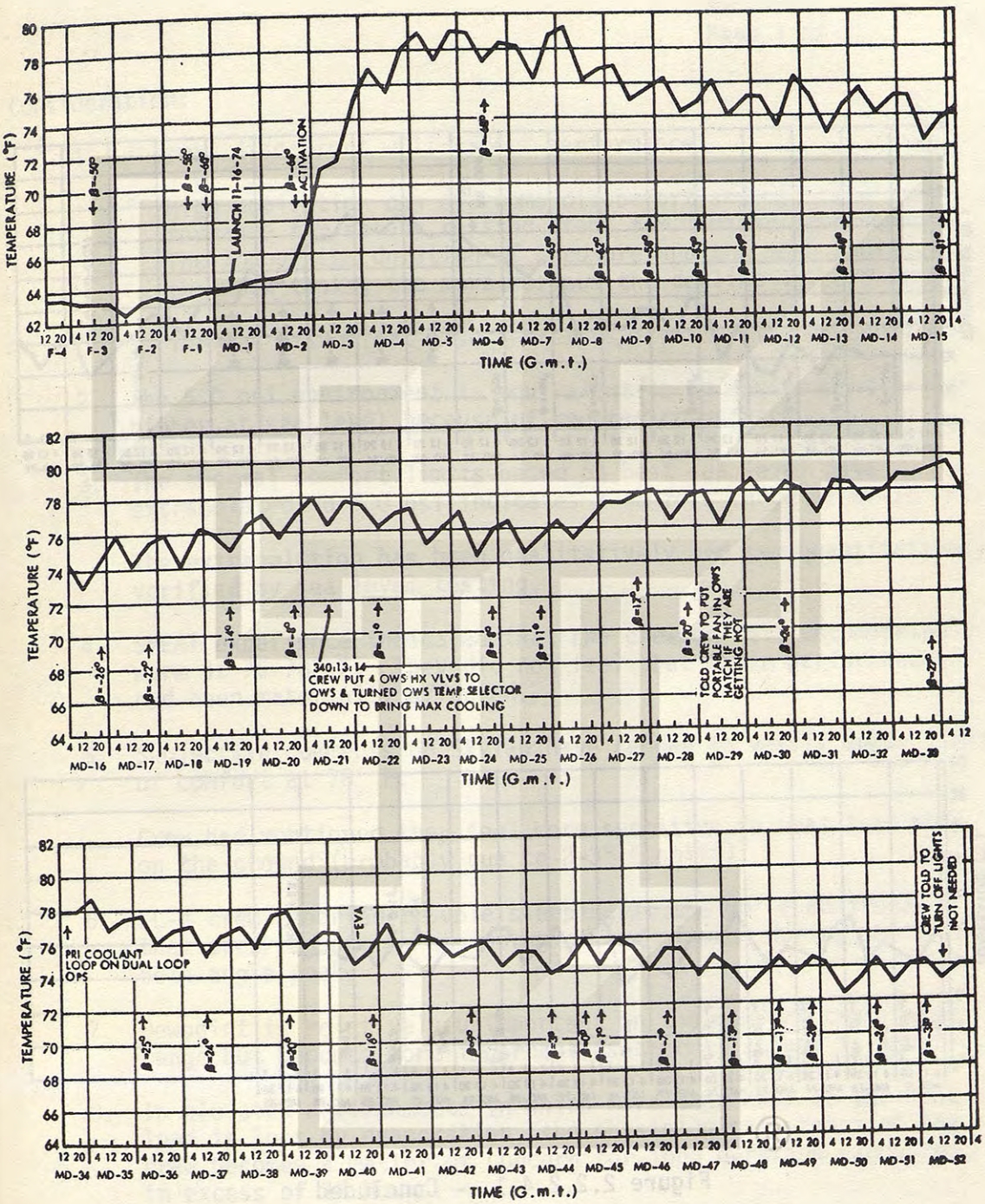


Figure 2.2.2.4-1. - OWS Average Temperatures (SL-4).

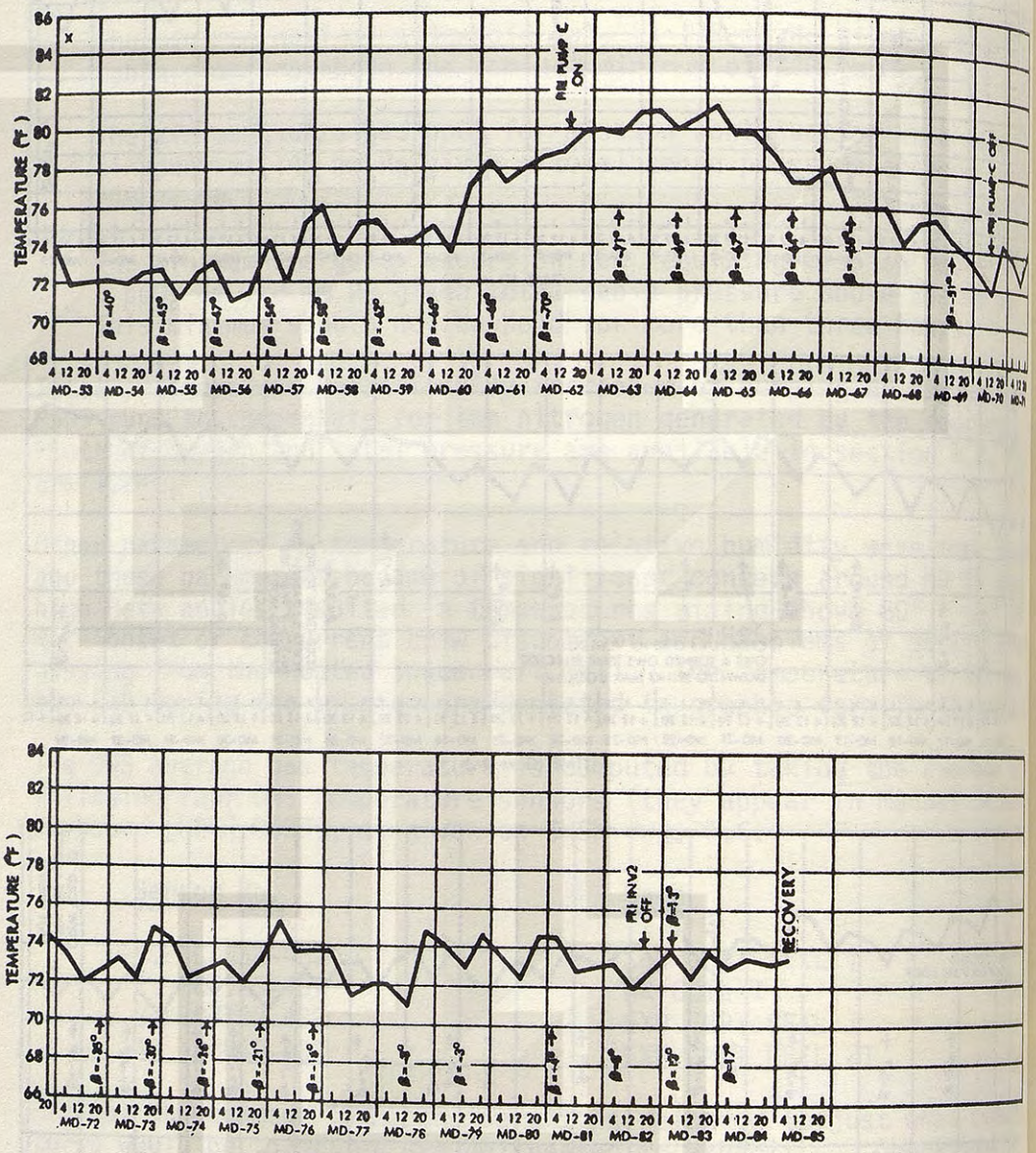


Figure 2.2.2.4-1. - Concluded

Consideration:

1. Thermal discomfort will affect performance.

   ° High motivation can overcome discomfort and maintain performance for safety related items for limited time periods. The longer the duration of exposure and the more routine the work tasks, the more serious the decline in performance.

   ° Thermal discomfort also increases irritability of people.

2. The 5.0 psi environment is equivalent to an environment 2-3° F higher at sea level because of reduced convection.

3. The thermal comfort limits based on best sea level data extrapolated to 5.0 psi indicates a comfort range of 67-78° F.

   The extrapolation has been qualitatively and semiquantitatively verified by sea level testing.

4. SMEAT experience indicated that the crewmen felt uncomfortably warm at 76-78° F. They did not feel that their performance had been materially affected.

5. Subjective comments on Skylab have tended to verify upper limit of comfort at 78° F.

   Crew had mentioned they feel more sensitive to heat than when on the ground (probably due to 2-3° F shift).

6. SL-4 crew reported trouble sleeping in the 80° F environment that occurred at the beginning of the mission during the first Beta angle peak.

7. Dewpoint is relatively unimportant in the comfort temperature range but becomes more important as thermal stress is applied.

8. In elevated environments in which more than half of the heat load is lost by evaporation, the physiological status of the crew becomes a matter of concern for long duration exposures, in excess of 12 hours.

9. At temperatures up to 80° F the crew can be expected to maintain a near normal work schedule with some tolerance of discomfort above 78° F.

10. From 80° to 85° F crew performance can be expected to interfere with work performance, sleep, and morale. A flexible crew controlled schedule would be advisable if this exposure is necessary. Physiological impairment of the crew would not be expected. Because of the effects of zero-g on the cardiovascular system, real-time evaluation is essential.

11. Above 85° F crew performance could be expected to be seriously affected. If this exposure cannot be avoided, severe restriction of workload should be required, and there would be concern about possible physiological effects from possible lack of water balance, dehydration and reducted cardiovascular tone.

- Recommend that we maintain temperature below 80° F, if possible.
- If temperature exceeds 80° F, we should proceed on a crew reduced limited schedule.
- We should keep temperature below 85° F if at all possible

DAY 0 1 90 90 0

S7170 TELEPRINTER LOAD TABLE 1 1481 1481
GMT 014:08:04:06

LOAD NO. 4001 MSG NO MSG TITLE LGTH ORIG/CODE
TOTAL LINES 46 6062 1 GM-OWS TEMPS 46 CRL/FC3
SITES GWM/
LOAD AT SITE YES

062 1 GM-OWS TEMPS 60/014
----------ALL----------
HERE ARE SOME GENERAL COMMENTS
ON THE OWS THERMAL SITUATION
TO BE EXPECTED IN THE NEXT
WEEK OR SO, UNTIL THE BETA
ANGLE DECREASE BEGINS TO HELP:
1. THE MAXIMUM OWS AVERAGE
INTERNAL TEMPERATURE IS
PREDICTED TO BE 88 DEG F
ON DOY 19 CONSIDERING THE
MAXIMUM NUMBER OF PROPOSED
EREP MANEUVERS POSSIBLE.
IF NO MANEUVERS WERE DONE,
THIS MAX TEMP WOULD BE 83.
DEG F. UNTIL DOY 19, THE
EFFECT OF EACH MANEUVER IS
TO ADD ABOUT 0.6 DEG F.
2. THOUGH THESE TEMPS ARE
SLIGHTLY HIGHER THAN PRE-
VIOUSLY EXPERIENCED, THE
OWS SHOULD BE DRY AND IT
IS NOT EXPECTED TO BE TOO.
UNCOMFORTABLE FOR WORKING.
WE WILL RELY ON YOU TO
GIVE US REGULAR SUBJECTIVE
OBSERVATIONS. HERE ARE
SOME ITEMS WE ARE CONSIDER
ING THAT MAY HELP:
A) ATTEMPTING TO SCHED-
ULE OWS ACTIVITIES IN
MORNING HOURS WHEN IT
IS COOLER IN THE OWS,
AND DO MDA ACTIVITIES
IN THE EVENING. THE
OWS WARMS UP ABOUT 1.
TO 3 DEG F DURING THE
DAY, DEPENDING UPON
MANEUVERS.
B) INSTALL THE PORTABLE
FAN IN THE OWS DOME
SUCH THAT AIR IS PUL-
LED FROM THE OWS TO-
WARD THE OWS HEAT
EXCHANGER IN THE 4FT.
COMPARTMENT.

86 DAY 0 1 0 4 YR 7 4 0

S7171 TELEPRINTER LOAD TABLE 2 1482 1482
GMT 014:08:01:40

LOAD NO. 4101 MSG NO MSG TITLE LGTH ORIG CODE
TOTAL LINES 32 6062 2 GM-OWS TEMPS 32 CRL FC3
SITES /
LOAD AT SITE

C) SLEEP IN THE AM/MDA . 01
IF THE OWS IS TOO . 02
UNCOMFORTABLE. . 03
D) CURTAIL MANEUVERS . 04
AND MINIMIZE HI IN- . 05
TENSITY LAMP USEAGE. . 06

4. THE OWS AVERAGE INTERNAL TEMP, CONSIDERING PROPOSED MANEUVERS, IS PREDICTED TO RETURN TO 80 DEG F BY DOY. 24.

6062 2 GM-OWS TEMPS . EOM

86 DAY 0 1 0 YR 7 5

S7174 TELEPRINTER LOAD TABLE 5 1485 1485
GMT 017:01:08:10

LOAD NO. 4401 MSG NO MSG TITLE LGTH ORIG/CODE
TOTAL LINES 42 6339A GM-THERMAL 42 MW /FC
SITES /
LOAD AT SITE

```
6339A  GM-THERMAL CONT  63/017
--------------ALL--------------
FOLLOWING ARE SPECIFIC GUIDE-.
LINES TO IMPLEMENT THE OWS   .
THERMAL CONTROL PHILOSOPHY OUT
LINED IN MSG 6062.           .
                             .
 SYSTEMS OPERATIONS:         .
  1. OPERATE BOTH PUMPS IN PRI
AM COOLANT LOOP.             .
  2. MINIMIZE POWER USAGE IN-.
SIDE OWS-TURN OFF AS MANY    .
SIA'S AS PRACTICAL; REDUCE   .
LIGHTING, ELIMINATE USE OF   .
HIGH INTENSITY LIGHTS EXCEPT .
WHEN REQUIRED BY FLIGHT PLAN..
PLEASE VOICE RECORD NUMBER OF.
SIA'S YOU TURN OFF AS A RESULT
OF THIS EFFORT. OTHER SUGGES-.
TIONS APPRECIATED.           .
                             .
 FLIGHT PLANNING:            .
  1. ALL M092 RUNS IN MORNING.
  2. NO MANEUVERS IF RESULTING
OWS TEMP HIGHER THAN 82 DEG AT
TIME OF M092 RUN OR IF RESULT-
ING TEMP ABOVE 85 DEG FOR LONG
ER THAN 3 HOURS.             .
  3. IF OWS TEMP ABOVE 82 DEG.
MINIMIZE OWS ACTIVITIES, CON-.
CENTRATE ON MDA.             .
                             .
 CREW OPTIONS:               .
  1. SCRUB ANY EXPERIMENT AC-.
TIVITY WHEN CREW JUDGEMENT IN-
DICATES REST REQUIRED. REDUC-.
ED MEDICAL PROTOCOLS WILL BE .
CONSIDERED IF REQUIRED.      .
  2. SLEEP IN MOST COMFORTABLE
LOCATION.                    .
-----------------------------
6339A  GM-THERMAL CONT      EOM
```

The IMSS was not exposed to any significant temperature elevation in SL-4.

The sleep compartment maintained a reasonable temperature profile except for the high Beta period in mid January at which time the SPT slept in the Airlock Module from MD 63 through MD 67.

An example of environmental parameter displays available to mission control in real time are attached as exhibit E.

Low relative humidity during the mission tended to hasten drying of the skin. The SPT also commented on how rapidly the blood dried in the finger stick hemoglobin technique.

Normally, there was appropriate airflow. However, the placement of the air vents in the sleep compartment caused the SPT and the CDR to have cold feet at night. To keep their feet warm, the CDR wore the lower half of his union suit and the SPT wore one or two pairs of sox. The PLT expressed the need for adequate airflow in the sleep compartment to keep cool but felt it made him "stuffy".

The airflow was essential to dispersal of odors. The crew found their food generated a great deal of persistent odoriferous flatus.

Other odor problems were present. Selected sites generally associated with urine handling were malodorous. The synthetic material used in crew clothing became odorous after a day's usage, and they did not have enough clean clothing at hand to change all items daily. The crew complained about the uncomfortable feel of the synthetic material when it became wet with perspiration, and they strongly recommended use of more absorbent cotton materials in clothing for future space travel.

The shower was reported to be broken on MD 77, but this had no significant operational impact. Cleanliness was maintained quite well with the shower or sponge baths. The former, while more efficient, was found to take twice as long, 45 minutes to an hour. The crew objected to the smell of the soap which they compared to "dog shampoo". They found the suction head of the shower to be insufficiently flexible to flow over the body smoothly for removal of water, and they complained of "freezing" as they had to float over several updrafts to reach their clothing.

Urine and fecal management were generally satisfactory although clean up procedures were considered too lengthy.

S7845A M071/M073 ENVIRONMENT 1 1221 1221

GMT 018:11:46:56
AMT 002:11:46:56
SITE/DATA ID CRO

C7000	URINE CHILL 1	45.3	DEGF	
C7002	URINE CHILL 2	44.5	DEGF	
C7004	URINE CHILL 3	44.8	DEGF	
C7006	URINE FRZR	-6.7	DEGF	
C7298	FOOD CHILL	41.0	DEGF	
C7284	WR FRZR 1	-9.4	DEGF	
C7285	WR FRZR 2	-6.7	DEGF	
C7281	FOOD FRZR 1	-2.8	DEGF	
C7282	FOOD FRZR 2	-2.7	DEGF	
C7283	FOOD FRZR 3	-1.2	DEGF	
L7008	H2O TANK 1 Q	102	LBS	
L7009	H2O TANK 2 Q	H	LBS	
L7010	H2O TANK 3 Q	56	LBS	
L7011	H2O TANK 4 Q	120	LBS	
L7012	H2O TANK 5 Q	H	LBS	
L7013	H2O TANK 6 Q	667	LBS	
L7014	H2O TANK 7 Q	123	LBS	
L7015	H2O TANK 8 Q	308	LBS	
L7016	H2O TANK 9 Q	566	LBS	
L7017	H2O TANK 10 Q	85	LBS	
D0205	N2 REG SUPPLY	150	PSIA	
D7137	ESS AMB PRESS	5.33*	PSIA	

C0207	DEWPOINT	49	DEGF
C0215	DEWPOINT	55	DEGF
D0237	O2 PART PRESS	4	PSI
D0239	O2 PART PRESS	-0	PSI
D0240	O2 PART PRESS	4	PSI
D0209	CO2 PART PRESS	4	MM
D0213	CO2 PART PRESS	4	MM
D7111	OWS PRESS 1	5.48	PSI
D7112	OWS PRESS 2	5.36	PSI
D0002	MDA PRESS ABS	5.60	PSI
D0207	AM FWD TO AMB	5.67	ΔP
D0217	AM LOC TO AMB	5.64	ΔP
D0218	AFT TNL/AMB	5.64	ΔP
C7164	DUCT 1 GAS	82	DEGF
C7166	DUCT 2 GAS	76	DEGF
C7308	DUCT 3 GAS	79	DEGF
C7256	SLEEP CMPT IN	79	DEGF
C7032	SLEEP CEILING	81	DEGF
C7094	SLEEP WALL	86	DEGF
C7255	EXP COMPT IN	79	DEGF
C7144	WARDROOM IN	79	DEGF
C7142	WMC GAS OUT	79	DEGF
C0246	AM AFT TUNNEL	0	DEGF
C0018	MDA COMPT	71	DEGF
C0019	MDA COMPT	83	DEGF
C7311	ESS AMB TEMP	60*	DEGF

*

Illumination levels were found to be generally adequate throughout but interior reflections made looking out of the window difficult.

Noise levels presented problems. While the OWS was reported to be extremely quiet, there were periodic noise irritants from the Apollo Telescope Mount (ATM) coolant pumps, rate gyros, Thruster Attitude Control System (TACS) firings, and the Mark I exercise. Verbal communications were impacted by several problems. The intercom boxes squealed; in addition, the SPT remarked he could not find a good lightweight headset or a good microphone.

Although there was a threat of it during the high Beta angle period, no toluene diisocyanate (TDI) or carbon monoxide (CO) problem occurred during the mission; details regarding toxicology are discussed in section 2.16.

The crew also commented, in view of the anticipated high incidence of *Staphylococcus aureus* on board, that there were no obviously dirty areas in the OWS. Maintaining clean surroundings was generally feasible. Food spills were hard to deal with because food was difficult to remove from the open grid work with its little pieces and sharp corners. The liquid cooled garments (LCG's) were a selective contamination site by fungus; this is detailed in section 2.13 of this report. Fungal samples were taken for postflight analysis, and the LCG's were cleaned of fungal growth.

Other in-flight observations: The crew commented on several miscellaneous observations where activities were impacted by zero gravity.

The PLT had a continual problem with nasal congestion in this environment and noticed that the supply of tissue seemed to be running out. He also observed the collection of a great deal of solid materials at places, such as fans, diffusers, *et cetera*, having a "sucking surface" and suggested that these surfaces have or be provided with a trash bag to collect the solid waste material.

The SPT was frustrated from the difficulty of finding the proper pens in the MDA/STS and also found working in the area very difficult because one had to move his head at a bad angle.

At zero-g, items tended to float off if they were not anchored and sometimes they were not found again. This happened with some of the SMS weights and some of the medication. The crew found that they too would drift away if they did not anchor themselves to the spot where they wanted to stay. Once outside the reach of a restraint, time was lost in ineffectual struggling.

2.2.2.5 Exercise

The following exercise devices were available to the crew of SL-4: the bicycle ergometer; the Mark I, an isokinetic force generating pulley; the Mark II, springs; the Mark III, the standard Apollo exercise device; and the treadmill and isometrics. More complete details about these devices are to be found in section 2.4.

The first exercise was performed by the crewmen on MD 3. The first treadmill exercise was initiated by the CDR and PLT on MD 8. The Mark III was not utilized to any significant degree except after the third Mark I failure on MD 80.

The crew took about three weeks to stabilize their respective exercise protocols. The standard for their respective exercise protocols is attached as exhibit F. Subsequent to this, modifications were made as per crew request. The crew wanted to keep their allotted 1-1/2 hours of exercise time as a single block; they objected to exercising after meals, found that breaking their exercise into two 45-minute periods required two separate clean-up times, and noted that the bicycle ergometer needed to cool down between uses so they could not use it in close succession. All this created flight planning restraints but the crew felt their exercise to be as important as the experiments.

About midway into the mission proposals were made to decrease the exercise time. Some of the ground personnel felt this contributed to tiredness and others wanted to selectively pull one man off his exercise to see the effect on the medical data. The Crew Surgeons felt strongly that the exercise time was inviolate. Medical status report number 44, figure 2.2.2.5-1, affirms the status of the exercise time.

Subsequent to this flurry, the SPT did drop approximately one-half of his standard protocol on a random basis. Throughout the mission, however, the crewmen had the option of fully dropping their exercise if they felt exceptionally tired as they did, for example, on MD 77. These considerations revealed that exercise should have been monitored as precisely as food intake and waste output and not left quite as loosely directed as it was. Had we started the mission with a systematic exercise regimen, then any deviations in-flight could have been structured more systematically. The crewmen were faithful in performing their exercise protocols. Several times during the flight, the crew did maximum effort instrumented work on the bicycle ergometer and the data indicated in-flight conditioning. The crew did not favor instrumented work on the other exercise devices, although they did give a couple of performances on the treadmill. Muscles used and stimulated by exercises performed at one-g were difficult to use and exercise at zero-g; the only equipment to work these muscles were the Mark I and

FLIGHT DIR MISSION LOG Aeromed	DAY	REV	PG

SITE/ACQ/LOS	FLIGHT EVENTS/HISTORY/BRIEFING
12:25	The following is the standard exercise that each
	crewmember will perform each day. We can assume
	negative reporting as the crew plans to report only
	deviations.
	CDR: A = Leg 30 min/5000 watt minutes
	B = A,D,E,F 10 min/20 repetitions ea
	C = C,D,F 06 min/20 repetitions ea
	E = A & B 03 min/10 repetitions ea
	F = Walk - 10 minutes
	Run - 01 minute
	Spring- 02 min/300 repetitions ea
	Toe Rises - 03 min/200 repetitions ea
	SPT: A = Leg 40 min/8337 watt minutes
	B = B, Curls - 20 min/100 repetitions ea
	F = Spring - 10 min/1000 repetitions ea
	Toe Rises - 10 min/200 repetitions ea
	PLT: A = Leg 35 min/6000 watt minutes
	B = A,B,D,E -08 min/50 repetitions ea
	C = B,C,D,E,F,G - 10 min/20 repetitions ea
	E = A & B - 02 min/10 repetitions ea
	F = Walk - 10 minutes
	Spring - 01 min/100 repetitions ea
	Toe Rises - 01 min/75 repetitions ea
	The above information is extracted from Dump Tape
	346-04 thru 346-06.

JSC Form 1441 (Apr 68)

FLIGHT DIRECTOR'S MISSION LOG

A=Ergometer C=Mark II (fig.2.4.3-6) E=Isometrics-AB= Thigh Adduction/Abd
B=Mark I (fig.2.4.3-5) D=Mark III (fig.2.4.3-5) F=Treadmill Isometrics

SL-4 MEDICAL STATUS REPORT NO. 44 DAY OF YR 363/64

A. CREW HEALTH

The crew remains in good health.

B. MEDICAL PROBLEMS AND PROPOSED SOLUTIONS

No significant medical problems exist.

Regarding exercise, it is understood that tomorrow's reduced exercise follows from the constraints of the JOP18 procedure; although flight plans or crew preference may result in occasional exercise time modification, there is at present no agreed to plan for systematic reduction of exercise time.

C. REMARKS

- The EVA was not associated with any medical problems.
- The persistent skin dryness (controlled by creams) and rare head fullness are two current observations.
- On high density days, the crew feels subjectively hungrier, although by objective tabulation all nutrients are adequate.

REPORT TIME:
(MSC LOCAL) 9:30 p.m.

Figure 2.2.2.5-1. - Medical Status Report.

the treadmill and neither device was completely satisfactory. The P summed up in-flight muscle use with the following succinctly expres observations: "Zero-g can work against you as well as for you. It tends to straighten you up, so if your posture is a crouched-over o bent-over position at the waist, then your expending extra energy a zero-g is hurting you."

2.2.2.6 Eating

Meals were important events. Like the SL-3 crew, the SL-4 crew noti that they became fatigued quickly if they did not eat on time. The taste of food was altered, but in general, what was liked on ground still enjoyed in zero-g. The high density food used every three day did not pose any unique problem(s) although the crew commented that continued to feel hungry on those days even though their dietary nee were satisfied. The PLT observed that the high density food lacked hedonic appeal and tended to be detrimental to morale. Available to the crew was a pool of extra foods from which they were allowed to supplement with minimal restriction; such supplementation became noticeably frequent after midmission. The crew did complain of bei rushed in their eating, especially early in the mission. The SPT fo the containers of seasoning difficult to use as the seasoning leake out many times or the drop ran up the side of the container. The CD found the hunched position of eating to be uncomfortable and suggest that the food table be at chest height. He also commented on the packaging of food in cans which he thought did the job, but because the possibility of being cut by the sharp edges of the open can, he suggested other ways be found to package the food.

2.2.2.7 Work/rest (Quantity and Quality)

The work/rest cycle was a key problem in this mission. Since approv of the extension in the mission duration to 84 days and the resulting changes in mission requirements came too late to meet publication dea lines, the preparation of a final-type flight plan was not issued although summaries of the changes in mission requirments were prepare and available under limited distribution prior to liftoff.

The following pertinent provisions are extracted from the Crew Sched section of the Flight Plan Notes to illustrate some of the crew scheduling requirements planned preflight. A typical crew day was t provide:

- Eight hours of sleep
- A typical crew duty day lasting 10 hours and 45 minutes with each crewman scheduled for one-half hour during the duty day for personal hygiene, in two 15 minute blocks.

- Each crewman was scheduled for 1-1/2 hours of exercise each day which could be broken into two 45 minute sessions. The exercise period was always followed by personal hygiene (PH). (The objections the crew had for separating their exercise period into two 45 minute increments are discussed in section 2.2.2.5.)

- Day off every seven days (±2).

- No crew activities were scheduled on days off except ATM, EREP, housekeeping, flares (real time), M071, reentry stimulations, debriefings, and crew actions required for T003.

- During the first 14 days of the mission, all housekeeping tasks were to be specifically scheduled. After the 14-day period only housekeeping tasks lasting longer than 30 minutes were specifically scheduled and the remaining tasks were listed for the crew to perform at their discretion during the specified day.

- During the first 14 days of the mission additional time, over and above times from end-of-mission SL-3 crew experience, are to be provided for all major crew tasks. After this period scheduling times revert to best estimates from SL 1/2 and SL-3 experience.

At too early in the mission, the crew was required to follow a scheduling pace comparable to the one set by SL-3 crew only later in their mission. By MD 10 the crew expressed the normal frustrations associated with getting behind in assigned time lines. Speeding up led to errors which compounded the feeling of frustration. In addition, the crew requested at least one hour of separation between eating and personal exercise.

The problem continued as evidenced by the following extract taken from the SL-4 Medical Status Report on MD 34.

> "There are still very significant comments from the crew describing the hurried response required by the flight plan. The crew's dissatisfaction seems to be based on their desire for more emphasis on more quality than quantity, but there is no evidence that any of the dissatisfactions represent either depression or difficulty in adjusting to the length of the mission. The crew apparently is expecting further accommodation to their request."

The air-to-ground conference on MD 45 summarizes the earlier problem clearly and the prelude to it is therefore included as exhibit G. In the operational conference the CDR indicated the crew's willingness to split the exercise session into two 45-minute segments whenever it became necessary, but not all the time. He also proposed that morning post sleep time be reduced from one and a half to one undisturbed hour to take care of morning clean-up, weighing in and breakfast and that the one hour presleep be free of interference from ground.

The following are excerpts from the air-to-ground operational conference with the CDR and CAPCOM as participants.

Cap Com: "Since the accomplishments listed at the first appear somewhat low compared to the premission plan we think there's two very important points that need to be made about this plan and I'll be very honest with you, they have not been completely discovered until the last couple of days, when we took the trouble to get a bunch of numbers out and I think you'll be interested in them. First of all, there've been a whole number of changes between the premission plan and the real world of SL-4 mission and I'd like to tick some of them off for you. After the plan was made we instituted and intensified the Kohoutek program. Our TV requirements are much heavier, it's turning out in the mission, than they were listed in the plan. There were no science demos scheduled, there were no hand held photos and observations. Furthermore, there's another significant difference that has only just now dawned on us as to the way the missions were accomplished during that two-week period which was a critical one. During Al's mission, we essentially were scheduling flight plans and increasing the workload on those guys as they asked for it. Because we remembered the latter part of SL-3 mission, we planned to up your workload to 28 hours after about 2 weeks. And so essentially, we were scheduling Al for a workload that he was accomplishing and then increasing it as he asked for it. For you, we were asking for 28 hours and due to lost events or being late here and there, we were getting a little bit less than what we were asking for. But the two missions essentially, the total that we were getting from each of you was - turned out to be almost exactly the same. At that time, which was about 10 days or so ago, maybe 2 weeks, we've been scheduling you for 24 hours of science per day, that does not include PT. Incidentally, the numbers that we took out of the two missions

Operations Conference Background

```
S7170          TELEPRINTER LOAD TABLE 1          GMT 1481/364:22:37:04

  LOAD NO. 4001      MSG NO  MSG TITLE   LGTH ORIG/CODE
  TOTAL LINES 44     4538 1  GM-OPS CONF   44   PS /FC1
  SITES /
  LOAD AT SITE

4538 1 GM-OPS CONF          45/364 |01|  THE ACCOMPLISHMENTS ARE LESS
----------CDR----------------------|02|THAN PLANNED FOR EREP, MEDICAL
   ACCOMPLISHMENTS SUMMARY .       |03|AND COROLLARY FOR TWO REASONS:
                                   |04|(1) SPACECRAFT SYSTEM PROBLEMS
  EREP PASSES: OF 24 PASSES IN     |05|(PRIMARILY THE CMG'S), AND (2)
THE PREMISSION SCHEDULE, 14 .      |06|SCHEDULING LESS SCIENCE MAN- .
HAVE BEEN ACCOMPLISHED. THIS .     |07|HRS/DAY THAN WE EXPECTED. .
WILL REDUCE THE TOTAL PLANNED.     |08|
FOR THE MISSION FROM 50 TO NO.     |09|  OUR PRELAUNCH PLAN FOR SL-4.
MORE THAN 40.                .     |10|ASSUMED THAT WE WOULD SCHEDULE
                             .     |11|ABOUT 22 HRS/DAY OF SCIENCE. .
  ATM: YOU HAVE ACCOMPLISHED .     |12|FOR THE FIRST 2 WEEKS AND THEN
153 HRS OF DATA TAKING COM-  .     |13|28 HRS/DAY AFTER THAT. BY .
PARED TO 123 HRS PLANNED. THIS     |14|MD 26 WE WERE SCHEDULING 26 TO
INCLUDES KOHOUTEK.           .     |15|27 HRS/DAY, BUT IT WAS NOT .
                             .     |16|WORKING WELL AND WE REVERTED .
  MEDICAL: 196 HRS HAVE BEEN .     |17|TO ABOUT 24 HRS/DAY. THIS IS .
ACCOMPLISHED TO DATE COMPARED.     |18|SIGNIFICANTLY LESS THAN WHAT .
TO 228 PLANNED.              .     |19|WE HAD PLANNED PREMISSION. .
                             .     |20|
  COROLLARY: 140 HRS HAVE BEEN     |21|
ACCOMPLISHED TO DATE COMPARED.     |22|
TO 235 HRS PLANNED. THIS IN- .     |23|
CLUDES KOHOUTEK SCIENCE.     .     |24|
                             .     |25|
```

S7171 TELEPRINTER LOAD TABLE 2 1482
GMT 364:22:37..

LOAD NO. 4101 MSG NO MSG TITLE LGTH ORIG/CODE
TOTAL LINES 41 4538A2 GM-OPS CONF 41 PS /FC1
SITES /
LOAD AT SITE

THE SCIENCE ACCOMPLISHMENTS.	01
FOR THE HRS INVESTED IS SOME-.	02
WHAT LOWER THAN WE EXPECTED. .	03
FOR INSTANCE WE EXPECTED EREP.	04
PREP TO BE REDUCED TO AN HR BY	05
NOW, AND THE TIME TO SHIFT .	06
FROM ONE TYPE OF ACTIVITY TO .	07
ANOTHER TO BE ALMOST NON-EX- .	08
ISTENT. WE ALSO HAD EXPECTED .	09
TO STOP SCHEDULING ROUTINE HK,	10
BUT WE HAVE NOT FOUND THIS TO.	11
BE VERY TROUBLESOME TO OUR .	12
FLIGHT PLANNERS. .	13
.	14
THE SCIENCE ACCOMPLISHMENTS.	15
PER HR INVESTED HAVE ALSO BEEN	16
REDUCED BY OTHER FACTORS SUCH.	17
AS THE CMG PROBLEMS. THIS HAS.	18
INCREASED THE MANEUVER TIMES .	19
FOR KOHOUTEK AND EREP, AND HAS	20
ALSO REQUIRED EXTRA HRS TO .	21
PROVIDE THE MONITORING FUNC- .	22
TION BY A SECOND CREWMAN. WE .	23

MANEUVERS IF YOU FEEL COMFOR-.	01
TABLE (WE DO). .	02
.	03
WE HAVE FOUND THE UNBROKEN .	04
PT TO BE EXTREMELY TROUBLESOME	05
IN PUTTING TOGETHER EVERY .	06
SINGLE FLIGHT PLAN. IT PRODUC-	07
ES ERGOMETER CONFLICTS AND .	08
LOSS OF GEOMETRIC OPPORTUNI- .	09
TIES (ATM, EREP, KOHOUTEK, .	10
S019, S183, S063, ETC) BECAUSE	11
IT PRODUCES SERIAL ACTIVITIES.	12
THAT CONFLICT WITH CREW AVAIL-	13
ABILITY AND VEHICLE STABILITY.	14
REQUIREMENTS. WE ALSO FIND THE	15
CONSTRAINT BETWEEN TIME OF .	16
	17
	18
	19
	20
	21
	22
	23

S7172 TELEPRINTER LOAD TABLE 3 1483
GMT 364:22:37..

INCREASED THE ... FOR KOHOUTEK AND EREP, AND HAS ALSO REQUIRED EXTRA HRS TO ... PROVIDE THE MONITORING FUNC- ... TION BY A SECOND CREWMAN. WE ...

S7172 TELEPRINTER LOAD TABLE 3 1483
GMT 364:22:36.

LOAD NO. 4201 MSG NO MSG TITLE LGTH ORIG/CODE
TOTAL LINES 44 4538 3 GM-OPS CONF 44 PS /FC1
SITES /
LOAD AT SITE

EATING TO TIME OF PT TO COM- . 01
POUND THE PROBLEM. THE EAT- . 02
WAIT-UNBROKEN EXERCISE SE- . 03
QUENCE IS A LONG TIME SEQUENCE 04
THAT BECOMES VERY DIFFICULT TO 05
PLACE RELATIVE TO THE GEOM- . 06
ETRIC OPPORTUNITIES. IT MAY BE 07
SUPRISING BUT, THE INEFFICIEN- 08
CY OF MULTIPLE PH'S RESULTING. 09
FROM MULTIPLE PT PERIODS CAN,. 10
IN MANY CASES, PRODUCE A MORE. 11
EFFICIENT SCIENCE DAY BECAUSE. 12
WE CAN TAKE ADVANTAGE OF THE . 13
OPPORTUNITIES AS THEY COME. . 14
. 15
IN THE AREA OF PSA, THE . 16
QUANTITY DOESN'T BOTHER US . 17
MUCH, BUT THE REQUIREMENT FOR. 18
UNBROKEN PRE AND POST SLEEP . 19
ALSO CAUSES US THE SAME KINDS. 20
OF PROBLEMS AS THE UNBROKEN . 21
PT. WE WOULD LIKE TO BE ABLE . 22
TO TRADE SCIENCE OPPORTUNITIES 23
THAT POP UP IN PSA FOR FREE . 24
TIME DURING THE DAY. THIS . 25

WOULD ALSO EASE OUR MOMENTUM . 01
MANAGEMENT PROBLEMS. WE DON'T. 02
DISAGREE WITH THE PSA TIMES WE 03
ARE USING NOW FOR FLIGHT PLAN- 04
ING BUT THE RIGIDITY WE NOW . 05
USE IN KEEPING THIS AS CLEAN . 06
AS POSSIBLE COUPLED WITH THE . 07
UNBROKEN PT FORCES US TO DO . 08
DIFFERENT SCIENCE THAN WE . 09
WOULD DO IF BOTH COULD BE . 10
BROKEN. . 11
. 12
WE HAVE SEVERAL THINGS FAC-. 13
ING US IN THE FUTURE. AS THE . 14
KOHOUTEK WORK DECLINES, THE . 15
EREP WORK BEGINS TO PICK UP. . 16
IN THE PERIOD FROM MD 47 TO . 17
MD 50 EARLY WAKEUPS WILL BE . 18
REQUIRED TO ACHIEVE SOUTH . 19

S7173 TELEPRINTER LOAD TABLE 4 1484 1484
GMT 364:22:39:19

LOAD NO. 4301 MSG NO MSG TITLE LGTH ORIG/CODE
TOTAL LINES 46 4538 4 GM-OPS CONF 46 PS /FC1
SITES /
LOAD AT SITE

AMERICAN AND AFRICAN PASSES. .
FROM MD 50 TO MD 53 STAYING UP .
LATE WILL BE REQUIRED FOR .
JAPANESE PASSES. BEGINNING .
MD 64 EARLY WAKEUPS WILL AGAIN .
BE REQUIRED FOR EUROPEAN AND .
AFRICAN PASSES. THE CONUS .
PASSES BEGIN MD 50 AND EXTEND.
THROUGH MD 78 DURING OFFICE .
.
HRS. .
.
OTHER FLIGHT PLANNING CHGS .
WE HAVE TO LOOK FORWARD TO ARE .
REVERTING TO 3+/-1 DAY INTER-.
VAL FOR MAJOR MEDICALS ON MD60 .
WE'RE CURRENTLY SCHEDULING AT.
4 MINUS 1 PLUS 0 INTERVALS. .
THE INCREASED FREQUENCY WILL .
REDUCE AVAILABLE TIME FOR .
OTHER ACTIVITIES. .
. .
BECAUSE OF THE HIGH GEOME- .
TRIC ACTIVITY WE'RE STARTING .
TRIC COM WITH SIMULTANEOUS .

TUNITIES WE HAVE EXCLUDED M509
AND T020 FROM COMPETING FOR .
TIME UNTIL AFTER MD 60. .
.
SO FAR WE HAVE TRIED TO IM-.
PLY THAT OUR FLIGHT PLANNING .
PROBLEMS ARE NOT A RESULT OF .
NEW REQUIREMENTS OR CHANGED .
REQUIREMENTS BUT A RESULT OF .
THE EXISTING CONSTRAINTS AND .
IT'S GOING TO GET WORSE, AT .
LEAST UNTIL KOHOUTEK IS OVER..
.
THE DECLINE OF KOHOUTEK .
SHOULD ALSO ALLOW US TO BE .
MORE EFFICIENT WITH SAL MAN- .
AGEMENT SINCE WE WILL BE ABLE.
TO REDUCE THE EQUIPMENT SHUT-.
TLING IN THE SAL. SAL UTILIZA-
TION WOULD ALSO BE IMPROVED BY
ALLOWING OPERATION IN PSA. .

S7174 TELEPRINTER LOAD TABLE 5 1485 1
GMT 364:22:39:

OTHER ACTIVITIES.

BECAUSE OF THE HIGH GEOME-
TRIC ACTIVITY WE'RE STARTING
INTO WITH SIMULTANEOUS

21 ALLOWING OPERATION IN PSA.

S7174 TELEPRINTER LOAD TABLE 5 1485
GMT 364:22:39:

LOAD NO. 4401 MSG NO MSG TITLE LGTH ORIG/CODE
TOTAL LINES 18 4538 5 GM-OPS CONF 18 PS /FC1
SITES /
LOAD AT SITE

```
                                .  01
  IN SUMMARY, WE ARE CONFIDENT  02
THAT YOU WILL CONTINUE TO RE-.  03
DUCE THE TIME REQUIRED FOR    .  04
ACTIVITIES, AND THAT THIS WILL  05
INCREASE THE SCIENCE OUTPUT   .  06
WITHOUT NECESSARILY INCREASING  07
THE NUMBER OF HRS REQUIRED.   .  08
                              .  09
  OUR TWO BIGGEST FLIGHT PLAN-  10
NING PROBLEMS ARE THE UNBROKEN  11
PSA (NOT THE TOTAL AMOUNT OF  .  12
FREE TIME) AND UNBROKEN PT.   .  13
                              .  14
LET'S TALK ABOUT EACH OF THESE  15
ITEMS THIS AFTERNOON.         .  16
-------------------------------  17
4538 5 GM-OPS CONF          EOM  18
                                 19
                                 20
                                 21
                                 22
                                 23
                                 24
                                 25
```

were based on the same kind of tally. We didn't use different ground rules, and since the last two weeks you've stayed completely up with our flight plans, or ahead of us, and as far as we're concerned, these last two weeks have been just going smooth as glass, with regard to getting done what we scheduled and we think it's a lot smarter flight planning."

CDR: "I really thought I'd made it plain to people that we did not intend to operate at that kind of pace because for a mission that was going to be an extra 28 or so days longer, it seemed to me we had to go for endurance not for max performance right at the beginning. I think one other area that you did not mention that was not preplanned or not in the mission plan, and that was all these medical tasks that we had, the limb volumes, the girth measurements and all that stuff we received little or no training and had never seen the stuff before. So that really turns into a time user. I might also add, too, that we very definitely felt the pressure come off about 10 days ago when you guys shifted gears down there. And I'll tell you, it was a very welcome event.

"We feel like we're doing a more efficient job up here. We feel like we're making less mistakes per man hour than we were when we were under the gun earlier. Two things pre-flight that came into mind was this hour and a half exercise thing that was recommended by the SL-3 crew, and I still think it's a darn good idea. Another thing prelaunch that we lost, and I'm very sorry we lost it, and that was the Day-4 day off. When we lost that day off we had no way, we had no slack left to catch up and the whole mess started snowballing on us and as you can see it took us nearly two weeks to get back up on the step."

Cap Com: "We have talked about this [exercise splitting] several times before. I know you guys have been bugged about it because we've asked you six or seven times and I'm sure you've wondered if we were never getting the word. But the simple reason that we've kept asking you is because it's given us so much trouble."

CDR: "I think the reason why we started hollering is there was just getting to be too much of the [busy presleep time], almost every night. We were running almost until bedtime."

CDR: "O.K., we got no quarrel whatsoever with the early or late EREP's, we're acquainted with the problems there and we've been ready from D-1 to play that game."

Cap Com: "Along this line again when we go to talking about flight planning like I mentioned to you yesterday, we think it's a lot better to talk about it on the air-to-ground than on the voice dump."

CDR: "O.K., we'll sure do it that way from now on."

Cap Com: "Right, and at the time and at least on the day it's bothering you so you'll be talking to the team that did it to you and you guys can have it out."

CDR: "Of course, it's been my feeling that we really do up here need to work at the fastest and most efficient pace. It looks to me now like we're approaching it from the right direction. I think our problem at the beginning was we started too high, and what we need to do is just ramp up to it until we get to the best level and then maintain that. Also, I think as I mentioned to you that a guy needs time - some quiet time to just unwind if we're going to keep him healthy and alert up here. If you keep him healthy and alert, you're going to keep him efficient and that's going to help."

The above quoted interchanges between the Cap Com and the CDR pointed up the necessity of making timely usage of the crew inputs in the future, and it was through modes such as this operational conference that mutually satisfying rules are established. The rest of the mission proceeded at a more even and emotionally satisfying pace.

Although the following observations by the crewmen were made in relation to their frustrations with impacted schedules, they are included here because they are interesting for other reasons as well and should not be lost in dead-filed data.

On MD-13 the CDR made the following two separate comments:

> "I was making a point that in spite of all the training we've had, we were still surprised when we got here. There were quite a few reasons, and most of them were not equipment problems. There were some stowage problems. Things were not stowed where they were supposed to be stowed. We got ourselves into a mode of having to ask the ground where everything was. In some cases the ground pointed out places - proper places where they were stowed, and in other cases, we just had to look for the things until we found them."

> "One of the most serious problems in activation was learning how to restrain ourselves, how to hold ourselves down in order to do a task. That's something that you could only learn, apparently, by experience. You could think about it and anticipate it all you want, but when you get up here in zero-g, it's a whole new world. And you just got to learn to get used to it; and it takes time. So everything we did took two to three times as much time as we thought it would take."

On MD-45 the PLT said the following when talking about relaxation:

> "I get more kick out of looking out the window and having time to look out the window than having good optical equipment."

On the same day, the CDR made the following comments regarding relaxing activities:

> "The only off-duty activities in the Kit that we've even had the chance to use is the music and the books. I have read one and one-half books. I'm busy working on my second book right now. My favorite off-duty activity is looking out the window with a pair of binoculars and just watching the Earth go by, and I'll never tire of that; I think that's the most relaxing and enjoyable off-duty activity that I could possibly do."

On MD 49, the SPT expressed views as follows:

> "Up here our days off, the only thing that's different is we get to take a shower. I flat have not had a chance to do anything. I guess the only think I've done that's not called out in the flight plan is to make sketches of the comet. I guess the only other piece of recreational equipment I've had is a couple of books that I've been reading - just light novels that help me wind down at night when I climb into the sack."

And on MD 66, the SPT projected his thoughts to the Shuttle program with the following:

> "There are several things up here which keep us, I think, enthused about the type of work that we are doing and make us look forward to the days when we get up. All of those things involve the use of judgment in one form or another. One prime example of that is the ATM, of course, where you're continually challenged by the displays you have in front of you to make judgments on how, when, where to take the data to bring the highest quality back. Another one is visual observation out the window. There is just a wealth of knowledge to be gained looking out the window and with a report and/or a photograph. I think a thought for the future that when you're planning payloads, you'd better not plan on having the guys strictly push the knob, pull the crank, strictly by the checklist type item, where you find your mind is getting completely bored and then performance level going down. We need something which challenges a guy mentally, not in the way of busy work, but in the way of human judgment.

On MD 61 the CDR highlighted another problem of long missions:

> "We had forgotten a lot of stuff that we had done in training and so we messed around quite a bit before we got it figured out."

The impact on satisfactory rest was seen in the number of sleeping me tions taken, although it must be stressed that the actual number did indicate a concern for habituation. The minor sleep disruptions for early EREP and occasional late Kohoutek or rocket observations were generally dispersed throughout the mission and compensatory sleep tim was made available.

It is good that no large circadian shift was effected significantly prior to splash. Long discussions were held preflight and early in- flight on just how to accommodate the approximately 10-hour circadian shift required. With thoughts of crew safety uppermost, there was active consideration given to effecting a gradual circadian shift with completion a couple of weeks prior to the end of mission and then main- taining this altered state for a few days (approximately seven) post- flight. The crew and their surgeons preferred taking the shift change as a large unit at the end of the mission. This was favored by the experimenters at JSC also. Accordingly, the crew was kept on Houston time (except for the premature shift to c.d.t. on 1 January), and a short shift forward was effected for the sleep period on MD 83, after which midday sleep on MD 84 was allowed. This proved an excellent way to go as there was no inordinate fatigue on recovery day. These details are delineated in the attached End of Mission Planning Summary as figure 2.2.2.7-1.

Sleep patterns, total sleep time and subjective quality for the mission are attached as figure 2.2.2.7-2 (see also figs. 1.2-18, -45, -46 and sec. 3.13). The sleep environment was satisfactory with few exceptions (sec. 2.2.2.4), and the sleeping bag was considered highly effective by the PLT.

A survey of accomplishments and some major events is attached as figure 2.2.2.7-3 to display the "work" done by the crew.

2.2.2.8 Psychological status

Overall, the psychological status of the crew was good. Undoubted stressors were the zero-g adaptation and the rushed activation, also failure to respond to the crew's inputs for a reduced schedule early in the mission, and particular sequential and impacting errors by the crew early in the mission. Despite these stressors, the crew's performance improved to SL-3 levels once ground took proper cognizance of the crew's requests.

Maintaining a healthy psychological status was assisted by regular family calls. Window viewing and hand held photography were found to be exceptionally interesting, pleasant, and relaxing, also.

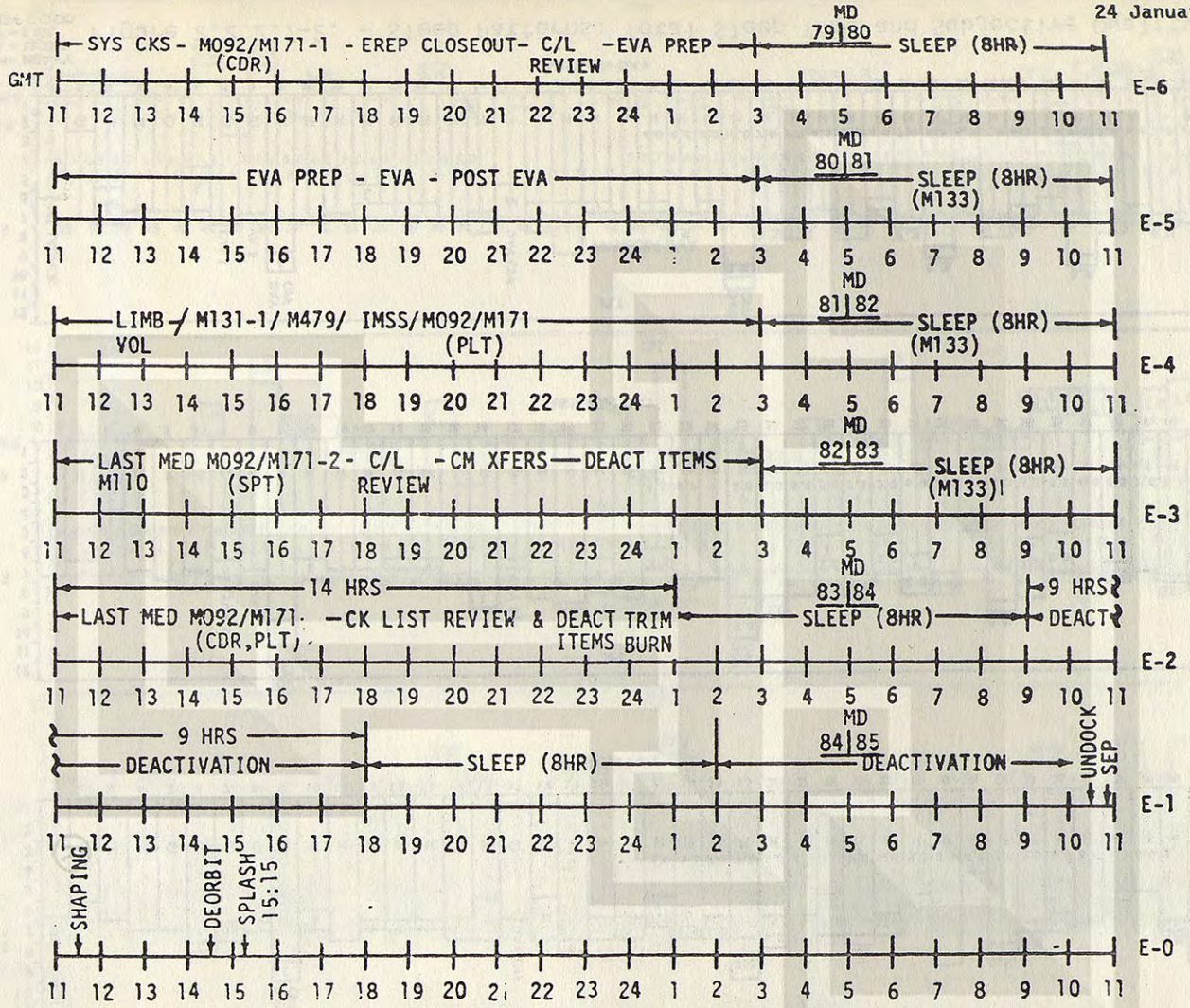
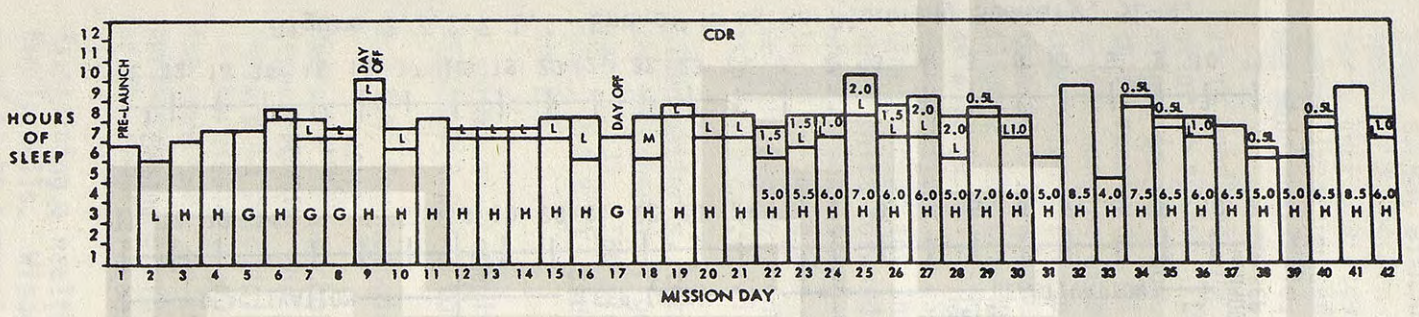
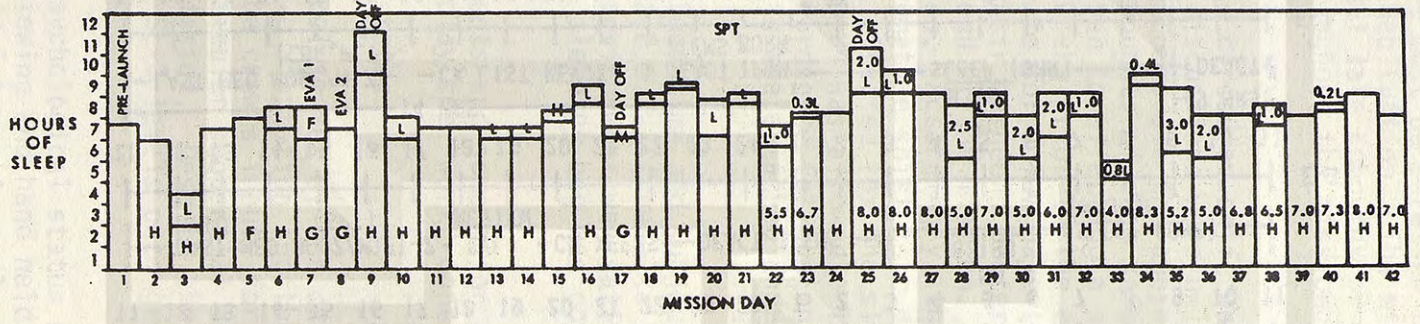
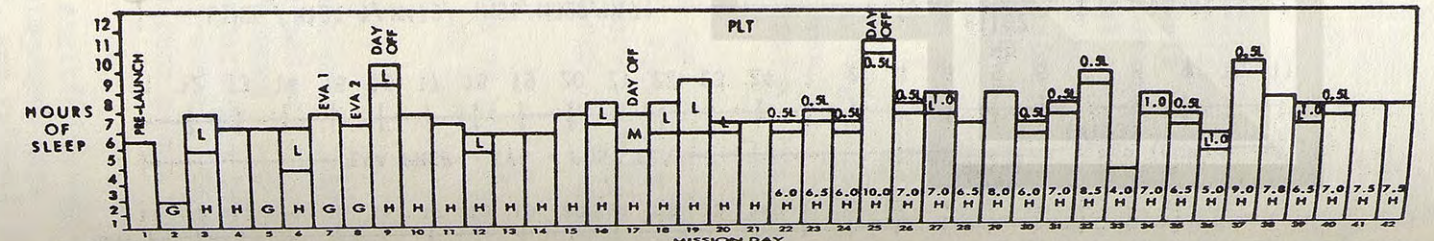


Figure 2.2.2.7-1. - End of Mission Planning Summary, SL-4.

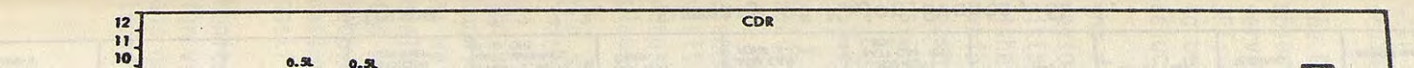


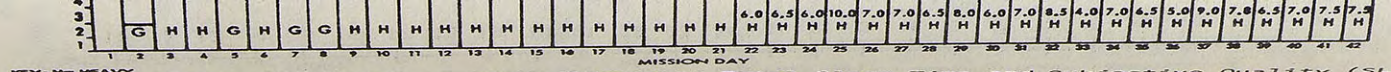




KEY: H= HEAVY
M= MODERATE
L= LIGHT

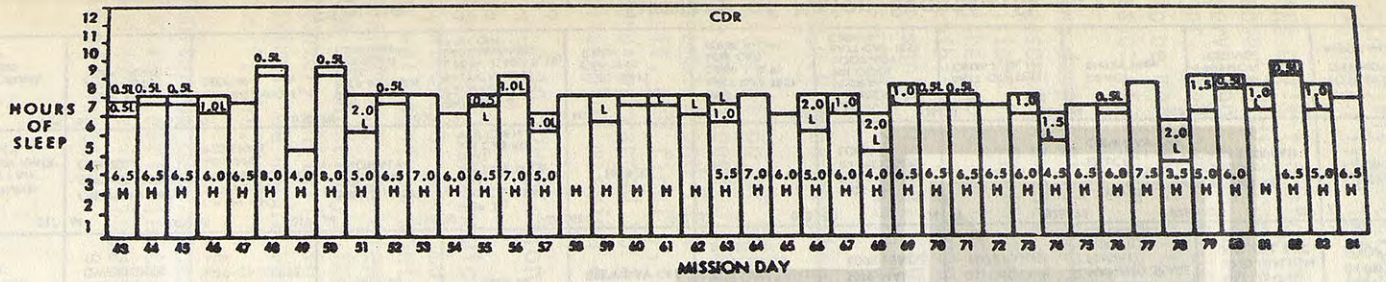
Figure 2.2.2.7-2. - Sleep Patterns: Total Sleep Time and Subjective Quality (SL-4).

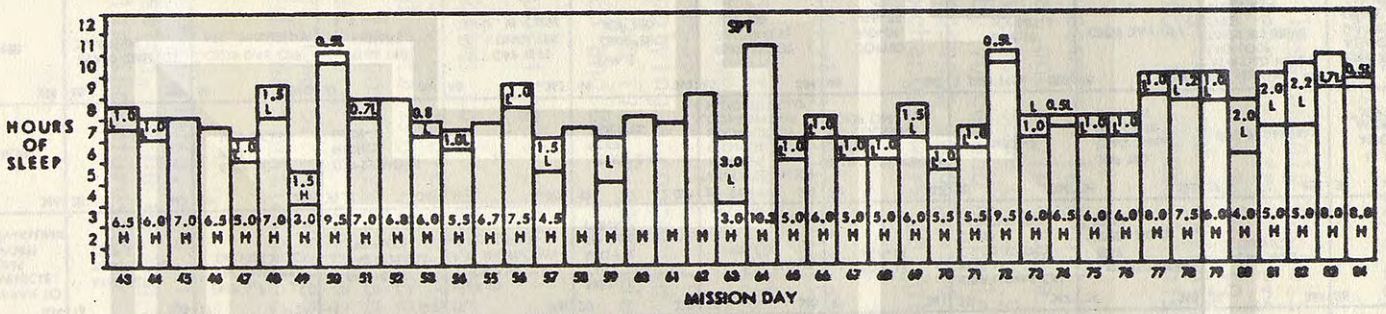


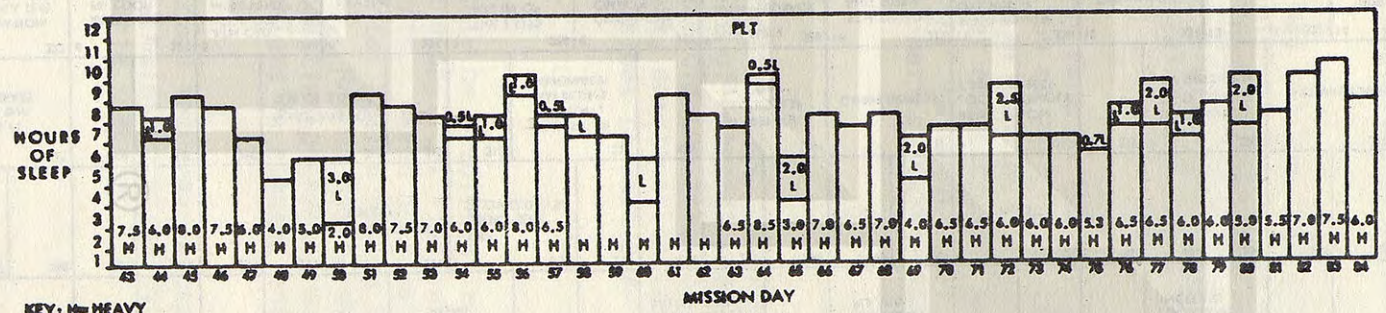


KEY: H= HEAVY
L= LIGHT
F= FAIR
G= GOOD

Figure 2.2.2.7-2. - Sleep Patterns: Total Sleep Time and Subjective Quality (SL-4).







KEY: H= HEAVY
L= LIGHT
F= FAIR
G= GOOD

Figure 2.2.2.7-2. - Concluded.

CABIN DEPRESS/REPRESS
SECONDARY TIMER TEST
1 OCT
CBRM 3 THERMAL MGMT
5055 TRANSIENT/POWER SUPPLY SWITCHOVER
N2 LEAK IN CAB PRESS RLF VLV
SEC COOLANT LOOP LEAK INCREASE
CBRM #9 BATT TRIP OFF.
5055 "QUIET SUN" STUDY (2 DAYS)
Pp=51°
Pp=45° MISSION SLIP OF 5 DAYS
TRANSIT OF MERCURY; AM RCDR 3 ANOMALY
INTERSTAGE CRACKS, SLIP OF 1 DAY
CABIN DEPRESS
ATM CAN ORB LOCK ANOMOLY: CABIN REPRESS
SL-4 LAUNCH O_2 TK 2 PRESS. SW SHIFT (CSM)
ACTIVATION
1 NOV
CMG #1 WHL SPD INCREASE
ACTIVATION SEC EPEA TEST, CBRM #9, 3RD ELECTRODE LAG
ACTIVATION, PRI LOOP RESERVICE, PRI LOOP ON
ATM C&D LOOP OFF; M092 VENT INTO WASTE TANK; AM PRI TRS ON
EVA PREP, LIQ CRYSTAL THERM INSTALL
EVA 1 S193 PIN IN O^{R} PITCH; H #C2 DOOR PIN
CMG #1 FAIL CBRM #9 OFF/ON PRI COOLANT LOOP OFF
TRIM BURN
COMM ANTI FEEDBACK ADAPTER INSTALLED BATT CAP TEST CBRM 5 ANOMALY
ATM TV MON AND S082 B TIMER EREP C/O
MANNED ATM OPS S056 BE COUNT FAIL S009 MOTOR RPLMT S054 FILTER STICK
S232 MNVR W/TACS ONLY
EREP 3 (1ST PASS OF MSN)
ATM CAN FAIL TO UNLOK VEHICLE VIBRATIONS (CREW REPORT) KLUNKETY-KLUNK EREP 4
ATM C&D PUMP C ON EREP 5
EREP 6,7, (TACS USAGE OF 1284 #/SEC)
EREP 8,9 (TACS USAGE 797 #/SEC)
EREP 10 S190A ANOMALY F/C SHUTDOWN MK1, EX, FAIL
EREP 11 CMG 2 GLITCH MK1 FIX TIP CMD FUNNY
CAL ROC SCRUB S190A FIX
EREP 12 JOP-13
EREP LUNAR CAL EREP 14 CMG2 GLITCH CDRM 15 VOLT DROP
ATM PTG STAB TEST S082A DOOR OPEN
CAL ROC LAUNCH
TRIM BURN
EREP 15 PSM VLV B CLSD
GYPSY MOTH BIRTH(S) M509-1
CREW DAY OFF EREP 16
EREP 17 ATM C&D FILTER INSPECT, CHANGE LOOP POLISH CONDENSATE HLDG TK DUMP
KLUNKETY-KLUNK JOP18D PRI COOLANT LOOP ON
M509-2
JOP 18D CMG 2-MA HTR CNTR INITIATE
LL MOX ANOMALY M509-3 JOP18D
JOP18D
EVA-2 (3866FEC) S054 FIXN
CREW DAY OFF ETC. PARAGUAY
STAR TKR FAILURE
BATT CAP TEST DR. KOHOUTEK CONF. W/CREW
EVA 3 (3689#SEC) JOP 18D
S082B DOOR ANOMALY; JOP 18D
JOP18D ND-24 AIA-23
EREP 18 JOP18D
CREW DAY OFF
1 JAN 1974
ATM C&D INTEG LTG LOSP S082B PRI DRIVE OSC S183 E CLIP JOP18D
EREP 19
EREP 20 ATM C&D LOOP GAS REMOVAL; URINE DUMP ANOMALY
URINE DUMP HTRS ON; JOP18D
EREP 21; JOP 18D; OWS LIGHTS TO 1/2
EREP 22; LUNAR CAL S019 CASSETTE JAM
EREP 23
EREP 24
EREP 25 CREW DAY OFF
EREP 26; S019 CAN FAIL; NUZ ERROR DETECTED
EREP 27; S019 MAL; ED72 LEAK
S190A MAGN DR CHGOUT; ED72 FAILED
EREP 29 (DBL DATA TAKE); MANNED SPACE FLIGHT DURATION RECORD SET
EREP X-5 DET ΔOUT AND REALIGN NRL CAL ROC
PUMP C ON IN PRI COOL LOOP
M509 (SHORT RUN); OWS HX FAN RPM; TOW XMTR ANOMALY
CREW DAY OFF; SCIENCE CONF; EREP 30
CMNB-6HZ NOISE PROB. OWS HX CLEAN; AM TAPE RCDR FAIL
EREP 32; M509 TOW XMTR ANOMALY
S183 CAMERA AM TAPE RCDR RPM; LAB RLF VLV OPEN
EREP 35; AM TAPE RCDR RPM; LAB RLF VLV OPEN
EREP 37
EREP 40; PUMP C OFF IN PRI COOL LOOP
EREP 41
EREP 42; EREP RCDR #2 SELECT; CREW DAY OFF
EREP 44,45; S183 FIX MRT EXER FAIL
EREP 46 JOP 25B
EREP 48; JOP 18D; EREP 49
CREW DAY OFF
JOP 18D; EREP 47
DEACT ENTRY PREP
ENTRY & POST MISSION ACTIVITIES
POST MISSION ACTIVITIES

There was no significant intracrew disharmony. The CDR ran the mission with fairly democratic control and there were no instances of gross deviation from the CDR's wishes.

The PLT's tendency to be less openly expressive was not new, and ground observed differences between the crewmembers reinforced this prior observation. (On MD 45, the PLT was asked to get into more films.) The SPT, the youngest of the group and a scientist by profession, tended to be more explicit, as for instance, in his medical descriptions associated with the M092.

The deeply philosophical comments (exhibit H) they made as the Christmas season approached are what one would hope a mission so peripheral and distant to Earth might evoke. Some of the ground originated Christmas wishes sent to the crew by voice and by teleprinter are attached, as exhibit I. The ground messages encompassed "earthy" to traditional season's wishes. Such exchanges were an integral part of maintaining psychological well-being.

2.2.2.9 Deactivation of Skylab (fig. 2.2.2.9-1)

Deactivation of SL-3 varied from prior Skylab deactivations. Many of the housekeeping procedures were omitted. Samples of material were assembled and left for a possible pickup in an anticipated 1975 revisit, and finally, by applying a concerted effort, deactivation tasks were rearranged to allow two full 8-hour sleep periods (albeit displaced) on mission days 83 and 84.

2.2.2.10 Prediction of postflight status

The postflight medical status could most accurately be predicted from knowledge of then current crew medical history and physical findings as well as from monitored data from the experiments. Based on Houston evaluation, the crew was in good physical and mental health during the two to three days immediately prior to splashdown. Had we had to make recovery while fatigue or some of the varied congestion phenomena were maximal, we might very well have anticipated problems in reentry and postflight.

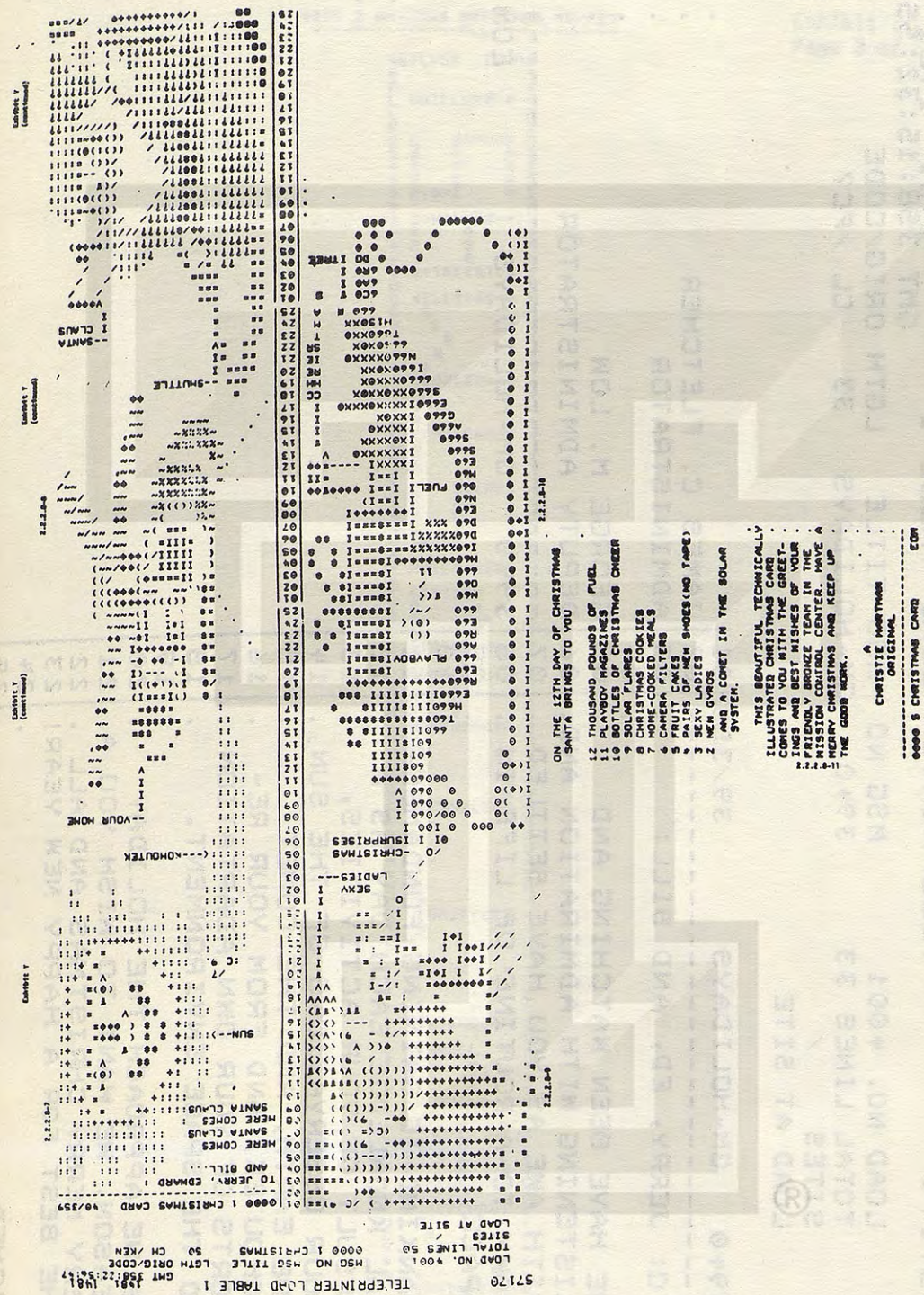
Monitoring data from the M071, M073, and M172 showed the crew, except for very early in the mission, to be eating well, maintaining weight, and not exhibiting any alarming diuresis or oliguria (section 1.2 trend charts).

CHRISTMAS COMMENTS

358:15:31:40 CDR You know, our Earth seems large to us as we look down on it. And yet those men who have flown Apollo to the moon say it's small. And as we see it, there are vast areas of desolation and great masses of water with man crowded only into the more temperate or hospitable zones of the Earth. Yet the men from Apollo perceive the Earth as a tiny blue island in the vast sea of space. Well, either way you look at it, the observation is humbling because the genuineness of our existence is emphasized by the need for man to get into harmony with his environment and with his fellow man. Among Christians, the Christmas season serves to heighten our awareness of others and the brotherhood of man. And whether we're Christians, or Jews or Mohammedans or Buddhists or Confucianists or Atheists, and no matter what the season is, or isn't, I think we all agree that one of man's principal goals for the future should be to learn to live in peace and harmony with one another.

358:15:35:01 SPT I think if we all, the people in the world, could take a step back and look at the world as we have been privileged to do over the past 40 days, you'd find that it looks smaller and that what we must do is understand one another and cooperate.

358:15:39:05 PLT And from the Skylab-3 crew, we wish to extend to people around the world a message of peace, good-will, and human understanding.



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GMT 358:15:32:55

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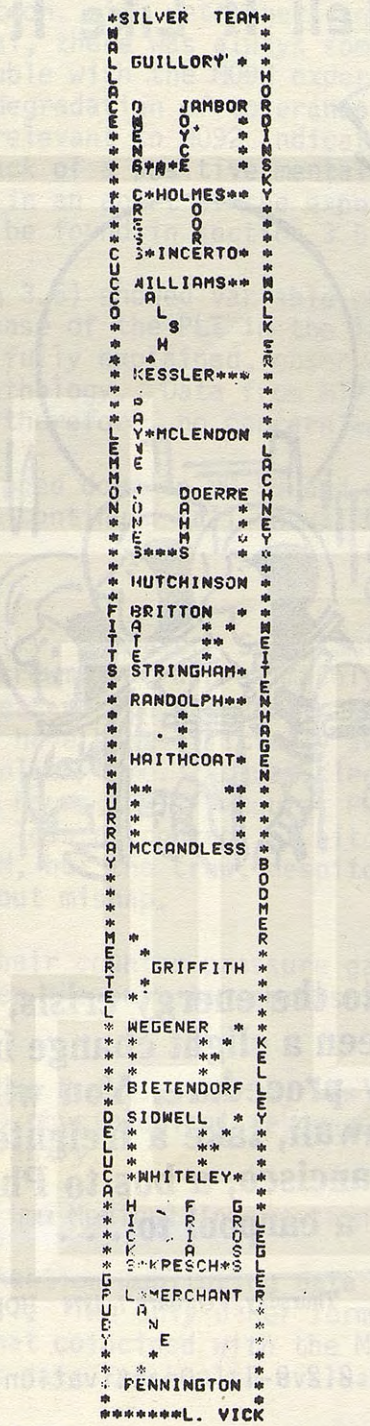
SITES /
LOAD AT SITE

```
3940   GM-HOLIDAYS          39/358 | 01 |                                .
-------------------------------- | 02 | JAMES C. FLETCHER              .
TO: JERRY, ED, AND BILL:       .  | 03 | ADMINISTRATOR                  .
                               .  | 04 |                                .
WE HAVE BEEN WATCHING AND      .  | 05 | GEORGE M. LOW                  .
LISTENING WITH ADMIRATION AND. .  | 06 | DEPUTY ADMINISTRATOR           .
WITH AWE AS YOU HAVE SETTLED   .  | 07 | ------------------------------
DOWN TO A ROUTINE OF LIFE IN   .  | 08 | 3940   GM-HOLIDAYS          EOM
SPACE.                         .  | 09 |
                               .  | 10 |
MANKIND IS GAINING FUNDAMEN-   .  | 11 |
TAL KNOWLEDGE EACH DAY AS A    .  | 12 |
RESULT OF YOUR ACTIVITIES,     .  | 13 |
YOUR OBSERVATIONS OF THE SUN,. .  | 14 |
THE EARTH, AND THE COMET       .  | 15 |
KOHOUTEK, AND FROM YOUR RE-    .  | 16 |
PORTS OF YOUR OWN ADAPTATION   .  | 17 |
TO THE SPACE ENVIRONMENT.      .  | 18 |
                               .  | 19 |
AS WE APPROACH THE HOLIDAY     .  | 20 |
SEASON, WE WANT TO WISH YOU A. .  | 21 |
VERY MERRY CHRISTMAS AND ALL   .  | 22 |
THE BEST FOR A HAPPY NEW YEAR! .  | 23 |
```

4099 1 GM-XMAS GREETNGS 40/359
ALL



4099 2 GM-XMAS GREETINGS EOM

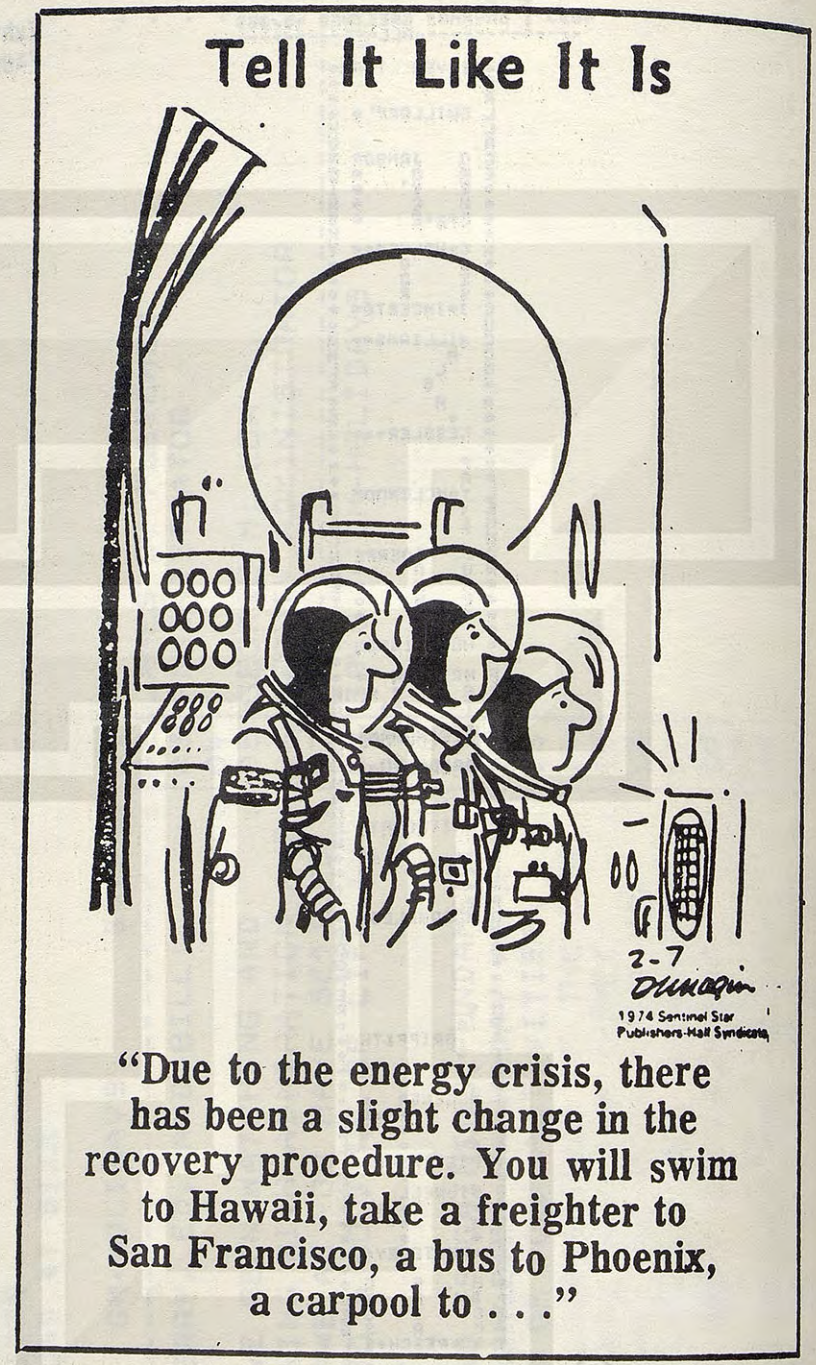


Figure 2.2.2.9-1. Deactivation of SL-4.

Monitoring data from M092 (times of performance, fig. 2.2.2.10-1), we noted sporadic termination, with yet other runs completed but in a marginal way; in general, there was always some extenuating circumstance that led to trouble with the M092 experiment. There were no patterns of continued degradation of tolerance to the M092. Some of the clinical comments relevant to M092 indicate that inadequate prior rest, hydration, and lack of a positive mental attitude can cause an intolerance and result in an abort of the experiment. A complete discussion of M092 can be found in section 3.5.

Data from M093 (section 3.6) showed variable changes during the mission and especially in the case of the PLT in the latter third of the mission. Although not fully explained, observed changes were not explicit for organic pathology. Data from M171 (section 3.15) showed improvement in-flight, therefore, no concern was generated.

The hemoglobin value dipped down on MD 59 and particular attention was paid to this but no continued fall in values was noted.

2.2.2.11 Reentry

In preparation for reentry, mandatory Scopolamine/Dextroamphetamine sulfate was taken by all three crewmen at approximately two hours prior to intended splashdown. The final eat-period was about three hours prior to splash. The crew would have been officially awake for 13-1/2 hours prior to that offical splash time. Actual sleep on the last sleep period was: CDR, 5-1/2 hours; SPT, 5 hours, PLT, 3-1/2 hours. During the reentry there was a loss of control of pitch and yaw in the automatic mode of the CM, but the crew, despite their serious concern, switched to manual without mishap.

The crew had inflated their counter pressure garments prior to burn and reinflated them after the burn to compensate for the increasing CM pressure.

Recovery was at 0817 hours P.d.t., the sky was clear and the sea was very still. No untoward physiological responses were commented on in the "on-chute" phase of entry.

2.2.3 Summary of Real Time Medical Information Handling

Operational bioinstrumentation monitoring data have already been discussed in section 2.2.2.1. The only other formal real-time monitoring was during the passes that coincided with the M092/M171 (M093) experiment performance. Experiment data for health evaluation have been discussed in section 2.2.2.

CDR

1 NO NO	2 NO NO	3 NO NO	4 NO NO	5 YES YES	6 NO NO	7 NO NO	8 NO NO	9 NO NO
10 NO NO	11 YES NO	12 NO NO	13 NO YES	14 NO NO	15 NO NO	16 YES NO	17 NO NO	18 NO NO
19 NO NO	20 NO NO	21 NO YES	22 NO NO	23 NO NO	24 YES NO	25 NO NO	26 NO NO	27 NO NO
28 NO YES	29 NO NO	30 NO NO	31 YES NO	32 NO NO	33 NO NO	34 NO NO	35 NO YES	36 NO NO
37 NO NO	38 NO NO	39 NO-93 W/BLOOD VOL-AND MIST EXER. NO	40 NO NO	41 NO NO	42 NO NO	43 NO YES	44 NO NO	45 NO NO
46 YES NO	47 YES NO	48 NO NO	49 NO NO	50 NO NO	51 NO YES	52 NO NO	53 NO NO	54 NO NO
55 YES NO	56 NO NO	57 NO NO	58 NO NO	59 NO YES	60 NO NO	61 NO NO	62 YES NO	63 NO NO
64 NO NO	65 NO NO	66 NO YES	67 NO NO	68 NO NO	69 YES NO	70 NO NO	71 NO NO	72 NO NO
73 NO NO	74 NO NO	75 NO NO	76 YES NO	77 NO NO	78 NO NO	79 NO YES	80 NO NO	81 NO NO
82 NO NO	83 NO YES	84 NO NO	85	86	87	88	89	90

SPT

1 NO NO	2 NO NO	3 NO NO	4 NO NO	5 NO NO	6 YES YES	7 NO NO	8 NO NO	9 NO NO
10 YES NO	11 NO NO	12 NO NO	13 NO NO	14 NO YES	15 NO NO	16 NO NO	17 NO NO	18 NO YES
19 NO NO	20 NO YES	21 NO NO	22 NO NO	23 YES NO	24 NO NO	25 NO NO	26 NO NO	27 NO YES
28 NO NO	29 NO NO	30 YES NO	31 NO NO	32 NO NO	33 NO NO	34 NO YES	35 NO NO	36 NO NO
37 NO NO	38 NO-93 W/BLOOD VOL- AND MIST EXER.	39 NO NO	40 NO NO	41 NO NO	42 YES YES	43 NO NO	44 NO NO	45 NO NO
46 NO NO	47 NO NO	48 NO NO	49 NO NO	50 NO YES	51 NO NO	52 NO NO	53 NO NO	54 YES NO
55 NO NO	56 NO NO	57 NO NO	58 NO YES	59 NO NO	60 NO NO	61 YES NO	62 NO NO	63 NO NO
64 NO NO	65 NO YES	66 NO NO	67 NO NO	68 YES NO	69 NO NO	70 NO NO	71 NO YES	72 NO NO
73 NO YES	74 NO NO	75 YES NO	76 NO NO	77 NO NO	78 NO YES	79 NO NO	80 NO NO	81 NO NO
82 NO YES	83 NO NO	84 NO NO	85	86	87	88	89	90

PLT

1 NO NO	2 NO NO	3 NO NO	4 NO NO	5 YES YES	6 NO NO	7 NO NO	8 NO NO	9 NO NO
10 NO YES	11 NO NO	12 NO NO	13 YES NO	14 NO NO	15 YES NO	16 NO NO	17 NO NO	18 NO NO
19 NO YES	20 NO NO	21 NO NO	22 YES NO	23 NO NO	24 NO NO	25 NO NO	26 NO YES	27 NO NO
28 NO NO	29 YES NO	30 NO NO	31 NO NO	32 NO NO	33 NO YES	34 NO NO	35 NO NO	36 NO NO
37 YES NO	38 NO NO	39 NO NO	40 NO NO	41 NO NO	42 YES YES	43 NO NO	44 NO NO	45 YES NO
46 NO NO	47 NO NO	48 NO NO	49 YES YES	50 NO NO	51 NO NO	52 NO NO	53 YES NO	54 NO NO
55 NO NO	56 NO NO	57 NO YES	58 NO NO	59 NO NO	60 YES NO	61 NO NO	62 NO NO	63 NO YES
64 NO NO	65 NO NO	66 NO NO	67 YES NO	68 NO NO	69 NO NO	70 NO YES	71 NO NO	72 NO NO
73 NO NO	74 YES NO	75 NO NO	76 NO NO	77 NO NO	78 NO YES	79 NO NO	80 NO NO	81 NO NO
82 NO NO	83 NO YES	84 NO NO	85	86	87	88	89	90

KEY: Upper value refers to M092-M093 and lower value to M092/M171.

Figure 2.2.2.10-1. - (M092), M093/M171 Performance Schedules SL-4.

The flow of medical information that transpired was relatively good. The various report packages were distributed in timely fashion (figure 2.2.3-1), including the eventual transmittal of the Daily Health Status Report to the Recovery Ship.

The experimental data used for the trend charts (figs. 1.2-1 through 1.2-18) provided a single and quick comparison with SL 1/2 and SL-3 data. These trend charts were supplemented by the crew surgeon's real time plots (figs. 1.2-19 through 1.2-25).

The crew had regular access to limited medical data formatted for and sent via the med status pad. Three examples of the kinds of information sent up to the crew are included as exhibit J. Miscellaneous uplink pads notified the crew of new or corrected procedures. Three pertinent examples are attached as exhibit K. Science conferences with the crew were on a weekly basis except for an omitted session on MD 49 and a hastily called one by Dr. Kerwin in place of Dr. Musgrave, on MD 56.

2.2.4 Postflight Medical Evaluation

2.2.4.1 Recovery

Splashdown was in Stable II position and remained so for about five minutes (15:16:55 - 15:21:47). Other than some initial pulling on the neck muscles, this was tolerated well. Initial on-water pulse rates were: CDR, 70; SPT, 80; PLT, 80 bpm. The CM was taken on board the U.S.S. *New Orleans* at 0859 hours P.d.t.

Because of a possible fuel leak, the fans had not been activated and the CM remained quite warm despite an outside air temperature of about 55° - 58° F (13° - 15° C). On opening at 0904 hours P.d.t., three smiling sweaty faces greeted us; two of the men had grown beards.

The initial crew checks were done in the CM; the results were:

	Supine, Suit Inflated		Sitting Suit Deflated		Sitting Suit Inflated	
	HR(bpm)	BP(mm Hg)	HR(bpm)	BP(mm Hg)	HR(bpm)	BP(mm Hg)
CDR	84	155/82	112	158/105	88	135/110
SPT	76	146/78	96	Not Available	96	128/100
PLT	68	162/78	64	138/90	72	138/84

SL-4.

The following receive a copy of all reports:

Bldg. 36
MER
Dr. Dietlein
Dr. Hawkins
Crew Surgeon (Dr. Hordinsky)
Health Serv. Div. (Dr. Armstrong/Dr. Zieglschmid)
Dr. Burchard
Dr. Buchanan

Additional Distribution is as follows:

Title of Report	Responsible Position	Additional Distribution	Total Copies To Be Made
Evening Status Report (Part of M071/73 Report)	Med Data	All boxes	22
Med Data Pack for Experimenters (Same as S/L Daily Crew Health Status Report. Includes OBS Data Summary Report When Applicable)	Aeromed	All boxes	22
FCD Uplink Med Pads	Med Data	All boxes	22
Voice Transcripts	Med Scien.	Applicable P.I. Mr. Johnston, Dr. Berry, Hdqs.	12
Flight Plan	Med Scien.	All boxes	22
Environment Report	Med Data	M171 P.I. M092 P.I.	10
Experiment Summary Report	Med Data	Applicable P.I. (M131 and M133 P.I.'s) require 2 copies	9 10
FOMR Inputs and Related Actions	Med Scien.	Applicable P.I. Mr. Johnston, Dr. Berry, Hdqs.	12

Special Reports Distributed by Originator.
(Above General Distribution does not apply.)

Bio Med Officer Status Report - Verbal at MMT	
Med Team Conference Minutes - Distributed by Mr. Van Nordstrand	40
MOCR Surgeon's Report to FD/MER - Delivered by MOCR Surgeon	3
Crew Surgeon's Report - Delivered by Crew Surgeon	3
Injury/Illness Report (Part of Daily Health Status Summary when applicable) - Aeromed	22
Biomed Problem Summary (Anomaly) - Maintained by Bio Med Officer	
FOMR Mission Report - Distributed by MER	

Figure 2.2.3-1. - SL-4 Life Sciences Report Distribution List.

```
      B4      DAY 3                    U                        C
REP-AT01      NUM-0069 VIEWID-      SEGS-0001 TO 0001 OF 0003
T050                          MSG NO  MSG TITLE   LGTH ORIG CODE
/                            /2105A /MED STATUS  //24/ /RRL/FCO?/
MSK /     /
```

```
2105A      MED STATUS      21/340 |01
-------------SPT--------------    |02
M071-DOY 339                  .   |03
     149*        154         145  .|04
    3078†       2904        3064  .|05
   20010§      00010       00010  .|06
338 2459        3516        3569  .|07
REMARKS: ALL LEG BAND CHANGE  .   |08
DATA HAVE BEEN WITHIN TM      .   |09
RANGE EXCEPT IN THE FOLLOWING.    |10
CASES:                        .   |11
                              .   |12
         DELTA P LEVEL WHERE  .   |13
         LEG BAND CHANGE      .   |14
CM  DOY  EXCEEDED TM RANGE    .   |15
--  ---  --------------------.    |16
SPT 333  EARLY IN 30 MMHG     .   |17
SPT 337  EARLY IN 30 MMHG     .   |18
PLT 324  LAST OF 50 MMHG      .   |19
PLT 329  LAST OF 50 MMHG      .   |20
PLT 332  MIDDLE OF 40 MMHG    .   |21
PLT 334  MIDDLE OF 50 MMHG    .   |22
-------------------------------   |23
2105A      MED STATUS        ECM  |24
                                  |25
```

KEY:

* Weights

† Water intake

§ Code to mineral supplements required

```
     B4         .AY3          U          8          ( )         U8
REP-AT01       NUM-0028 VIEWID-      SEGS-0001 TO 0001 OF 0003
T050                     MSG NO   MSG TITLE   LGTH ORIG CODE
/                     /4005A /MED STATUS   //17/ /MEF/FC8 /
MSK /     /

4005A      MED STATUS        40/359
---------------SPT-------------
M071-DOY 358                      .
       148*       153          146.
      3631+       3326        3345.
     00000§       00002       00000.
357  2570         3262        3220.
REMARKS:MERRY CHRISTMAS! AT       .
YOUR OPTION YOU MAY EACH HAVE.
ONE FRUITCAKE (IN LOCKER A2       .
BEHIND FILM VAULT). ONLY MENU.
IMPACT IS THAT CDR SHOULD RE-.
DUCE HIS OPTIONAL SALT FROM       .
6 TO 4,AND PLT FROM 1.5 TO 0..
LET US KNOW ON EVENING REPORT.
------------------------------
4005A      MED STATUS           EOM
```

KEY:

* Weights

† Water intake

§ Code to mineral supplements required

```
REP-AT01      NUM-0013 VIEWID-      SEGS-0001 TO 0001 OF 0003
TOSO                     MSG NO  MSG TITLE   LGTH ORIG CODE
/                        /8507   /MED STATUS  //32/ /KEH/FC8 /
MSK /     /
```

```
8507   MED STATUS              85/039
-------------SPT--------------
M071-DOY 038                        .
     148*        153        147     .
    3009†       3317       3442     .
   00010§      00002      00000     .
037 2862        2735       3105     .
********CONGRATULATIONS********     .
A JOB WELL DONE FROM THE            .
MEDICAL COMMUNITY AND THANKS        .
FOR ALL OF THE DATA. THE            .
ANALYSIS WILL KEEP US BUSY FOR      .
SOME TIME. WE HAVE 5.4 MILES        .
OF VCG STRIPCHART FROM YOUR         .
MISSION.                            .
**************************          .
INFLIGHT CANDIDATE RECORDS FOR      .
THE GUINESS' BOOK OF RECORDS        .
              *****                 .
MOST FOOD CONSUMED IN LBS           .
    511         436        558      .
              *****                 .
MOST H2O INTAKE IN GALLONS          .
   54.45       60.54      73.36     .
              *****                 .
```

```
MOST URINE OUTPUT IN GALLONS        .
    20.66       21.01      24.48    .
              *****                 .
MOST FECES IS STILL TO BE DE-       .
TERMINED.                           .
------------------------------      .
8507   MED STATUS              EOM
```

KEY:

* Weights

† Water intake

§ Code to mineral supplements required

```
REP-AT01      NUM-0017 VIEWID-      SEGS-0001 TO 0001 OF 0003
T050                      MSG NO  MSG TITLE   LGTH ORIG CODE
/                        /0834   / GM-GEN INFO//40/ /ML /CGS3/
M3K /     /
```

```
0034   GM-GENERAL INFO  08/327
-------------CDR--------------
1. REQUEST ALL FUTURE LIMB VOL
   MEASUREMENTS BE DONE PER THE
   BIOMED CHECKLIST.          .
2. IN ORDER TO CORRELATE DATA.
   BETWEEN ACTIVATION AND BIO-.
   MED C/L'S, REQUEST THE FOL-.
   LOWING ONE TIME ONLY TEST: .
     THE NEXT TIME LIMB VOLUME.
   MEASUREMENTS ARE TAKEN,    .
   APPLY THE REFERENCE TEM-   .
   PLATE PER ACTIVATION C/L,  .
   AND IDENTIFY TO THE NEAREST
   MILIMETER ALONG THE MEASURE
   MENT POSITIONS THE LOCATION
   OF THE TIBIAL TUBER/KNEECAP
   INDENTATION. DO FOR EACH   .
   CHN AND VOICE RECORD POSI-.
   TION. THEN DO COMPLETE MEAS
   UREMENT PROCEDURE PER BIOMED
   C/L.                       .
3. NO COMMENTS HAVE BEEN RE-  .
   CIEVED ON GARMENT USAGE    .
   (M#07). CAN WE ASSUME THEN.
   THAT THE ONLY GARMENTS YOU .
   CHANGED HAVE BEEN SOCKS AND.
   UNDER-GARMENTS?            .
4. DURING 9019 AMS REPLACEMENT
   MAKE THE FOLLOWING OBSERVA-.
   TIONS ON AMS MIRRORS AND   .
   RECORD COMMENTS:           .
     HOW DO REFLECTING SURFACES
    COMPARE WITH RESPECT TO:  .
    (A) APPARENT REFLECTIVITY?.
    (B) DEPOSITS AND SCRATCHES?
    (C) COLOR AND VISIBLE PAT-.
        TERNS?                 .
-------------------------------
0834   GM-GENERAL INFO     EOM
```



```
REP-AT01      NUM-0028 VIEWID-      SEGS-0001 TO 0001 OF 0003
```

```
REP-AT01      NUM-0028 VIEWID-      SEGS-0001 TO 0001 OF 0003
T@50                     MSG NO  MSG TITLE   LGTH ORIG CODE
/                       /184SB1/GM-OVERAGE  //50/ /ALA/FC84/
MSK /    /
```

184SB1 GM-OVERAGE 18/337

----------ALL----------

PERMANENT GENERAL MSG. NO. 007

---

1. FREE CALORIE FOODS IN OVERAGE WERE LISTED IN DOY 13/332. MED PAD. THE FREE CALORIE ITEMS LISTED BELOW SUPERSEDES THAT INFORMATION.

2. MOST OVERAGE IS PART OF PLANNED MENUS AND SHOULD NOT HAVE BEEN EATEN YET.

3. EXTRA FREE CALORIE FOOD ITEMS AND THE QUANTITY AVAILABLE WITHOUT MENU IMPACT ARE AS FOLLOWS:

ITEM #	FOOD NAME	AMOUNT.
77	APPLE DRINK	6 .
48	BISCUIT	15 .
76	BUTTER COOKIE	28 .
78	CHERRY DRINK	10 .
81	COFFEE W/SUGAR	9 .
62	COFFEE BLACK	10 .
42	GRAPE DRINK	22 .
41	HARD CANDY	2 .
4	LEMON PUDDING	2 .
23	LEMONADE	26 .
66	TEA	33 .
28	VANILLA WAFERS	5 .

4. OVERAGE NOT USED IN SCHEDULED MENUS THAT MAY BE USED IN MODERATION ARE AS FOLLOWS:

43	APPLESAUCE	2 .
22	ASPARAGUS	1 .
7	DRIED APRICOTS	1 .
73	GREEN BEANS	3 .
74	MACARONI & CHEESE	1 .
69	PEACH AMBROSIA	8 .
46	PEACHES	8 .
47	PEARS	3 .
59	PORK & POTATOES	1 .
13	SAUSAGE	1 .
16	SCRAMBLED EGGS	1 .
64	STEWED TOMATOES	1 .
3	TUNA	35 .
40	TURKEY & GRAVY	1 .
53	TURKEY RICE SOUP	1 .
71	VEAL & BBQ	1 .
14	CHOC. CHIP BAR	2 .

```
REP-AT01      NUM-0027 VIEWID-      SEGS-0001 TO 0001 OF 0003
T050                      MSG NO  MSG TITLE   LGTH ORIG CODE
/                        /1845A2/GM-OVERAGE  //08/ /ALA/FC84/
MSK /    /
```

```
5. THIS IS AN INTERIM LIST    .  01
CURRENT AS OF THE END OF DOY  .  02
17/336. PLANS HAVE BEEN MADE  .  03
TO TAKE AN INVENTORY OF       .  04
FREEZER AND AMBIENT FOOD IN   .  05
THE FUTURE.                   .  06
------------------------------   07
1845A2 GM-OVERAGE          EOM   08
                                 09
                                 10
                                 11
                                 12
                                 13
                                 14
                                 15
                                 16
                                 17
                                 18
                                 19
                                 20
                                 21
                                 NN
```



```
T059                      MSG NO  MSG TITLE   LGTH ORIG CODE
```

```
T059                                MSG NO  MSG TITLE   LGTH ORIG CODE  2071
/                                  /3638  /CL-EVA 2    //50/ /RSM/CG3 /
MSK /    /
```

```
3638 /    CL-EVA 2          36/355
---------CDR-AND-SPT-----------
EVA PREP & POST Q CARD CHG 002
-------------------------------
PG 1.1-2 LEFT COL AFTER~(D404)
 UNSTOW LCG'S & FCS'S (3)~ADD:
*******************************
*EVA 2 ONLY                   *
*PERFORM LCG FUNGUS SAMPLING  *
* PER IMSS-1F1 PROCEDURE TOP  *
* OF PG 32-15 OF IMSS C/L.PRE-*
* FERRED SAMPLE SITE SHOULD   *
* HAVE VISIBLE FUNGUS. IF NONE*
* VISIBLE, SAMPLE AREA PREVI-*
* OUSLY MOST CONTAMINATED TO  *
* INSURE GOOD FUNGUS PICKUP.  *
* THE SAMPLE SITE FOR ONE SET*
* OF SWABS MAY BE A LARGE AREA*
* OF THE LCG AND AS SUCH WILL*
* REPRESENT A COMPOSITE SAMP-*
* LING AS OPPOSED TO A DIS-   *
* CRETE. RECORD THE LCG CHOSEN*
* AND AREA ON LCG FOR SAMPLING*
*******************************
RT COL, BEFORE ~INSTALL S054 .
```

```
 ON VC TREE & LOCK~ ADD:
*******************************
*INSTALL SHUTTER OVERRIDE AC-*
* TUATOR PER ATM SYS CL &     *
* DATA BOOK, PG 1-8.          *
*REF ATM SCHEMATIC BOOK, X-RAY
* SPECT (S054) (SHT3), ZONE H7
*******************************
PG 3.2-4 CENTER COL, AFTER
 ~POUCH NEXT TO PNL 316~ ADD:
*******************************
*EVA 2 ONLY                   *
*-----------                  *
*UNSTOW MIRROR/PENLIGHT ASSY *
* & SCREWDRIVER FROM AM POUCH*
*E624-1E STOW MIRROR          *
*E625    STOW PENLIGHT        *
*M144-3  STOW DRIVER, 1/8     *
*         BLADE               *
*******************************
-------------------------------
3638      CL-EVA 2          EOM
```

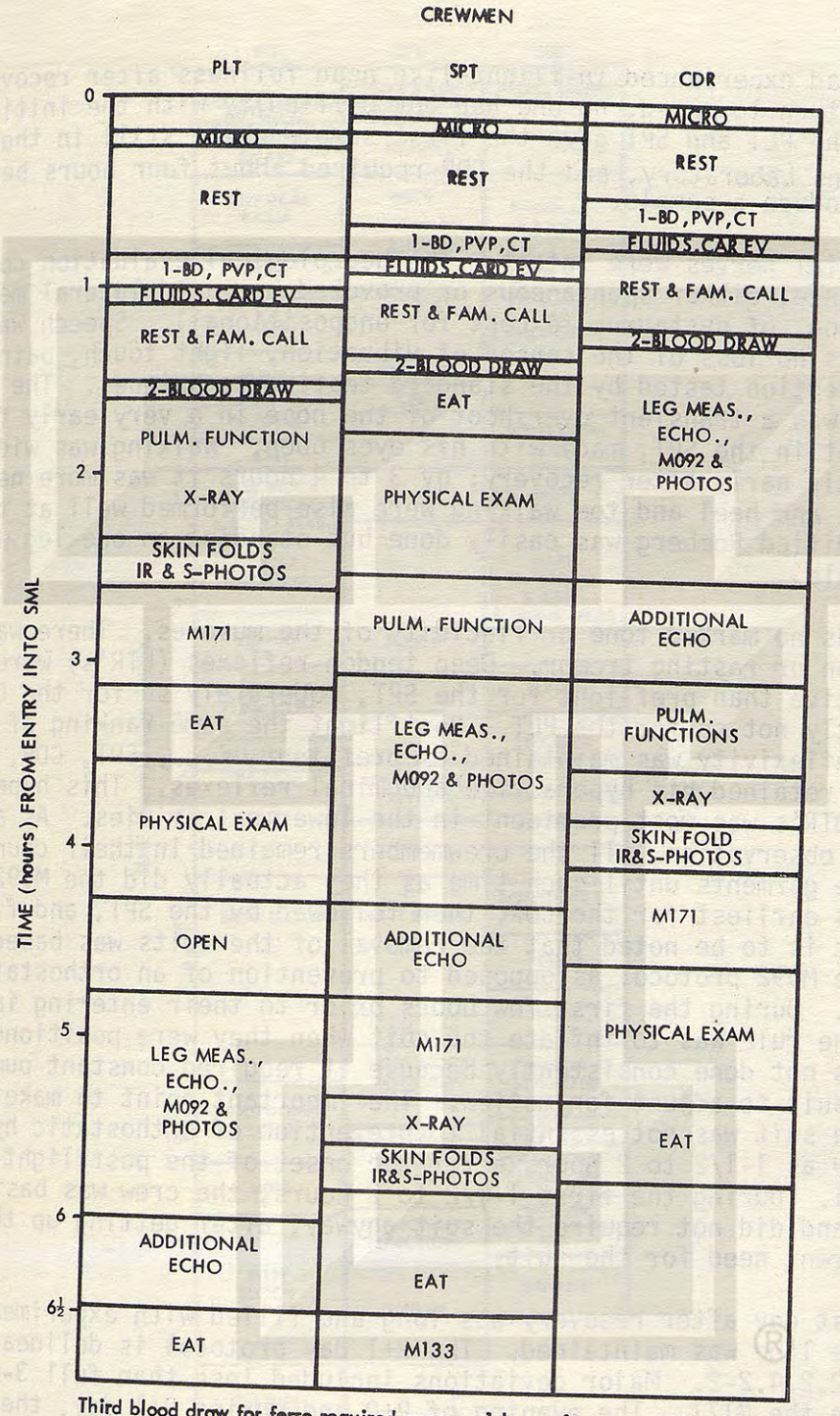
```
TEXT EDITING
  SHIFT LINES /     / TO /   /.
  DELETE LINES /    / TO /   /.

TELEPRINTER COORDINATOR CAPABILITIES
  MERGE TPT / / INTO TPT / /.
  REINITIALIZE TPT / /.
  SEND TPT / / TO MOC.
  MERGE MESSAGES /  .  ,  ,  / FROM TMP INTO TPT / /.
  REINITIALIZE TPR MESSAGE POOL FROM /  / TO /  /.
  I DESIRE TO REDEFINE A BACKGROUND FORM / /.

TELEPRINTER POOL DISPLAY REQUEST /  /.


RKA122I DATA HAS BEEN QUEUED
```

The crew moved around inside the narrow space of the CM remarkably well and all assumed a sitting (semi-standing) posture easily. The CDR and SPT exchanged places in the Lower Equipment Bay while the PLT merely sat on his couch. All were noticeably unstable as they exited from the CM. This was caused more by musculoskeletal instability, a subjective difficulty in predicting just how much force to apply in making movements. Vertigo without nausea was more noticeable outside the CM, although there were comments about it within the CM also. The vertigo was largely occasioned by forward/backward head motion but was not subjectively the main basis for the instability. There was no dizziness remarked on. Although the extremities felt as if they were experiencing a pull of 1-1/2 to 2 g's, this also apparently was not contributing in a major way to instability. The prime problem was, to reiterate, difficulty in coordinating one's movements, especially the lower extremities, and in applying just the correct amount of force and motion to accomplish the desired movement. All three uneventfully took their places on the chairs of the forklift, with the SPT exiting the CM first, and the CDR last. The Skylab Mobile Laboratories were officially entered and the postflight medical protocol began at 0931 hours local P.d.t.

2.2.4.2 Medical status onboard PRS

The R+0 day protocol is attached as figure 2.2.4.2-1. Essentially, it was completed in predicted time. Major deviations included a termination of pulmonary function testing in the CDR occasioned by a vagal response triggered by forced expiration, and because the PLT's blood pressure was noticed to be dropping, the M092 was terminated early. A repeat cardiac X-ray was required on the PLT because of technical difficulties. All X-rays were taken with suit deflated. Earlier planned remote ECG sensoring had been deleted because of unpredictable vagaries in the system.

All three men were hungry and thirsty on arriving in the SML's. No one was in any acute distress. No one was incapacitated by vertigo or head motion although head motion was minimized. (The CDR and PLT's vertigo subsided over the next week, although most subsidence occurred in about two days; the PLT could still elicit a trace of vertigo with rapid anterior-posterior head movements on R+11 days. The SPT said he had no vertigo about seven hours after splash.) No one had any particular skin problems but there was minimal thickness of the skin of the distal finger tips. A couple contusions and pinch points stemming from the deactivation were noted on the crew. The CDR had a transient headache during entry, but none was noted post recovery. The PLT complained of left ear fullness after recovery, the physical was negative; a single Ornade® was given that afternoon after the medical protocol and symptoms completely resolved.



Third blood draw for ferro required approx. 1 hour after second blood draw.

Figure 2.2.4.2-1. - Actual R+0 Day SL-4 Operations Timelines in the SML's.

No one had experienced in-flight-like head fullness after recovery. After return to one-g, no one had any difficulty with the initial ... tion. The PLT and SPT gave the first sample while still in the Medi... Operations Laboratory, and the CDR required about four hours before ... could produce a sample.

The cranial nerves were intact. The neurological evaluation confirm... the absence, either spontaneous or provoked by rapid lateral medial ... eye motion, of nystagmus (except for endpositional). Speech was norm... There was no loss of the senses of vibration, light touch, pain, or ... proprioception tested by the standard testing techniques. The one e... ception was a transient overshoot of the nose in a very early finger-... nose test in the SPT, made with his eyes open. Walking was wide-base... and ataxic early after recovery; by 3 to 4 hours it was more nearly ... nominal, and heel and toe walking were also performed well at this t... An unmodified Romberg was easily done but standing on one leg was ... impossible.

There was no marked tone or flacidity of the muscles. There was no ... intention or resting tremor. Deep tendon reflexes (DTR's) were more ... hyperactive than preflight for the SPT, moderately so for the CDR, a... apparently not so for the PLT. Postflight the same ranking of most ... least reflexivity was maintained as preflight, *i.e.*, SPT, CDR, PLT. ... The PLT retained his hyperactive abdominal reflexes. This hyperacti... of the DTR's was most prominent in the lower extremities. As a fin... R+0 day observation, all the crewmembers remained in their counter ... pressure garments until such time as they actually did the M092 seq... This was earliest for the CDR, then followed by the SPT, and finally ... PLT. It is to be noted that the removal of the suits was based on ... into the M092 protocol as opposed to prevention of an orthostatic hy... tension. During the first few hours prior to their entering into th... M092, the rule was to inflate the suit when they were positioned up... This was not done consistently because it required constant pumping ... of the suit to adjust for motion. The important point to make here ... that the suit was not essential to prevention of orthostatic hypote... as early as 1-1/2 to 2 hours after the onset of the postflight medi... protocol. During the first 1-1/2 to 2 hours, the crew was basically ... supine and did not require the suit anyway; after getting up there ... no apparent need for the suit.

The first day after recovery was long and filled with experiments b... the time line was maintained. The R+1 day protocol is delineated in ... figure 2.2.4.2-2. Major deviations included less than full 3-step ... loads in the M171. The evening of R+0 and during R+1 day, the crew ... noted to have petechiae in the lower legs. Those of the SPT and CDR ... were largely perifollicular, while those of the PLT were more in pa... like distribution. Either pressure from the counter pressure garme...

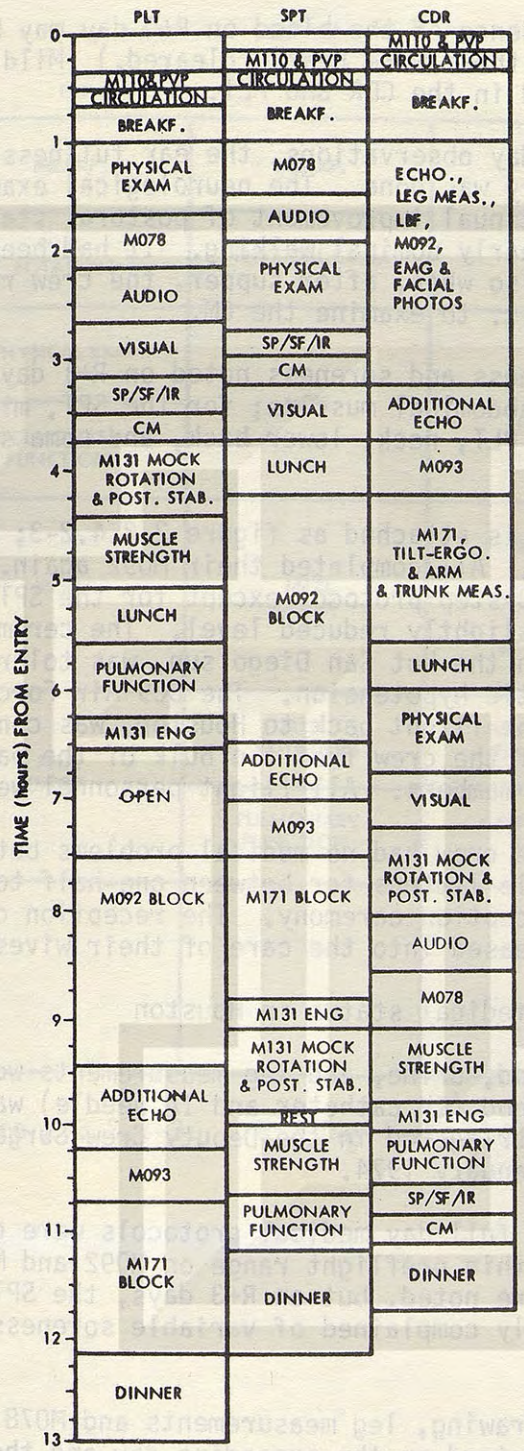


Figure 2.2.4.2-2. - Actual R+1 Day SL-4 Medical Protocol.

or the gravity dependence of the blood on R+0 day may have occasioned these. (By R+3 days these were nearly cleared.) Mild vertigo on head motion persisted in the CDR and PLT.

Continuing with R+1 day observations, the ear fullness experienced by the PLT after recovery was gone. The neurological examination of the three men showed continual improvement of postural stability; this was reflected by their nearly nominal walking. It had been remarkably nominal on R+0 day also when, after supper, the crew returned at 2000 hours local P.d.t. to examine the CM.

There was mild stiffness and soreness noted on R+1 day: for the CDR, lower back and left abdominal muscles; for the SPT, mid back and neck muscles; and for the PLT, neck, lower back, and some soreness over the coccyx.

The R+2 day protocol is attached as figure 2.2.4.2-3; completion of it was rapid and timely. All completed their M092 again. The M171 was completed in a full 3-step protocol except for the SPT who completed his third step at a slightly reduced level. The ceremony, at approximately 1300 P.d.t. in the hot San Diego sun, was tolerated well and without any orthostatic hypotension. The DC9 Air Force Medical Evaluation Airplane, for the flight back to Houston, was configured for efficient separation of the crew from the bulk of the passengers, who were largely Medical Team members. All flight personnel were primary contacts.

During the flight the crew had no medical problems but all variably utilized the available litters for between one-half to one hour of rest prior to the reception ceremony. The reception ceremony went well and the crew was released into the care of their wives.

2.2.4.3 Postflight medical status in Houston

On R+3 days only blood, urine, and leg measurements were done. Cardiac output by direct method (IV catheter and IA needle) was omitted because of the sinus arrest triggered in the Deputy Crew Surgeon while acting as a control on 18 January 1974.

On R+4 and R+5 days, full day medical protocols were conducted and the crew proved to be within preflight range on M092 and M171. No untoward physical findings were noted, but on R+3 days, the SPT had run five miles and subsequently complained of variable soreness of the calves and anterior thighs.

On R+7 days, blood drawing, leg measurements and M078 were done. All of the crew had exercised on the preceding day and the following areas were sore:

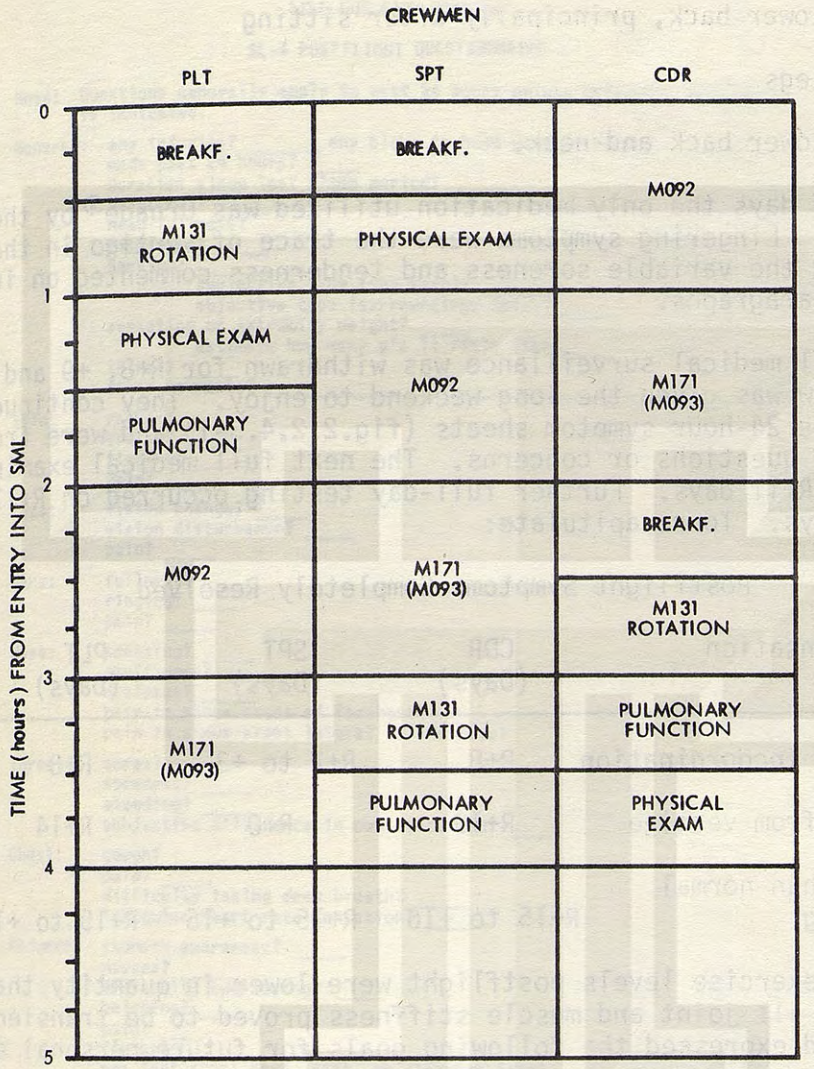


Figure 2.2.2.4-3. - R+2 Day Medical Protocol.

CDR - Lower back, principally after sitting

SPT - Legs

PLT - Lower back and neck.

Through R+7 days the only medication utilized was Ornade® by the PLT on R+0 day. Lingering symptoms were the trace of vertigo in the CDR and PLT and the variable soreness and tenderness commented on in the preceding paragraphs.

All official medical surveillance was withdrawn for R+8, +9 and +10 days and the crew was given the long weekend to enjoy. They continued to complete the 24-hour symptom sheets (fig.2.2.4.3-1) and were free to call in any questions or concerns. The next full medical examination day was at R+11 days. Further full-day testing occurred on R+17, R+31 and R+68 days. To recapitulate:

Postflight Symptoms Completely Resolved

Sensation	CDR (Days)	SPT (Days)	PLT (Days)
Muscular Incoordination	R+8	R+2 to +3	R+8
Freedom from vertigo	R+10	R+0	R+14
Easier than normal fatiguing	R+15 to +16	R+15 to +16	R+15 to +16

The crew's exercise levels postflight were lower in quantity than preflight, but all joint and muscle stiffness proved to be transient and the crew had expressed the following goals for future personal exercise:

CDR - competitive sports
SPT - run five miles four to five times per week
PLT - run five miles three times per week

The medical debriefing, scheduled for 27 February, gave the crew an opportunity to summarize some of their feelings of medical nature to the general scientific community.

Through R+68 days there were no untoward arrhythmia events. Throughout this postflight phase the crew remained in good health.

FILL OUT EACH MORNING

SL-4 POSTFLIGHT QUESTIONNAIRE

Note: Questions generally apply to past 24 hours unless different time period is indicated.

General:
any injuries? _____ any blows to head past 24 hours? ____
meds past 24 hours? ____
Duration sleep last sleep period? ____
headaches? ____
head fullness? ____
dizziness? ____
vertigo? _____
subjective type (you spin)? ____
objective type (surroundings spin)? ____
sensation of extremity weight? ____
estimate how many g's it feels like ____
thirst? ____
other comments? _____

Skin:
rashes? ____
cracks? ____
itching? ____
pain? ____

Eyes:
vision change? ____
vision disturbance? ____
pain? ____

Ears:
fullness? ____
ringing? ____
pain? ____

Nose:
sneezing? ____
stuffiness? ____
drainage? ____
pain in sinus areas of forehead? ____
pain in sinus areas lateral to the nose? ____

Throat?
sores? ____
soreness? ____
bleeding? ____
subjective difference in own voice now? ____

Chest:
cough? ____
pain? ____
difficulty taking deep breath? ____
irregular heart rate sensation? ____

Abdomen:
stomach awareness? ____
nausea? ____
difficulty swallowing? ____
belching? ____
pain? ____
flatus? ____
was last stool hard, soft, or diarrhea-like? _____

Back/extremities
joint or muscle pains? _____ where? _____
joint or muscle stiffness? ____ where? _____
sensation of weak muscles? ____ where? _____
leg cramps? ____
sense of incoordination present? ____ when incoordination noted most? ____

Genito-urinary:
difficulty urination? _____

Neurological:
any paresthesias? (*i.e.*, tingling sensations) ____
tremors noted? ____
any further comments on instability, walking? ____
or using hands? ____

Exercise: (time allotted and type done) _____

_____

Figure 2.2.4.3-1. - SL-4 Postflight Questionnaire.

2.2.5 Operational Considerations

Preflight: Having the Crew Surgeon and Deputy Crew Surgeon head up a task force was a very satisfying and effective mode of operation. The approach followed, namely, the Crew Surgeons pulsing the experimenters on their demands and then getting the composite before the Directorate for approval or disapproval, worked well.

In-flight: Alternating three-day centers of duty provided a workable mode without excessive strain for the Crew Surgeon and his deputy. Analysis of the last mission's breakdown of shifts showed the detail shift gave the best coverage to the Crew Surgeon. Coverage for all medical personnel is depicted in figure 2.2.5-1.

The MOCR Surgeon acts as overseer to the medical team as a general rule. Because of cutback in personnel, the shifts were only partly covered by the surgeon. The basic MOCR medical scheduling was maintained in continuity by the Biomed and his med data and med systems support personnel working with Med Science. The Surgeon, assisted by the Aeromed, served largely as a consultant to the ongoing process and to developing health problems, whether noted by himself or by other Life Sciences Directorate (LSD) or Flight Operations Directorate (FOD) team members. This support by the Aeromed was in addition to his other assignments such as handling returning VCG data and preparing the Daily Health Status Summary (fig. 2.2.4.3-1) and reviewing dump tapes for medical items. The flow of medical information was discussed in section 2.2.3.

It would be advisable for the Crew Surgeon, with Directorate and MMT approval, and in conjunction with any other appointed members from the LSD of FOD, to sit on a Crew Status Committee to prevent the kind of momentum toward crew overloading that occurred on this mission. As a direct consequence of crew overloading, the Skylab Program was completed without the performance of IMSS verification procedures, an operational checkout of the IMSS equipment that was considered to be quite important to the overall program.

The crew surgeons required immediate data cataloging so that downflow of information could be systematically portrayed. On this mission support of this function was not consistent.

Primary Recovery Ship: The PRS phase went smoothly. Dr. LaPinta left with the Recovery Ship from San Diego on 4 January and was joined by the SML's, a basic SML crew, and by the Department of Defense (DOD) medical personnel subsequently at Hawaii on 11 January 1974. The remaining medical team onloaded at San Diego on 25 January, speeded up by the "threat" of erratic acting gyros. Dr. LaPinta maintained a

Figure 2.2.5-1. - In-Flight Schedule of Duty.

posture to do basic (table 2.2.5-I) but thorough medical evaluation in the event of early termination. The full medical team used its days onboard to rehearse the program for the R+0, R+1, and R+2 day protocols, and was completely ready to act on recovery day. The DOD medical personnel were integrated to provide backup support for medical and surgical contingencies should casualties occur during recovery; this plan is attached as exhibit L.

The Daily Crew Health Status Summary was transmitted to the ship daily and there was a daily communication (comm) with one of the Houston surgeons. For the future, one should be able to maintain comm capability between the crew's surgeons and the crew even after the former are on the Recovery Ship. The problem was that data transmission, although timely, was not consistent in content and did not always have the answers to questions the crew's surgeons would have put to the crew to maintain symmetry and continuity with the comm contents maintained by the crew's surgeons prior to leaving for the ship. Also, minutes of MMT and FMT meetings should be forwarded to the ship during the stay of the medical team onboard the recovery ship.

Onboard the PRS, medical data transmitted from ship to shore and back was largely oral. Execuport (teleprinter style) data transmission was tested for the eventuality of private data transmission but was not formally used.

Postflight: The JSC postflight phase involved continuous crew surveillance for 18 days and initiation of SL-4 report writing. The Deputy Surgeon assumed increased responsibility for the followup handling of crew protocols.

2.2.6 Inflight Medical Support System

2.2.6.1 IMSS training

The basic review of the IMSS material by the crew was done at Sheppard AFB from 5 through 7 March 1973. Each chapter of the book was discussed by the appropriate consultant and the emphasis was on learning basic diagnostic techniques and gaining familiarity with the medical hardware as well as medical terminology.

Additional training was obtained at Lackland AFB on 17 and 18 April. There the crew actually participated in dental extractions as part of their instruction on the use of the dental kit.

Practical exposure was obtained under the personal guidance of five Houston physicians (Drs. Warshaw, Sheena, Nelson, Price and Shoss). Emergency procedures were observed at Ben Taub Hospital on 7 and

TABLE 2.2.5-I. CONTINGENCY SHIP PROTOCOL (11-27 JANUARY 1974)
(Listed times are estimated times to do the procedure per crewmember)

Schedule		
R+0 Day	R+1 Day	R+2 Days
Blood pressure/pulse every 5 min for 1 h.	Blood/PVP, 15 min.	Physical, 30 min.
Microbiology, 10 min.	Physical, 45 min.	Leg measurements, 10 min.
Blood & PVP, 15 min. (Micro & blood are done during the same time that blood pressure and pulses are being checked.)	Leg measurements, 10 min.	Arm/Trunk measurements, 10 min.
	Arm/Trunk measurements, 10 min.	M171 (Crew), 50 min.
Heart auscultation, 10 min.	Audio, 15 min.	Mock rotation, 30 min.
	Visual, 60 min.	Food/Sample collection, minimum of 30 min, 3 times/day.
Physical, 30 min.	M171 (Crew), 50 min.	
Stand Test, 30 min.	Postural stability, 10 min.	
Skin folds, 5 min.	Mock rotation, 30 min.	
Leg measurements, 10 min.	Muscle strength testing, 45 min.	
Arm/Trunk measurements 10 min.	IR/Misc. Photos, 15 min.	
M171 (Crew), 50 min.	Food/Sample collection, minimal of 30 min, 3 times/day.	
IR/Misc. Photos, 15 min.	M133, 10 min presleep.	
Food/Sample collection, minimal of 30 min, 3 times/day.		
Chest X-ray (PA & lateral), 15 min on two occasions.		
Total time for R+0 day contingency is 345 min, or 5 h, 45 min.	Total time for R+1 day is 420 min, or 7 h.	Total time for R+2 days is 220 min, or 3 h, 40 min.
SUBSEQUENTLY ADDED TO R+0 - M092. (1 Hour Per Man)		

NOTE: The following items are deleted as compared to the normal R+0, R+1 and R+2 day protocol: M078, Pulmonary Function, Echo Cardiography, Stereo Photos, ECG Sensoring, Isotope Work, Circulation Time.

The following items are modified from the normal R+0, R+1 and R+2 day protocol: Cardiac X-rays (synchronized) and Microbiology.

Jerry R. Hordinsky, M.D. Charles K. LaPinta, M.D.

25 January 1974

MEDICAL PLAN
SKYLAB-III RECOVERY

I. MISSION: PRS/DOD medical personnel will provide medical and surgi- care to all PRS, NASA, DOD, and other embarked personnel; control casu- evacuation; provide for a walking blood donor program for the astronau- provide for x-ray studies as needed for the astronauts; provide labora- facilities to function as a backup to the NASA medical laboratory.

II. EXCUTION:

A. The surgical team will be under the military command of the Commanding Officer of the PRS and subject to his authority for disci- and administration. Medical personnel of the PRS will provide assis- tance as required to the Surgical Team.

B. The Medical Officer of the embarked ship shall perform his normally assigned duties as ship's medical officer and staff medical officer. He will discharge his responsibility to the ship's Commandi- Officer.

C. Medical and Surgical Care: The ship's sick bay area and asso- ated facilities will be available to those individuals embarked on the SKYLAB mission. Routine sick call will be from 0800 to 0900 hours and 1300 to 1400 hours daily. Emergencies will be handled at any time.

D. Casualty Evacuation:

1. Astronauts:

a. Command Module Recovery: Three teams of four persons each will be designated as litter-bearers for the astronauts. These individuals will be screened the day prior to recovery for illnesses a will be wearing protective maskes or respirators as required by NASA. They will stand ready at the Hanger Deck level in the vehicle stowage area. An evaluation of the astronauts will be made by the NASA physi- cians on the egress platform. Should the astronauts be able to egress on their own, the litter-bearers will remain on hand in case of emerge until entrance into the SML's. If the astronauts are unable to egress on their own, Mel Richmond (NASA) will signal Milt Heflin (NASA) as to the number of litters required. The signal will be relayed to YN3 Renadette, team leader of the litter-bearers who will then lead the

required number to the CM. The litter-bearers will hand the litters to the NASA physicians who will be responsible for placing the astronauts on the litters. The astronauts will then be carried, under the direction of NASA physicians, either to the SML's or the casualty elevator into sick bay.

b. Helicopter Recovery: Should this method of recovery occur, the litter-bearers stationed at the vehicle stowage area at the hanger deck level will be alerted by the announcement on the 1MC, "The astronauts will be recovered by helicopter". They will, upon the signal from the Hanger Deck Petty Officer, move to the no. 2 aircraft elevator. Once the helicopter has landed and shut down, the no. 2 elevator will ascend to the flight deck. Should the astronauts be unable to egress under their own power, Mel Richmond will signal YN3 Renadette as to the number of litters required. YN3 Renadette will then lead the required number to the helicopter. The astronauts will be lifted out of the helicopter, carried to the no. 2 aircraft elevator, descend to the hanger deck level and be carried to the SML's or casualty elevator as determined by the NASA physician.

c. Astronaut Casualties: Initial identification and extent of injuries/illness among the astronauts after splashdown will be made by the NASA Flight Surgeon on the scene. Upon notification of Sick Bay personnel, the litter-bearers will proceed as in a supine recovery, either helicopter or CM type. Should the astronauts require emergency care, they will be carried to the casualty elevator located port side, aft hanger deck level. The elevator can provide means of ascent into Sick Bay for two astronauts and two physicians at one time. The NASA Flight Surgeon will determine in what order the astronauts will ascend into Sick Bay. The astronauts will be removed from the elevator by a team located in the S&R area of Sick Bay. The casualties will be placed on Gurney stretchers and taken to the ICU for triage and stabilization or directly to the OR depending on the extent of injuries. The DOD Surgical Team consisting of two surgeons and two anesthesiologists will work in conjunction with NASA physicians to provide immediate care and definitive therapy as required in the ICU area.

2. Non-astronaut Casualties:

a. Prior to and following recovery: Two teams of four men each will be available for the casualty handling. They will be called away by the 1MC or 5MC when an injury occurs. If the injury occurs on the hanger deck, the litter-bearers will carry the injured directly to Sick Bay via the casualty elevator. If it occurs on the

Flight Deck, the same method as described in a helicopter recovery (section D.1.b) will be used. Injuries below deck will be brought to Sick Bay by the most accessible route. In the case of mass casualties the following procedure will be followed:

(1). Sorting will be done by the following categories:

I - Ambulatory requiring no immediate care
II - Walking wounded or ill
III - Litter-borne ill
IV - Expectant category (Shock, airway problems)
V - Dead

(2). Traffic pattern

(a). Category I and II will be led from the triage area located at the casualty elevator to the casualty overflow compartment via the starboard trunk or if no conflicting vehicle traffic via the vehicle stowage area and fantail. Patients with minor wounds will first go to X-ray, then showers and finally, to the S&R area for debridement.

(b). Category III will be taken to the casualty overflow compartment via the casualty elevator and go to the starboard passageway to X-ray and treatment room.

(c). Category IV patients will have first priority to be taken up the casualty elevator to the S&R area for resuscitation and preparation for surgery, including washing, I.V. fluids, type and cross matching blood, portable X-rays, *et cetera*.

(d). Category V. The patients who have expired will remain on the hanger deck until all other casualties are cleared out of the triage area. The dead will then be taken directly to the morgue on the after hanger deck.

b. At the time of recovery: Two teams of litter-bearers will be available for casualty handling. They will be called away by the 1MC and 5MC; they will pick up the casualties on the flight deck and carry them to the no. 1 aircraft elevator. They will descend to the hanger deck level and carry the injured to the casualty elevator. If the injury occurs on the hanger deck, the injured will be carried to the casualty elevator by the most direct route in the same fashion as an injury occurring below decks.

E. Walking Blood Donor Program: Blood donors for each of the following blood types have been identified and blood samples tested for RPR and HAA. These are A+ and B+. Each donor will have an identification card to gain access to Sick Bay if needed. Five units of blood for each astronaut will be drawn 48 hours before recovery and be kept available for use. If any additional blood is required, the remaining donors will be called away on the 1MC by, "All designated blood donors report to Sick Bay".

F. X-ray: The ship's X-ray machine and technician will be required for use in examining the astronauts. The X-ray technician will be screened prior to recovery for any infectuous process. During the time of the X-ray examination Sick Bay will be closed to non-authorized personnel except for medical emergencies.

G. The ship's laboratory will function as the primary blood bank and as a backup laboratory for the NASA investigative team. It will be manned by ship's personnel and three DOD laboratory technicians. They will be responsible for the typing and cross matching of blood as well as the actual obtaining and storing of the blood.

H. Security: Should the Sick Bay be required for the astronauts, four marine guards will be stationed to prevent access by unauthorized personnel. The list of authorized personnel will be posted at each of the entrances.

I. The casualty elevator, located port side aft hanger deck level, will be manned by an operator while the astronauts are in the SML's, and the operator will be on call during the entire time the astronauts are on board.

K. Personnel Assignments

1. Recovery stations

Dr. Boyd	Sick Bay
HMC Banks	Sick Bay
HM1 Johnson	Sick Bay
HM1 Canas	Sick Bay
HM2 Kline	Flight Deck
HM2 Gnuschke	Sick Bay
HN Morel	Flight Deck
HM Kilian	Hanger Deck
HN Holquin	Life Boat
HN Colwell	Sick Bay

2. If after splashdown and recovery of astronauts no illness injury is reported, the astronauts will be taken to the SML's and the above assignments will hold.

3. Casualty Treatment Assignments

a. Treatment team no. 1	LTC Powell LDCR Carson SSGT Ebert
b. Treatment team no. 2	LTC Pauling LTC Watson TSGT Lawhon
c. Treatment team no. 3	LT Boyd LT Haag HN Colwell
d. Administrative/communications coordinator	HMC Banks
e. Blood donor center	HM1 Johnson HM1 Sydejko Designated NASA personnel
f. S&R litter-bearers	MSGT Stewart HM2 Kline HM2 Gnuschke HM2 Kilian
g. Casualty elevator operator	DT2 Collier
h. X-ray	HM2 Kilian
i. Pharmacy	HM2 Kline

L. If on splashdown astronauts present with injuries/illness, word will be passed, "All designated medical personnel report to Sick Bay". Designated DOD, NASA and ship's company personnel will immediately report to the S&R area of Sick Bay for briefing and further instructions.

M. After briefing and instructions the following preparatory measures will be carried out:

1. TSGT Lawhon and HM2 Gnuschke insure ICU ward is ready to receive patients.

2. HN Colwell, and SSGT Ebert insure the three OR's are properly prepared and ready to receive patients.

3. HM1 Johnson and HM1 Sydejko insure blood center is prepared.

4. MSGT Stewart insure S&R area is ready for patients.

5. HM2 Kilian make ready the main X-ray and one portable unit for immediate use.

N. Should surgical intervention be required, treatment teams will utilize the operating rooms as follows:

Treatment team no. 1 to OR no. 2
Treatment team no. 2 to OR no. 1
Treatment team no. 3 to OR no. 3 (Treatment Room)

8 September. Actual procedures were practiced at a dog laboratory a the Medical Center.

Examples of observed cases included: Serous otitis, tonsillitis, perforated ear drum, maxillary sinusitis, right-side tonsillar absces pericardial rub, pleural rub, rales (various) and palpation of PAC's and PVC's.

In the dog laboratory, the following procedures were performed: IV's were started, sutures were placed, tracheotomy, and intracardiac injection.

Additionally, "medical letters", summarizing items of medical import were given to the crew to use on an as-required basis. Topics covere in this fashion included such material as SL 1/2, SL 3 medical data a reviews of "motion sickness" in prior crews as well as potential rem

An example of crew requested training was setting up for crew blood drawings; though largely set up to train in the technique of blood drawing, the setups were further utilized to demonstrate the variabi of cholesterol and triglyceride in response to time of day and generi diet patterns.

2.2.6.2 IMSS Checklist evaluation

The checklist is a quick review of already mastered procedures and pro vided an appropriate review of the basic routine and emergency medica problems. The checklist has many built-in assumptions which a medica oriented person easily understands, but which can easily confuse the layman; therefore, many more hours of medical exposure would have bee necessary before this checklist could have been utilized with ease an correctness. It is fortunate that no time-consuming evaluation of disease or injury arose during the 84-day mission.

To help expeditious response in two specific areas, special "usage rules" were added to the IMSS Checklist which allowed for access to the freshest of the many onboard drugs (most having been launched with SL-1 and others added with each subsequent manned mission), and a special SWS Cue Card (2-21) was added which compiled the most time-critical emergency procedures. The "usage rules" and the Cue Card are appended as exhibit M.

2.2.6.3 Drugs

The "usage rules" referenced in section 2.2.6.2 were necessary as several sets of replacement drugs were on board the OWS. The drugs

D72

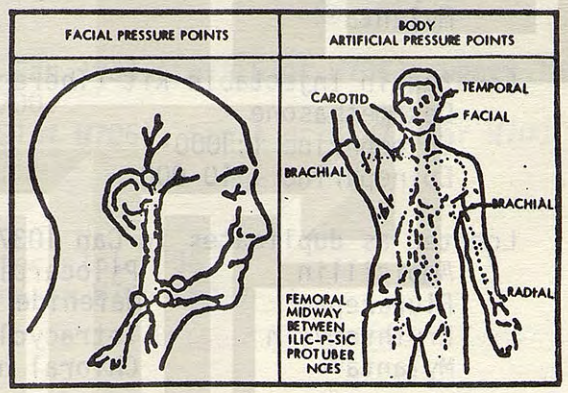
IMSS EMERGENCY 9/13/73

Airway Sequence

1. (23-7) Tilt head back - lift chin forward
2. (23-7) Sweep mouth - tongue anterior - plastic airway optional
3. (23-7) Hit between shoulder blades
4. (23-9) Artificial ventilation:
   a. Mouth to mouth
   b. Once every 4-5 seconds
   3. Monitor skin color, pupils, carotid pulse
5. (23-19) Tracheotomy:
   a. First groove below thyroid cartilage
   b. Continue artificial ventilation thru tracheotomy

Hemorrhage Sequence

1. (23-25) Major bleeding - pressure points
2. (23-25) Oozing - add broadly dispersed pressure to site of bleeding
3. Be alert to not over-pressing on scalp, if bone fracture is possibility



Cardiores-piratory Sequence

1. Need dictated by observation of respiration/ skin color/pupils/ carotid or radial pulse.
2. Strike breastbone 3 times
3a. (23-13) 2 man rhythm: 1 ventilatory assist (3 counts)/5 circulatory assists (5 counts)
3b. (23-15) 1 man rhythm: 2 ventilatory assists (6 counts)/15 circulatory assists (15 counts)
4. (23-17) Cardial needle with 10 cc Epinephrine
   a. Insert 1-1/2"-2" (perpendicular to surface) at left side lowest part sternum,
   b. Then turn syringe-needle in direction of left shoulder, pushing another 2"-2-1/2",
   c. Inject 5 cc Epinephrine as soon as blood sucked up,
   d. Reinsert and inject 5 cc Epinephrine after 30 seconds heart-lung resuscitation.

Shock Sequence

1. Diagnosis indicated by: Anxiousness; restlessness; skin pale; cool, clammy, sweaty; pulse rapid, weak, thready; BP falling; pupils dilated.
2. As noted above: Control hemorrhage, maintain airway, give required heart-lung resuscitation.
3. Monitor BP/P/Resp at least every 10 minutes
4. (23-37, 23-39) IV fluids

SWS CUE CARDS

DRUG INVENTORY/LOCATION GUIDE

SL 1/2 FRESH RESUPPLY DRUGS:

NOTE: Fresh SL 1/2 drugs will have fill dates of April or May '7

Located in Drug Drawers (W707)

Ampicillin	Pilocarpine
Chloral hydrate	Scopolamine
Flurazepam	Mafenide
Dextroamphetamine	Fluocinolone
Erythromycin	Tetracycline
Mylanta®	

Located in Injectable Kit (Therapeutic Kit - W709)

- Dexamethasone
- Epinephrine 1:1000
- Epinephrine 1:10 000

Located as duplicates in Can 1037 (Left Slot, W706)

Ampicillin	Pilocarpine	Scopolamine drops
Flurazepam	Mafenide	Dextroamphetamine
Erythromycin	Tetracycline	
Mylanta®	Chloral hydrate	

SL-3 FRESH RESUPPLY DRUGS:

NOTE: Fresh SL-3 drugs will have fill dates of June or July '7

Located in Drug Drawers (W707)

Polymyxin	Nasal Emollient
Oxymetazoline	Neosporin® Ointment
Diphenhydramine	pHisoHex®
J&J® First Aid Cream	Scopolamine/Dextroamphetamine sul
Cephalexin	Tolnaftate

Located in Injectable Kit (Therapeutic Kit - W709)

Heparin Sodium	Diazepam
Cyclizine	Mephentermine
Meperidine	Lidocaine 1% c̄ EPI
Pentobarbital	Lidocaine 2%

Located in Dental Kit (W709)

- Lidocaine 2% c̄ 1:100 000 EPI

®Registered

SL-4 FRESH RESUPPLY DRUGS

NOTE:* Fresh SL-4 drugs will have fill dates of August or September '73.

SL-4 resupply drugs that are added to W707 drawers or to W709/injectable kit may be used interchangeably with fresh SL 1/2 - SL-3 drugs located there, but SL-4 resupply ophthaine is to replace ophthaine presently in W754.

ORIGINAL SL 1/2 DRUGS:

Capsules, tablets, topicals: Can 1034 (Left Slot W706), upper level in W706, can A or B/W732 or W700.
Injectables: Can 1034 (Left Slot W706), Can A or B/W732 or W700.

ORIGINAL SL-3 DRUGS

Undeployed Cans remain in center slot W706
Topical drug supply kit remains in W706 (pg 1-3)

ORIGINAL SL-4 DRUGS:

Cans in right slot W706 can be opened but are not deployed
Topical drug supply kit remains in W706 (pg 1-3)

USAGE RULES: Oral/Topical Drugs

Check if desired drug is in fresh SL-4 supplies (pgix), fresh SL-3 (pgx), or fresh SL 1/2 (pgx) and use if available.

If not in fresh supplies, use drug in SL-4 cans (W706 right), in topical drug supply kit (W706 left), or in W754 chiller.

Injectables

Use any in injectables kit or dental kit.

NOTE: Ten cc intracardiac epinephrine/syringe and one cc epinephrine in tubex syringe located in W700 along with tracheotome, BP cuff, and hemostat.

supplied fresh for SL-4 and in addition to the regularly supplied dr
drug kits were:

Scopolamine/dextroamphetamine sulfate
Aerosporin® Otic Solution
Tinactin® Solution
Neosporin® Ointment
Thorazine® Suppositories
Epinephrine 1:1000
Epinephrine 1:10 000
Marezine,® Injectable
Penicillin
Peri-Colase®
Ophthaine®
Penicillin-G, Injectab
Decadron,® Injectable

®Registered

The injectables were largely resupplied because of potential degrada
noted in Skylab concurrent ground-based testing simulating the Skyla
environment (except for zero-g). One injectable, Penicillin-G, was
replace an inadvertently returned one by SL-3. The noninjectables in
cluded drugs with potential for heavy use, or drugs about which data
accumulated indicating that the original OWS drugs may have incurred
further degradation subsequent to the increased temperatures of the
post SL-1 launch phase.

2.2.6.4 Equipment evaluation

The preflight evaluation of the IMSS equipment was generally satis-
factory. Items in question included:

Tracheotome - Inadequate sharpness, somewhat time consuming to u

IV Bags - Plastic tubing crushed in packaging

Endotracheal Tube - Crushed in packaging

Injectables - Difficult to pull covers off needles

10-cc, 1:10 000 Epinephrine Injectable - Glass broken on one sample container

Catheterization Kit - Kit contained inadequate sized collection bags

Head Mounted Light Source - Light focused poorly

Thermometer - Unverified accuracy

2.2.6.5 In-flight utilization

As already discussed under various sections dealing with in-flight crew health, the primary use of the IMSS was as a source of drugs for miscellaneous medical problems.

The diagnostic equipment utilized included the otoscope for the evaluation of the PLT's left ear fullness (occurring MD 29 through 32), the thermometer during several of the "congestion" episodes and the hemoglobinometer and refractometer as part of routine checking by the crew. Refer to section 2.2.6.7 for comments on the hemoglobinometer and refractometer usage.

The CDR's diagnostic acumen was noticed when he recognized by the change in voice sound that the Cap Comm, Hank Hartsfield, had a cold.

2.2.6.6 Checklist and performance evaluation

To test the IMSS procedures which had not had verification of the facility in zero-g, the crew requested preflight that the IMSS procedures be included on a "shopping list" format to allow checking out the techniques in the event that specific procedures were not required because of actual disease or injury.

Unfortunately, in spite of best intentions, no formal inclusion of simulated illness or injury was possible because of the extremely tight time lines.

Optimization of IMSS procedures for zero-g environment must await the Shuttle program. A list of the checkout procedures that had been included in the "shopping list" were as follows:

IMSS-D1*	Emergency
	Artificial ventilation and circulation Two-man heart-lung resuscitation
IMSS-D2	Emergency
	Artificial ventilation and circulation One-man heart-lung resuscitation
IMSS-D3	Chest/Lung Examination
	Heart Examination
IMSS-D4	Head/Neurological Examination

IMSS-D5 Abdominal and GU Examination

IMSS-D6 Eye Examination

IMSS-D7 Ear, Nose, Throat Examination

IMSS-D8 Musculoskeletal Examination; simulating closed fracture and open fracture

IMSS-D9* Wound closure simulation

IMSS-D10 Blocked airway and tracheotomy simulation

IMSS-D11 Intravenous infusion and verification of flow chart

*Included in the crew options was the use of the Data Acquisition Camera (DAC) for M516 photography of the IMSS-D1 and -D9 demonstrations.

2.2.6.7 Hemoglobin and specific gravity

Hemoglobin and specific gravity were checked at the time of the regular blood drawings in SL-3. This same plan was initially followed by the SL-4 crew, but, as a time saving measure, the specific gravity was deleted except for clinical necessity after MD 38.

The hemoglobin level continued to be checked but because of low readings around MD 59, additional checks were made between regular blood drawings. It was during this period of increased need for hemoglobin determinations that a shortage of hemolysis applicators was noted and a "reuse" plan for the applicators was formulated and sent to the crew.

A fingerstick Hb was performed on the PLT on MD 21 as the syringe had floated off and could not be located; Hb was nominally done from venous blood. The extra hemoglobin checks done toward the end of the mission were, again, also from fingerstick blood.

2.2.7 Skylab Rescue Readiness

Charles E. Ross, D.O., M.S.

The Skylab Rescue (SL-R) Mission medical plan was basically conceived during the primary comprehensive planning for the Skylab Program. The actual operational version evolved during the SL-3 Mission when propellant-oxidizer system problems developed in two of the four service module quadrants, threatening an early termination of the mission. Thus, a medical plan that could be readily implemented was developed by a cadre of medical and engineering personnel.

The major problems of the SLR-3 Mission held in common to any other SL-R mission included:

- the number of days to ready a crew and a Command Service Module/Launch Vehicle for a launch and rescue mission,
- the mission duration which could be variable from 51 hours to a design capability of 5 days,
- the Rescue Mission recovery problems which involved the nominal entry of five suited crewmen into a recovery area of decreased daylight, and
- the return of fewer medical specimens, due to weight allocation, causing alteration of the design of medical experiment data.

The SLR-4 Mission was to have been a contingency mission designed to provide for the safe return to Earth of the SL-4 crew in the event the CSM was rendered unusable for a safe return, or, it could have been initiated if Life Support System problems in the SWS compromised the crewmembers to the extent of creating incapacitation.

Considered to be strictly an operational mission, only a minimal amount of experimental data was to have been obtained during the pre-flight period and after a rescue mission was announced.

The crew designated for the SL-R mission was Vance Brand, the Commander, and Don Lind, the Pilot. These two crewmen had served as backup crewmembers for the SL-3 and SL-4 Missions. In addition, they had been designated for an SL-3 Rescue Mission, which was never flown. Both individuals had had multiple designated (*Skylab Medical Requirements* document, MSC-00794, Revisions A and B) physical evaluations during the conduct of the above described missions. No medical problem was identified during these sequences, and in fact, the general trend of medical and operational experimental data showed continuing improvement,

or at least favorable stability. The only medical operational concern was an idiosyncratic reaction which the PLT had on oral testing of the antimotion sickness medication - scopolamine/dextroamphetamine sulfate. This was a transient reaction consisting of "visual confusion" related to the pharmacological effects of scopolamine on the eyes.

On 19 January, 1974, a medical examination (F-30 day type) including complete laboratory evaluation and anthropometric measurements was performed, and the crew was briefed on the proposed FCHSP for SLR-4 (exhibit N).

The health stabilization program attempted to provide optimum protection to the SLR-4 crewmen since there was no assigned backup crew, and to prevent any illness that would compromise the SL-4 experiments and crew medical assessment. The guidelines for an SL-R mission were implemented by the SLR-4 Crew Surgeon, Dr. Charles Ross, who interviewed and physically examined both crewmen weekly; he also gave surveillance to the families' health status. Bacterial and viral cultures were obtained from the SL-R crewmen at frequent intervals during the final month of SL-4 as the immunological status of the CDR and PLT was of continuing concern during this period of time, but no pertinent clinical changes were noted. Multiple interfaces were made between the SLR-4 Crew Surgeon and the SL-4 Crew Surgeon and personnel from the FCHSP Office and the bacteriology and virology laboratories to discuss clinical data of operational importance.

If a rescue mission had been announced, certain listed actions were to have been taken, but no medical experiment baseline testing was scheduled during the 10-day preflight period. A prelaunch physical examination (exhibit O) was scheduled between F-7 and F-5 days after which daily brief medical examinations were to be performed. The need for a SLR-4 Mission did not materialize.

SKYLAB RESCUE CREW EVALUATION

Thursday, January 10, 1974, Bldg. 8

0730-0800 Laboratory Evaluation

Blood - 45 ml

(1) Hematology
(2) Chemistry
(3) Immunology
(4) Cellular Immunology

Urine

(1) 24-hour urine sample
(2) Urine (midstream) for routine analysis

Microbiology

(1) Oral Microbiology
    a. Throat swab
    b. Throat gargle
(2) Body surface swabs
(3) Feces
(4) Urine

0800-0815 Anthropometric Measurements

0815-0915 Personal Hygiene and Breakfast

0915-1030 Physical examination on PLT and dental examination on CDR

1030-1145 Physical examination on CDR and dental examination on PLT

January 8, 1974

FLIGHT CREW HEALTH STABILIZATION FOR SLR - 4

Purpose: To provide general guidelines for SLR-4 crewmen to minimize the probability of exposure to infectious disease during the prelaunch period of an SLR-4 mission.

Guidelines (unannounced mission):

- Verify that approved immunizations for all family members are current.
- Be alert for any signs of potential disease onset in self and family members.
- Report to Flight Medicine Clinic for examination of self and/or family members if any change in general health status noticed.
- Instruct all family members to avoid contact with known ill individuals.
- Limit personal contact to own household and normal work related individuals.
- Be alert for and avoid contact with individuals that may appear to be expressing disease symptoms.
- Avoid outside activities involving individuals other than household members and normal work related individuals (parties, banquets, press conferences, etc.).
- Avoid meetings, training sessions, site visits, and etc. that may involve individuals other than normal work related population.
- Take special precautions in planning family activities to avoid contact with children other than own and with individuals who are ill or who are expressing indications of disease onset.
- Make arrangements for alternate residency for self or family members in case of family member illness to avoid repeated contact.
- Avoid activities during off-duty hours that result in excessive fatigue and stress.
- Obtain medical microbiology and provide family history on a weekly basis.

Guidelines (announced mission):

- Crewmen will reside in on site (JSC) house trailers and will eat Skylab food.
- All personnel contacting crewmen will wear surgical masks.
- Meetings at JSC or other locations involving non-primary contacts and the crewmen will be held via telephone and closed circit TV where possible.
- Meetings where the above arrangements cannot be made should adhere to the following procedures.
  - (1) Crewmen should be seated in an isolated area in the conference room.
  - (2) Attendance should be minimized. Crewmen and meeting attendees must wear surgical masks. The senior management leader should poll the attendees to determine if anyone is feeling ill or members of their family have an infectious disease. If anyone does indicate that either of the two above conditions exists, they should be asked to leave the meeting.
  - (3) The Health Stabilization Office should, if possible, be notified at least one to two hours before the meeting so that this plan can be implemented.
- Guidelines for unannounced mission, as applicable.

2.3 Nutrition

2.3.1 Food, Vitamin Evaluation

Malcolm C. Smith, Jr., D.V.M.; Norman Heidelbaugh, D.V.M., Ph.D., M.P.H.; Clayton S. Huber, Ph.D.; Harry O. Wheeler, Ph.D., Rita M. Rapp, M.S.; and Paul C. Rambaut, Sc.D.

Nutrition in the third manned Skylab mission was remarkable in that the crew adhered to the prescribed menus under the most adverse conditions, namely, loss of food quality due to age and high environmental temperatures in the OWS, and the very long duration of the mission. Also, the foods added to extend the mission duration were developed primarily for nutrient efficiency instead of consumer acceptance. These foods tend to become monotonous after only a few menu cycles.

The flight menus were adjusted to provide each crewman with his preflight ground-based energy requirements. The increased energy requirements were estimated based upon the second and third manned Skylab experiences. The food on the OWS was sufficient to supply the scheduled menus for a 56-day mission except for a minimum number of beverages (15) and a diminshed quantity of energy adjustment items.

In order to provide food for the 28-day extension, High Density Food Bars were developed and included in the preflight, in-flight, and post-flight food systems. These foods made it possible to remain within CSM launch weight and volume constraints while maintaining nutrient intake tolerances specified by Medical Experiments M071 and M073.

A total of 159 pounds of food was stowed in the CSM. This was approximately 110 pounds more than the nominal CSM food supply. Food was removed from the usual stowage volumes in the L-3 and A-7 lockers and stowed in Beta cloth bags on the side of lockers A-7 and A-9. Other Beta cloth bags were located on top of A-1, A-3, A-4, A-5, and A-6 lockers.

The nominal 6-day menu cycle was increased to a 9-day cycle utilizing "high density menus" (figure 2.3.1-1) every third day. The high density menus were developed especially for this mission and consisted of one-half the caloric intake provided by the High Density Bars and the other half by nominal Skylab foods and beverages available in onboard overage food items.

Approximately 10 days of food was required to support a rescue mission. This contingency food supply consisted of 120 chocolate flavored Survival Bars. The bars measured 3/8 in. x 2 in. x 4 in. and provided approximately 500 calories each. Contingency menus were also developed which could be used in the event of a freezer failure and a loss of