

Thornton

24 JANUARY 66



MOL
manned
orbiting
laboratory

CREW TEST AND MONITORING



**MISSILE & SPACE
SYSTEMS DIVISION**

REVIEW OF CREW TEST AND MONITORING EQUIPMENT STUDIES

24 JANUARY 1966

AEROSPACE CORPORATION

BUILDING A1, ROOM 1062

AGENDA

9:15 AM	INTRODUCTION	D. E. HAVENS
9:20 AM	BIOMEDICAL BASELINE	J. M. DICK
9:30 AM	BASIC PHYSIOLOGICAL MONITORING INSTRUMENTATION	S. T. SCHY
9:45 AM	INTEGRATED CARDIO-PULMONARY MEASUREMENTS	J. M. DICK
10:05 AM	FLUID BALANCE AND DISTRIBUTION	J. M. DICK
10:30 AM	BREAK	
10:45 AM	ON-ORBIT WET CHEMICAL ANALYSIS	R. P. COX
11:00 AM	PREPARATION AND PRESERVATION OF BIOCHEMICAL SPECIMENS	R. P. COX
11:15 AM	PHYSIOLOGICAL CONDITIONING	J. A. MASTROPAOLO
11:45 AM	BODY MASS DETERMINING DEVICE	R. GRIMES
11:55 AM	CREW TEST AND MONITORING SYSTEM INTEGRATION	D. E. HAVENS
12:00 PM	LUNCH	

BASIC BIOMEDICAL MONITORING EQUIPMENT

V111-5

GEMINI SYSTEM

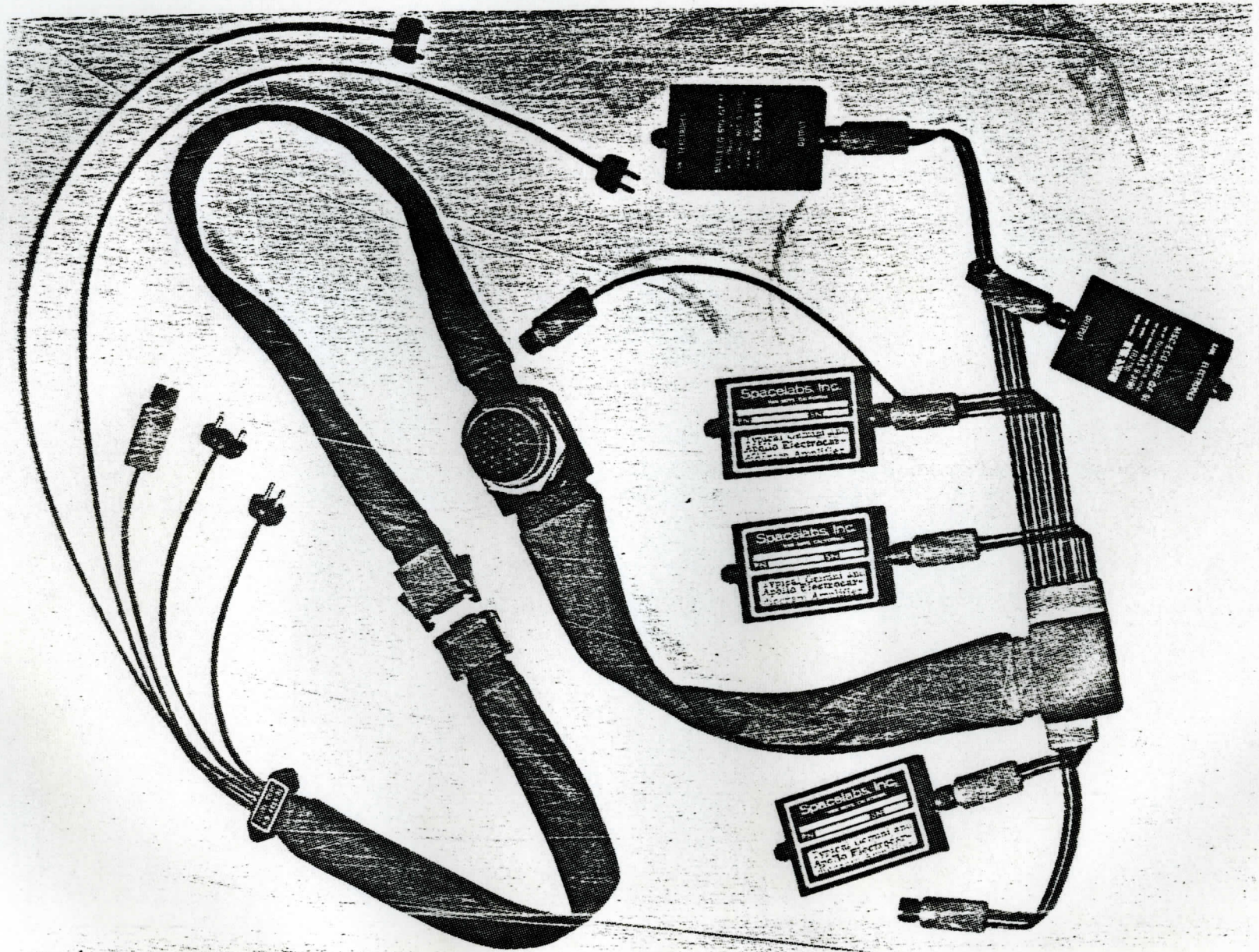
- E. K. G. STERNAL
- E. K. G. AXILLARY
- IMPEDANCE PNEUMOGRAPH
- BLOOD PRESSURE
- ORAL TEMPERATURE

PROPOSED BASIC MOL SYSTEM

- CARDIOTACHOMETER
- INTEGRATED V. C. G. VEST
- ARTERIAL BLOOD PRESSURE - SAME AS GEMINI
- ORAL TEMPERATURE - SAME AS GEMINI

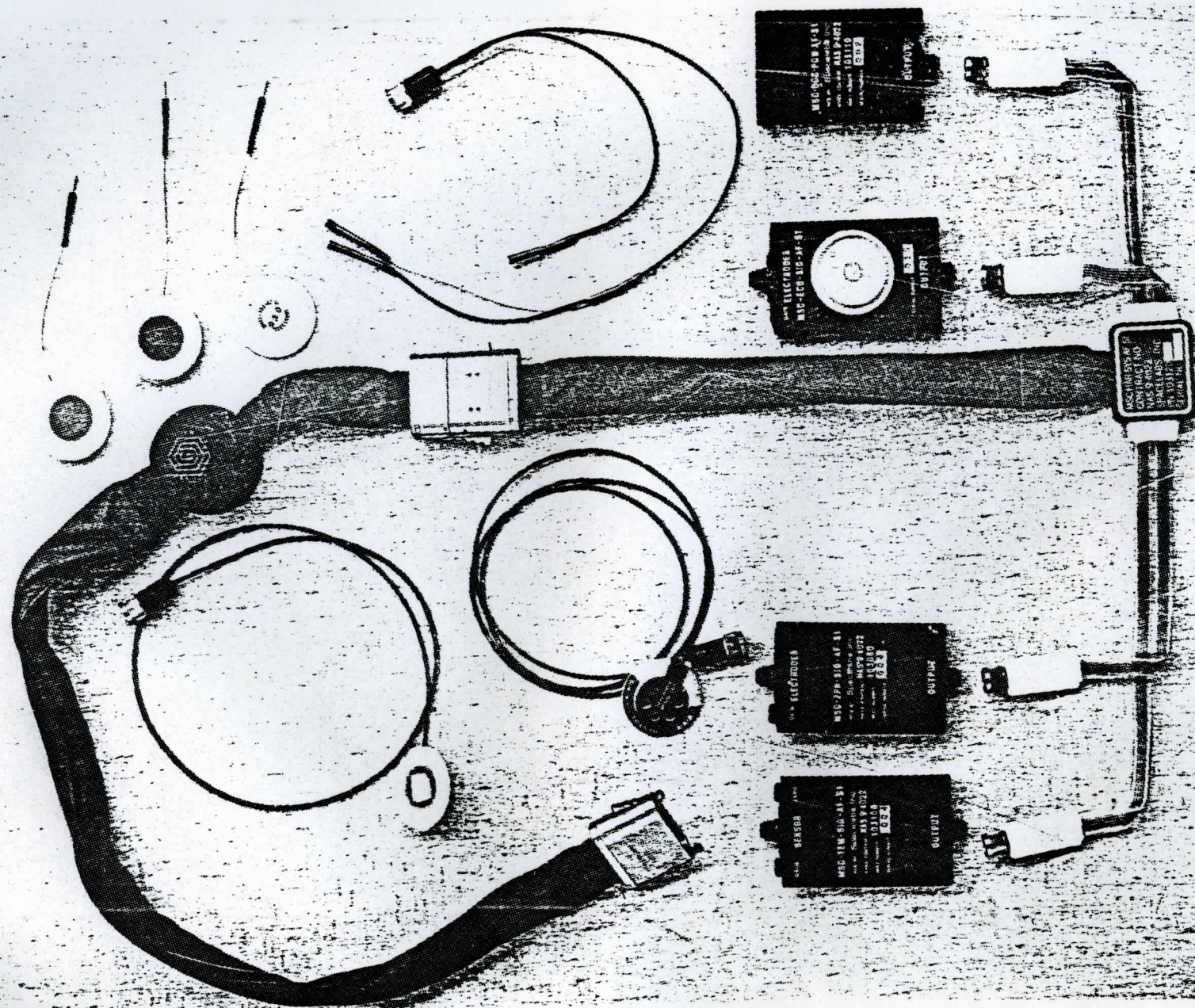
GEMINI BIOINSTRUMENTATION

V109-7



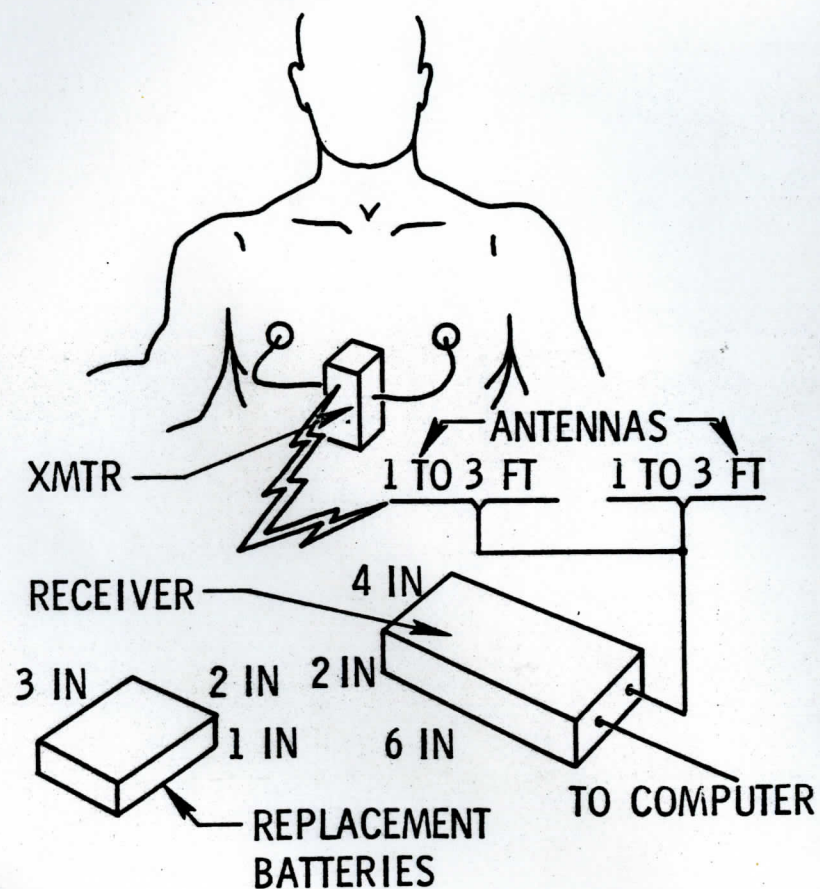
APOLLO BIOINSTRUMENTATION

V109-6

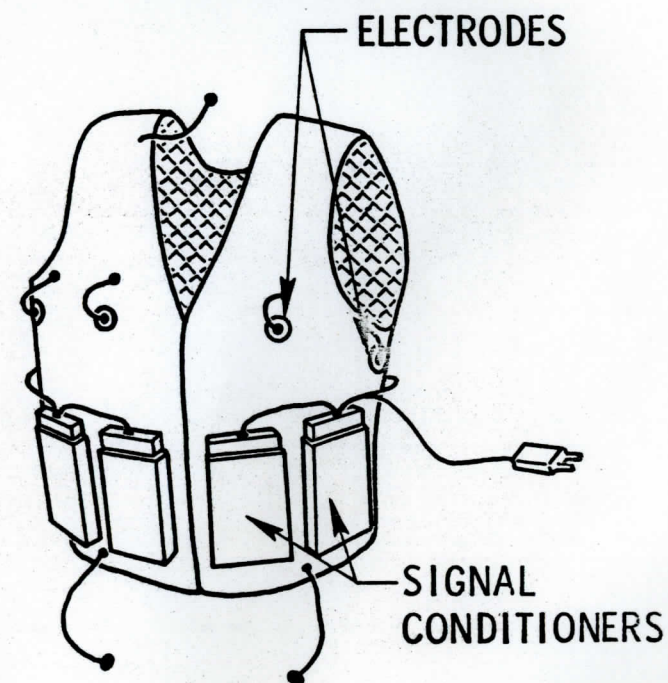


BIOMEDICAL MONITORING DEVICES

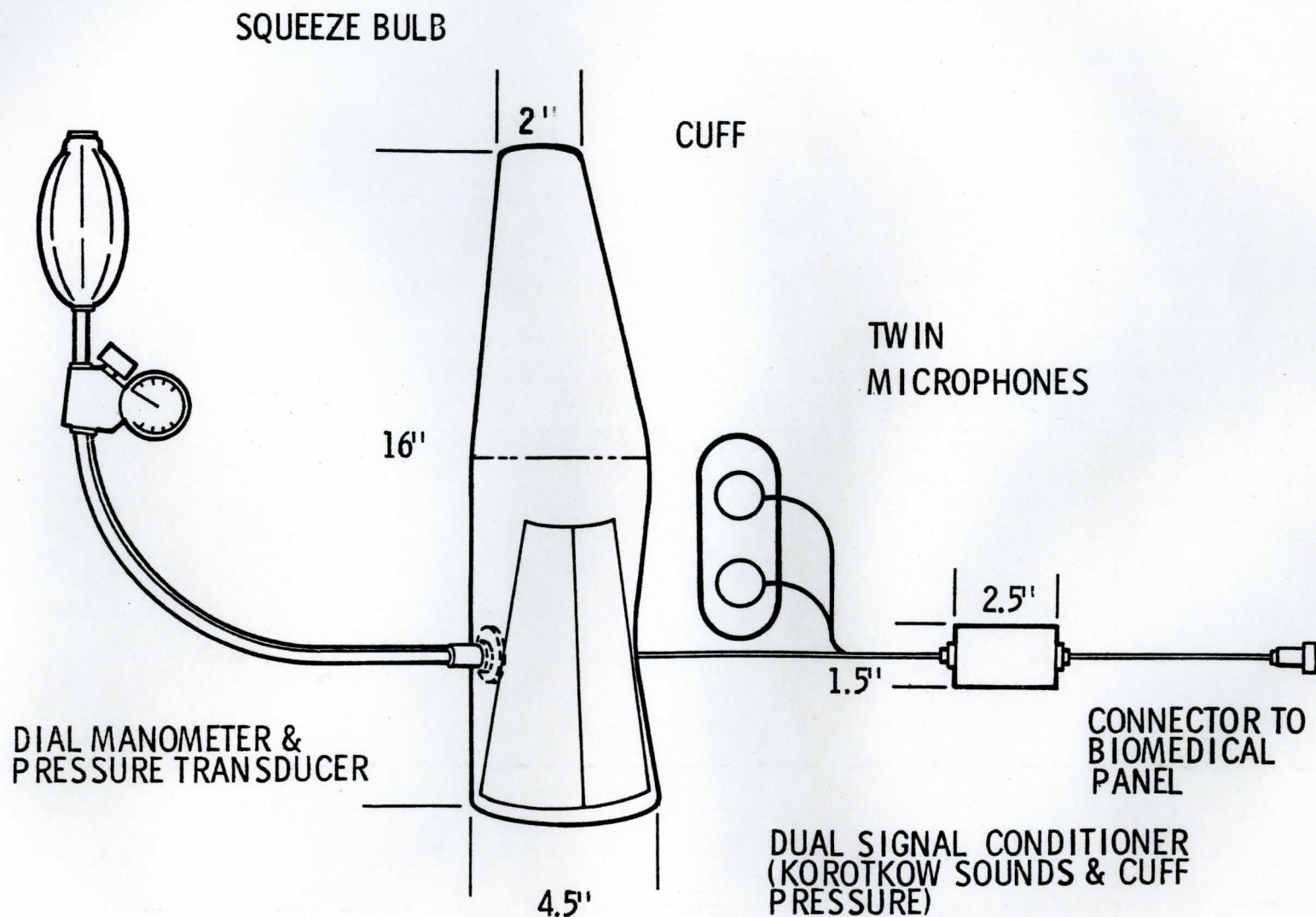
HEART RATE



VCG VEST

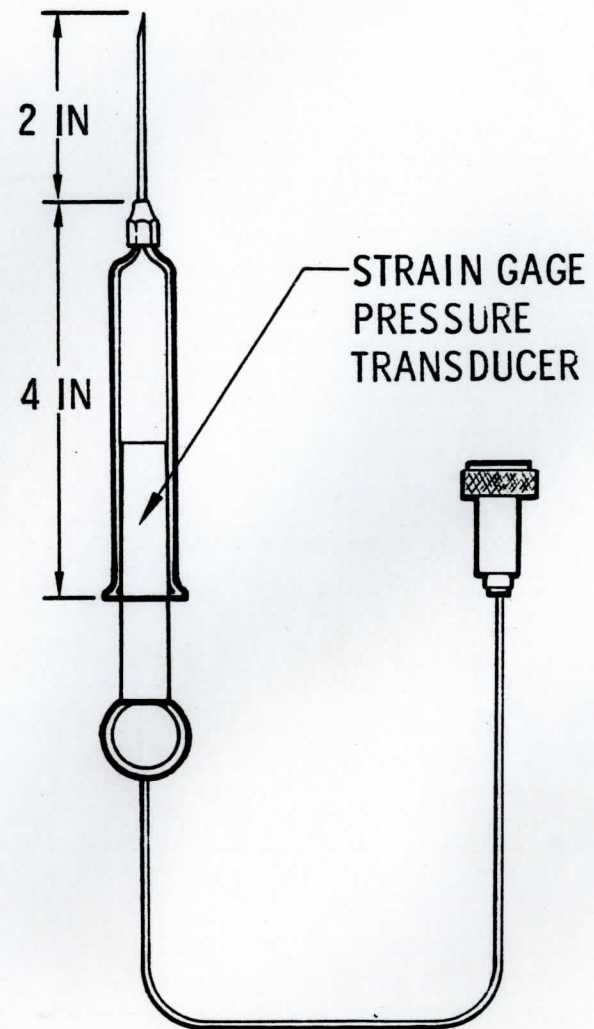
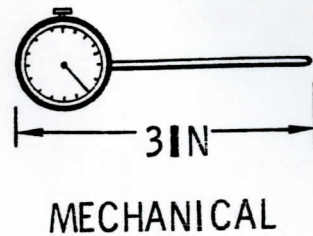
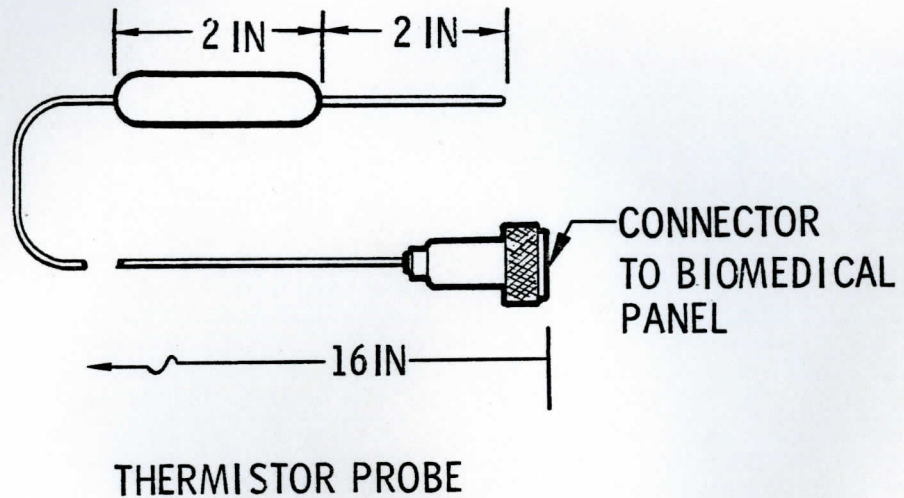


BIOMEDICAL MONITORING DEVICES

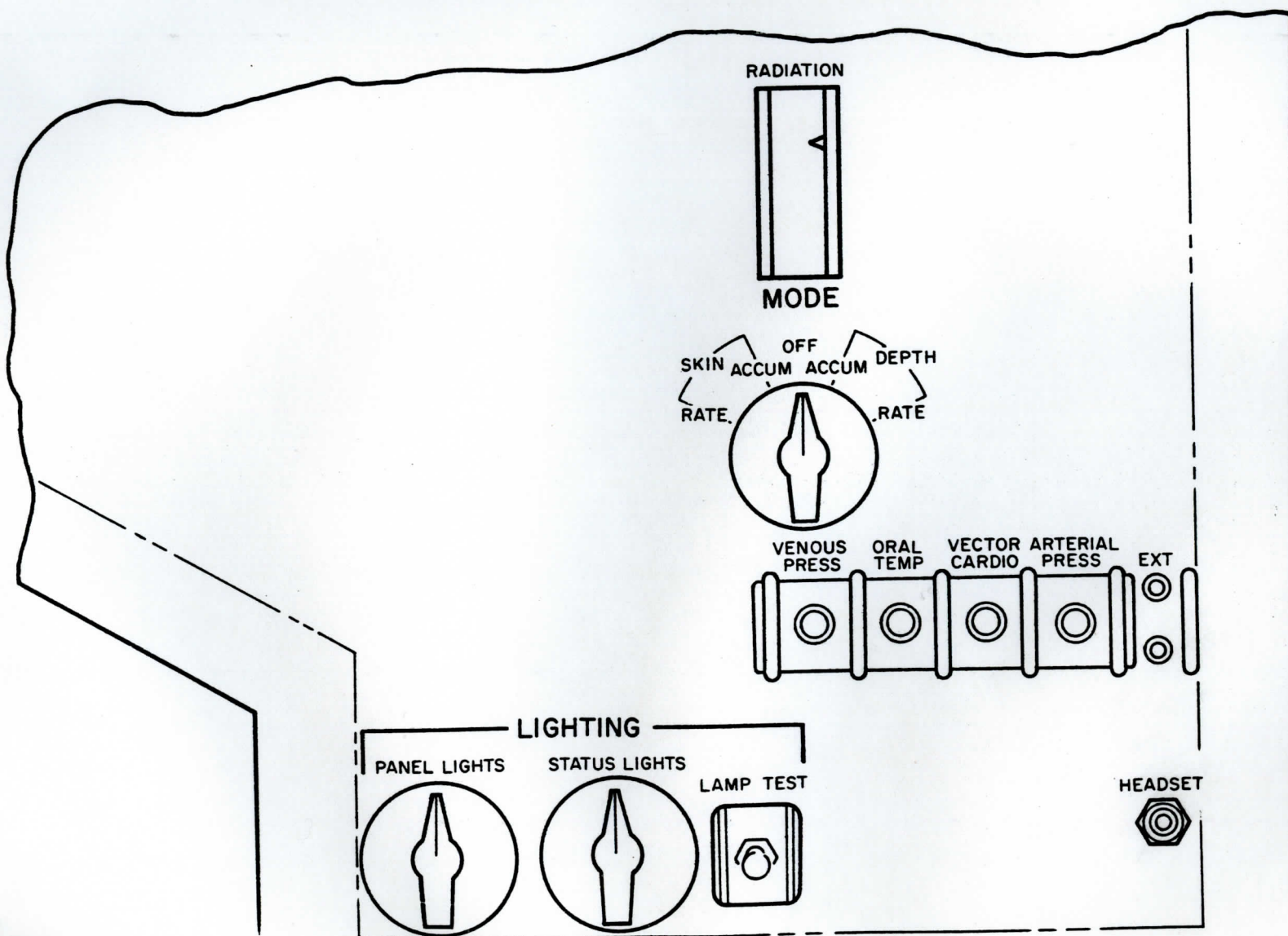


BIOMEDICAL MONITORING DEVICES

V080-9

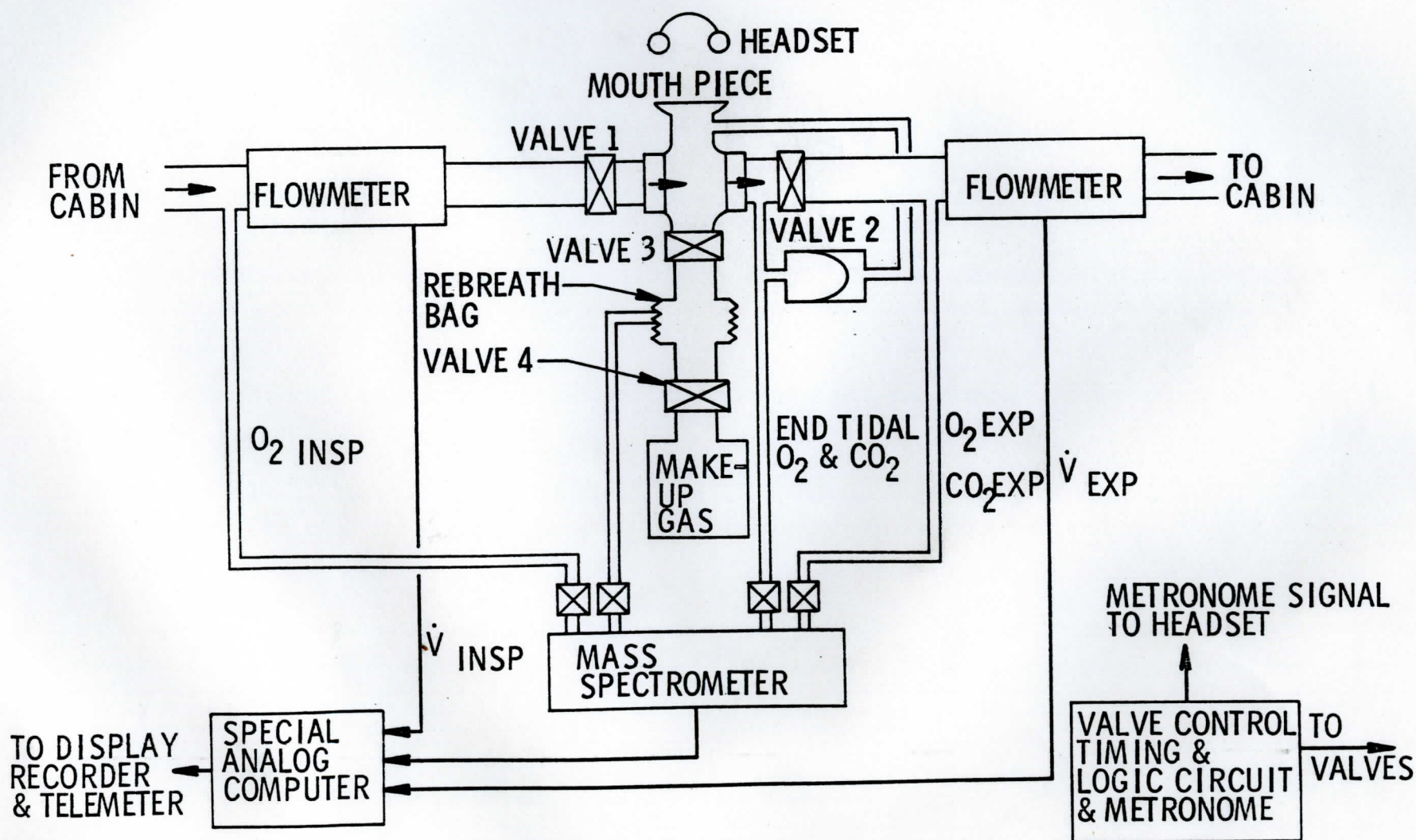


BIOMEDICAL CONTROL DISPLAY PANEL



INTEGRATED RESPIRATION, METABOLIC RATE AND CARDIAC OUTPUT

WITH DRY SPIROMETER OR GAS FLOW METERS



FLUID BALANCE AND DISTRIBUTION

A. TOTAL BODY WATER DETERMINATION

1. DHO

a. MASS SPECTROMETER

b. INFRARED ANALYZER

2. THO

a. MASS SPECTROMETER

b. INFRARED ANALYZER

c. RADIATION DETECTOR

3. ON ORBIT ANALYSIS

a. MASS/SPECTROMETER REQUIREMENTS

b. INFRARED ANALYZER REQUIREMENTS

c. RADIATION EXPOSURE

FLUID BALANCE AND DISTRIBUTION

(CONT)

B. BLOOD PLASMA VOLUME

1. T-1824; HcT REQUIREMENT
 - a. COLORIMETRIC ANALYSIS
 - b. OXIMETER ANALYSIS
2. INDIO GREEN
3. ON ORBIT ANALYSIS

C. RED CELL MASS

1. CR⁵¹ TAG; HcT REQUIREMENT
 - a. CLINICAL REQUIREMENT
 - b. RADIATION EXPOSURE
2. ON ORBIT ANALYSIS

BASIC ON-ORBIT BIOCHEMICAL DETERMINATIONS

V089-3

SPECIMEN	CONSTITUENT	NORMAL LEVELS (mg/ 100 ml.)	PERCENT NOR- MAL VARIATION
BLOOD PLASMA	GLUCOSE	70-110	± 22
	CREATININE	0.6-1.3	± 10
	UREA NITROGEN	5-25	± 67
	SODIUM	300-345	± 7
	POTASSIUM	16-22	± 16
	CHLORIDES	348-387 (AS CL)	± 5
	CALCIUM	4.25-5.25	± 10
	T-1824	NONE	--
URINE		NORMAL LEVELS (WT. / 24 HRS.)	
	GLUCOSE	500 mg.	
	PROTEIN	TRACE MUCUS	
	OCCULT BLOOD	NONE	
	KETONES	20-50 mg.	± 43
	pH	4.8-7.4	± 21
	SODIUM	3-6 gm.	± 33
	POTASSIUM	2-4 gm.	± 33
	CHLORIDES	VARIABLE	
	CALCIUM	10-300 mg.	± 92
	SOLIDS	55-72 gm.	± 13

EARTH ANALYSIS OF RETURNED SPECIMENS

BLOOD PLASMA

CONSTITUENT CHEMICAL CLASSIFICATION

INORGANIC	ORGANIC			
	PROTEINS	LIPIDS	HORMONES	MISC.
CALCIUM	TOTAL	CHOLESTEROL	ACTH	GLUCOSE
CHLORINE	FRACTIONS	CHOL. ESTERS	CATECHOLAMINES	LACTATE
IODINE	PREALBUMIN*	FREE FATTY ACIDS	CORTISOL	PYRUVATE
MAGNESIUM	PEPTIDES**	PHOSPHOLIPIDS	INSULIN	BILIRUBIN
PHOSPHORUS	ALKALINE P'TASE	TRIGLYCERIDES		CREATININE
POTASSIUM	AMYLASE			UREA NITROGEN
SODIUM	LDH			URIC ACID
	LIPASE			T-1824
	5-NUCLEOTIDASE			
	SGPT			
	SGOT			

* - THYROXINE BINDING

** - PARATHYROID

EARTH ANALYSIS OF RETURNED SPECIMENS

URINE

CONSTITUENT CHEMICAL CLASSIFICATION

INORGANIC	ORGANIC			
	PROTEINS	LIPIDS	HORMONES	MISC.
CALCIUM	TOTAL	NONE	ALDOSTERONE	BILE
CHLORIDES	TOTAL N ₂		CATECHOLAMINES	5-HYDROXYINDOL ACETIC ACID
MAGNESIUM	AMINO ACIDS		17-HYDROXYCORT.	
MANGANESE	HYDROXY PROLINE		17-KETO	INDICAN
PHOSPHORUS	MUCO PROTEINS		TETRAHYDRO ALDOSTERONE	UROBILINOGEN
POTASSIUM	AMYLASE			
PYROPHOSPHATE	LIPASE		UROPEPSIN	
SODIUM				
ZINC				

EARTH ANALYSIS OF RETURNED SPECIMENS

FECAL

CONSTITUENT CHEMICAL CLASSIFICATION

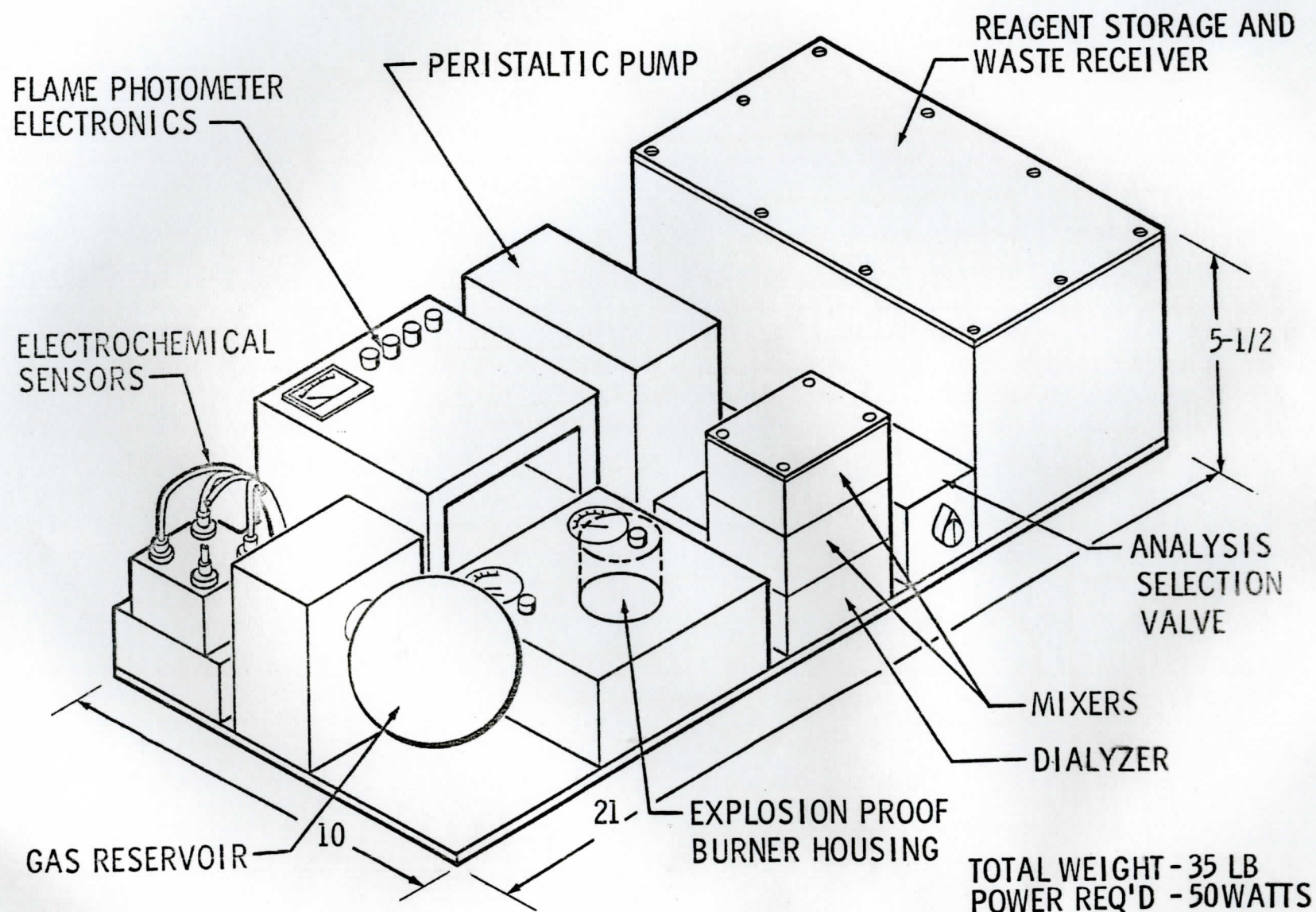
INORGANIC	ORGANIC			
	PROTEINS	LIPIDS	HORMONES	MISC.
CALCIUM	TOTAL N ₂	TOTAL FAT	NONE	BILE PIGMENTS
CHROMIUM	TRYPSIN	TRIGLYCERIDES		
MAGNESIUM		FREE FATTY ACIDS		
PHOSPHORUS				
POTASSIUM				
SODIUM				

ON-ORBIT WET CHEMICAL ANALYZER

SYSTEM I

SUBSYSTEM	SPECIMEN	ANALYSIS	
		CONSTITUENT	ACCURACY (%)
AUTOMATIC BIOCHEMICAL ANALYZER	BLOOD PLASMA	GLUCOSE	± 2
		CREATININE	± 5
		SODIUM	± 1
		POTASSIUM	± 1
		CALCIUM	± 10
		T-1824	± 1
DIPSTICK ANALYZER	URINE	GLUCOSE	± 20
		PROTEIN	± 20
		OCCULT BLOOD	± 20
		KETONES	± 20
		pH	± 20
ELECTROCHEMICAL ANALYZER	PLASMA	CHLORIDES	± 1
	URINE	SODIUM	± 1
		POTASSIUM	± 10
		CHLORIDES	± 1
REFRACTOMETER	URINE	SOLIDS	± 10

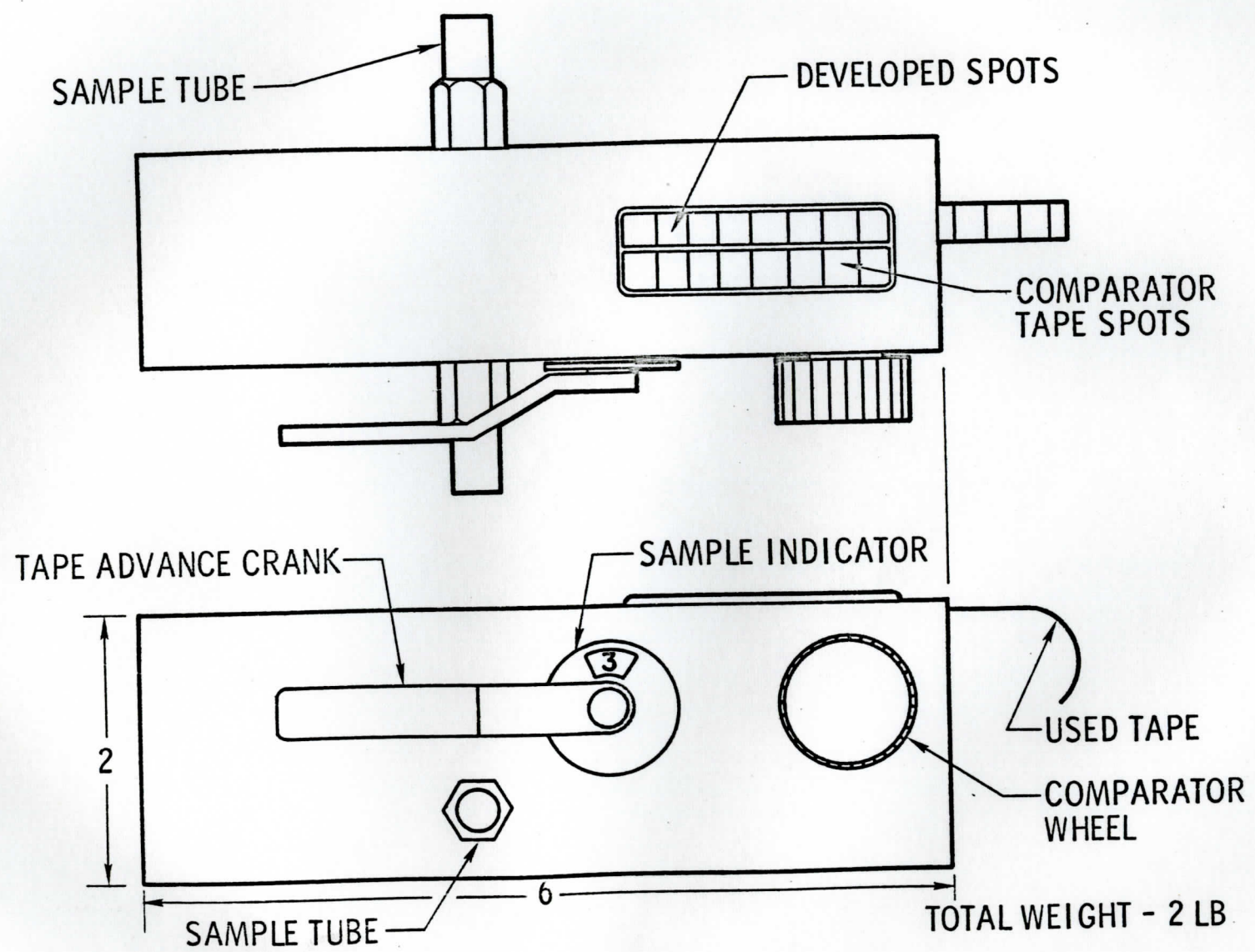
AUTOMATIC BIOCHEMICAL ANALYZER



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V081-3

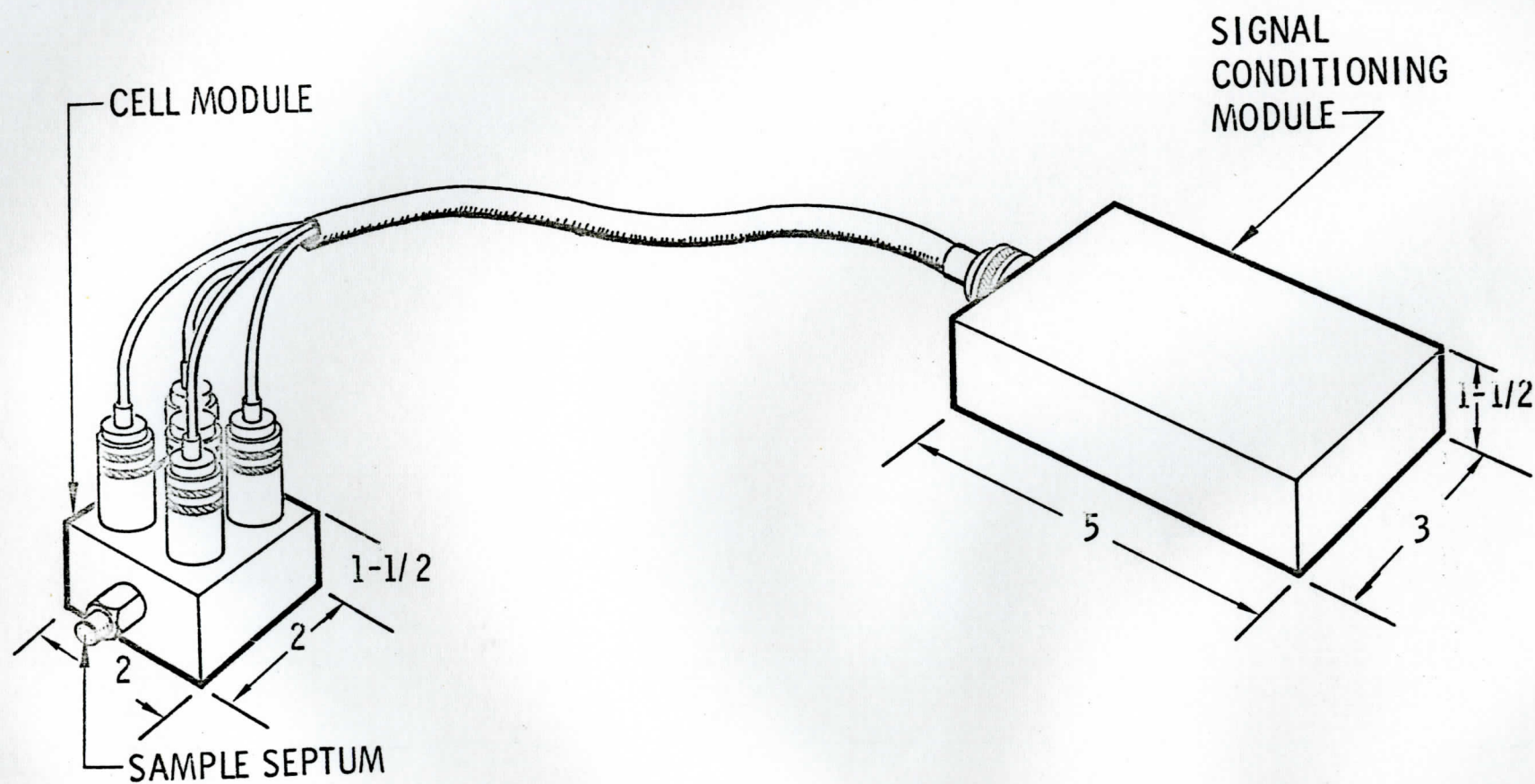
DIPSTICK ANALYZER



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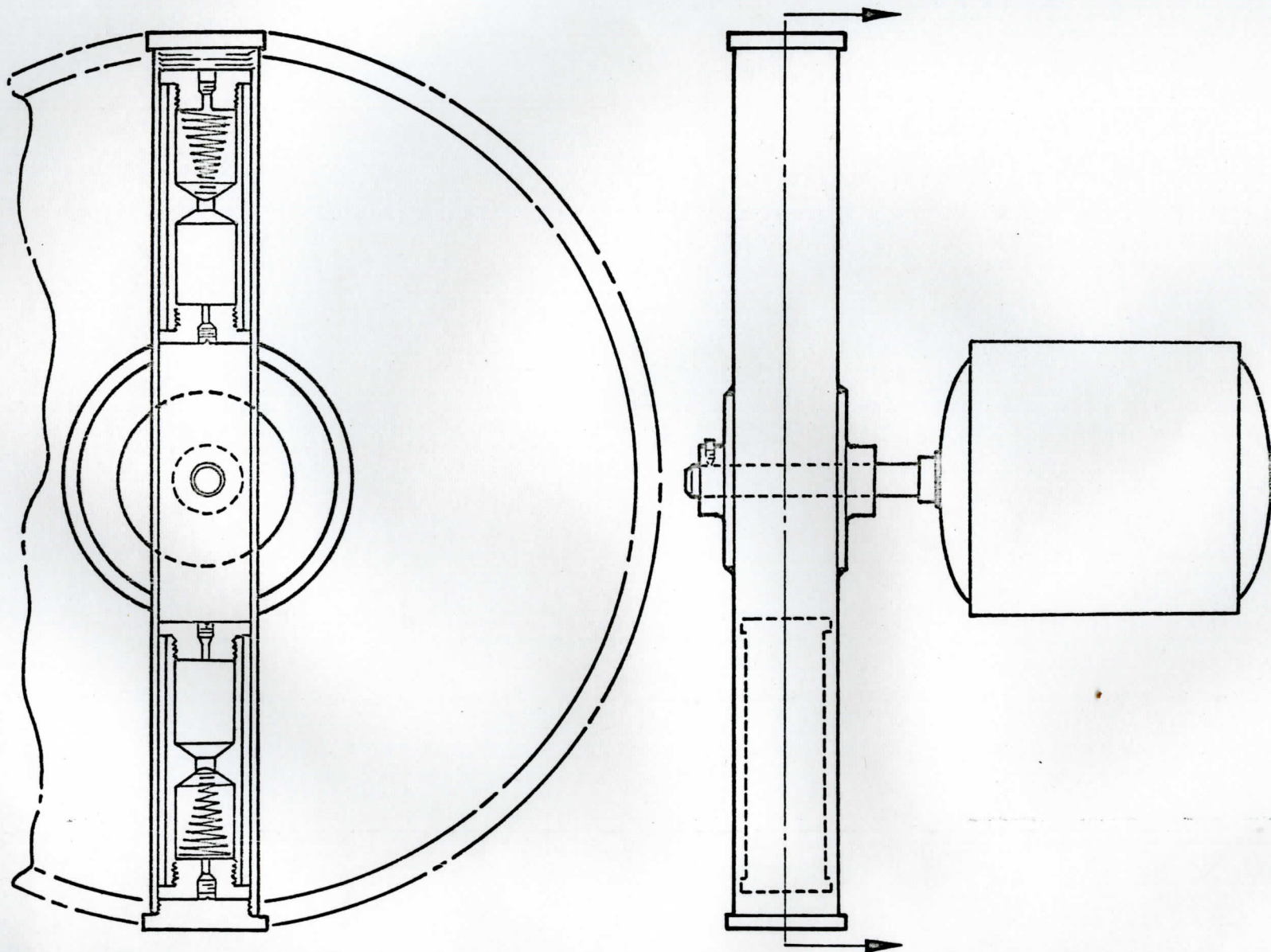
ELECTROCHEMICAL ANALYZER



TOTAL WEIGHT - 3 LB
POWER REQUIRED - 2 WATTS

ANALYTICAL CENTRIFUGE

V081-2



ON-ORBIT WET CHEMICAL ANALYZER SYSTEM II

SUBSYSTEM	SPECIMEN	ANALYSIS	
		CONSTITUENT	ACCURACY (%)
FLAME PHOTOMETER	BLOOD PLASMA	SODIUM	±1
		POTASSIUM	±2
		CALCIUM	±10
	URINE	SODIUM	±1
		POTASSIUM	±2
		CALCIUM	±10
DIPSTICK ANALYZER	BLOOD PLASMA	GLUCOSE	±20
		UREA NITROGEN	±20
	URINE	GLUCOSE	±20
		PROTEIN	±20
		OCCULT BLOOD	±20
		KETONES	±20
REFRACTOMETER	URINE	pH	±20
		SOLIDS	±10

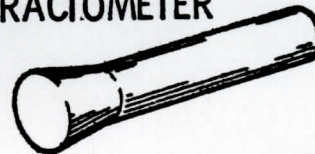
ON-ORBIT WET CHEMICAL ANALYZER SYSTEM III

SUBSYSTEM	SPECIMEN	ANALYSIS	
		CONSTITUENT	ACCURACY (%)
DIPSTICK ANALYZER	PLASMA	GLUCOSE	± 20
		UREA NITROGEN	± 20
	URINE	GLUCOSE	± 20
		PROTEIN	± 20
		OCCULT BLOOD	± 20
		KETONES	± 20
ELECTROCHEMICAL ANALYZER	PLASMA	pH	± 20
		SODIUM	± 1
		POTASSIUM	± 10
	URINE	CHLORIDES	± 1
		SODIUM	± 1
		POTASSIUM	± 10
REFRACTOMETER	URINE	CHLORIDES	± 1
		SOLIDS	± 10

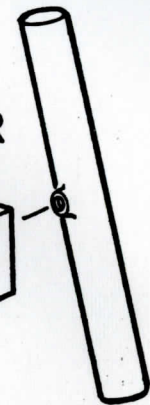
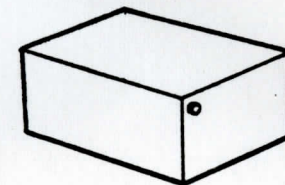
BIOCHEMICAL ANALYSIS SYSTEM III

V081-4

REFRACTOMETER

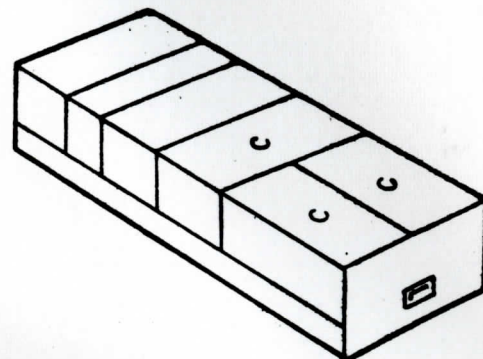
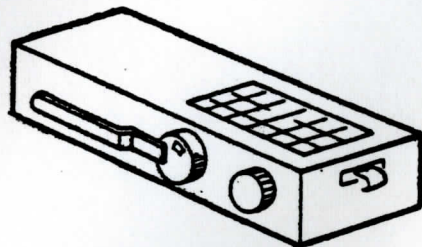


CENTRIFUGE MOTOR

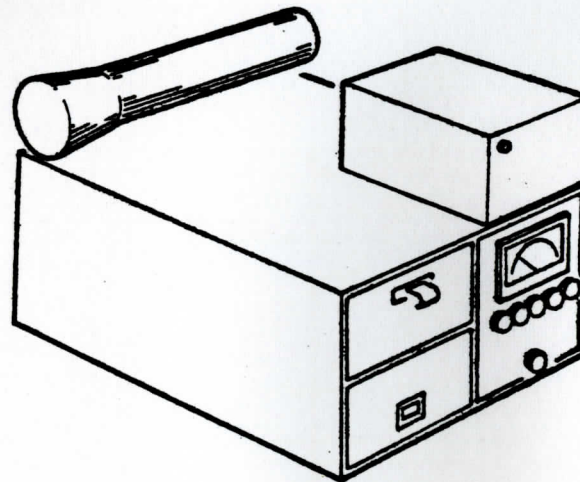


CENTRIFUGE

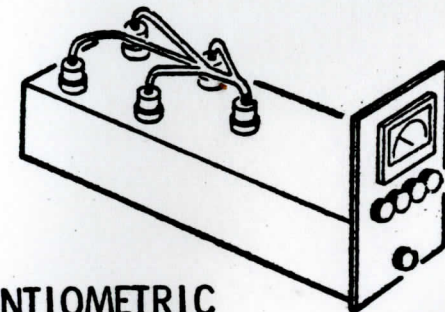
DIP STICK ANALYZER



STOWAGE DRAWER



POTENTIOMETRIC ANALYZER



ON-ORBIT WET CHEMICAL ANALYZER SYSTEM

SYSTEM	SUBSYSTEM	PENALTIES			
		WEIGHT* (LB)	POWER * (WATTS)	VOLUME* (CU. FT)	REL. DEV. * COST (DOLLARS)
I	AUTOMATIC BIOCHEMICAL ANALYZER	35.0	50.0	0.93	225,000
	DIPSTICK ANALYZER	2.0	0.0	0.02	30,000
	ELECTROCHEMICAL ANALYZER	3.0	2.0	0.03	76,000
	REFRACTOMETER	2.0	0.0	0.02	2,000
TOTALS		42.0	52.0	1.00	333,000
II	FLAME PHOTOMETER	6.0	10.0		96,000
	DIPSTICK ANALYZER	3.0	0.0		30,000
	REFRACTOMETER	2.0	0.0		2,000
TOTALS		11.0	10.0		128,000
III	DIPSTICK ANALYZER	3.0	0.0		30,000
	ELECTROCHEMICAL ANALYZER	3.0	2.0		76,000
	REFRACTOMETER	2.0	0.0		2,000
TOTALS		8.0	2.0		108,000

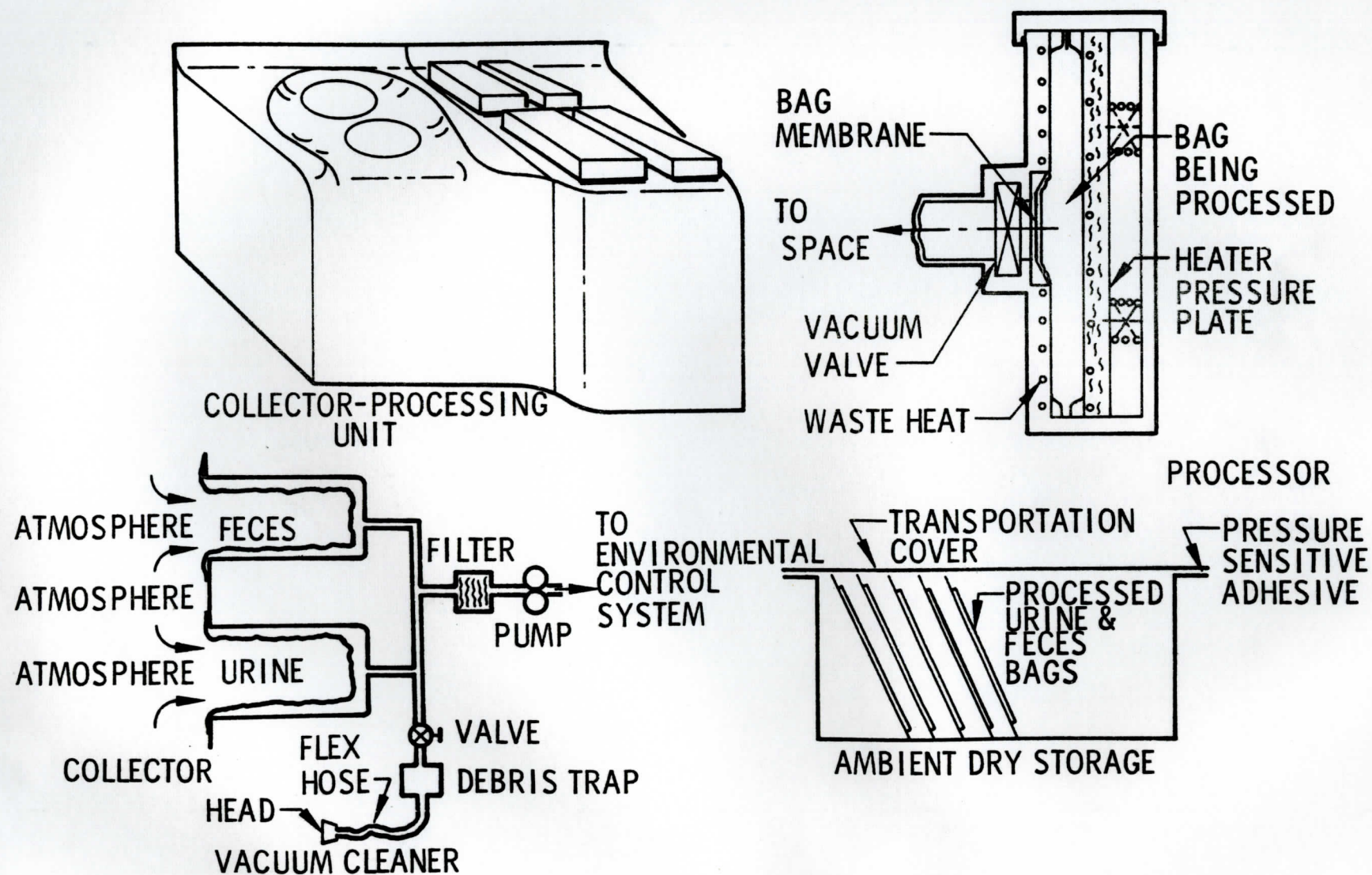
*CENTRIFUGE - WT. - 7.5 LB., POWER - 125 W, VOLUME - 0.25 CU. FT. AND DEVELOPMENT COSTS - \$15,000 ARE NOT INCLUDED IN THESE PENALTIES.

ON-ORBIT WET CHEMICAL ANALYZER SYSTEM

V095-9

EVALUATION CRITERIA	COMPARISON MATRIX		
	SYSTEM I	SYSTEM II	SYSTEM III
ANALYTICAL CAPABILITY	3	2	1
ACCURACY	3	2	1
WEIGHT	1	2	3
VOLUME	1	2	3
HARDWARE STATUS	0	0	0
POWER	1	2	3
DEVELOPMENT COST	1	2	3
UNIT COST	1	2	3
DEVELOPMENT TIME	1	2	3
EFFECT ON PROGRAM SCHEDULE	1	3	3
SAFETY	3	3	3
RELIABILITY	1	3	2
MAINTAINABILITY	1	2	3
EASE OF USE	1	2	3
QUALIFICATION TESTING	1	2	3
CREW TIME	2	1	3
	22	32	40
RECOMMENDATIONS SYSTEM III			

WASTE MANAGEMENT SYSTEMS



MASS MEASUREMENT POSSIBILITIES

- VOLUMETRIC DETERMINATION BY AIR-DISPLACEMENT

AIR BEHAVIOR IS WELL-DEFINED IN TWO LIMITING SITUATIONS

- ADIABATIC LIMIT
(RAPID - NO HEAT TRANSFER)

PROBABLY NOT POSSIBLE

- ISOTHERMAL LIMIT
(SLOW - AIR IN THERMAL
EQUILIBRIUM)

NO EASY CRITERION FOR THERMAL
EQUILIBRIUM. REQUIRES CAREFUL
MONITORING OF TEMPERATURE TO
ESTABLISH CONSTANCY.

- MASS DETERMINATION

- OBSERVE RESPONSE TO KNOWN
FORCE FROM SPRING

NO FUNDAMENTAL OBJECTION. ALL
SUCH METHODS ESSENTIALLY
EQUIVALENT, BUT ACCURACY DEPENDS
ON EXPERIMENTAL DESIGN.

SPECIMEN PREPARATION VS EARTH ANALYSIS

ANALYTICAL RECOVERY COMPARISON MATRIX

SPECIMEN	CHEMICAL CLASS	SYSTEM			
		FREEZE (-20 C)	LYOPHILIZATION (-20 C)	FREEZE DRY (-5 C)	VACUUM DIST (2 TO 5 C)
PLASMA	INORG	4	4	4	4
	PROTEINS	4	3	2	0
	LIPIDS	4	4	4	2
	HORMONES	4	3	3	0
	MISC	4	4	4	0
SUBTOTALS		20	18	17	6
URINE	INORG		3	3	3
	PROTEINS		3	2	1
	HORMONES		3	3	1
	MISC		3	3	1
SUBTOTALS			12	11	6
FECAL	INORG		3	3	3
	PROTEINS		3	2	1
	LIPIDS		3	3	2
	MISC		3	3	1
SUBTOTALS			12	11	7

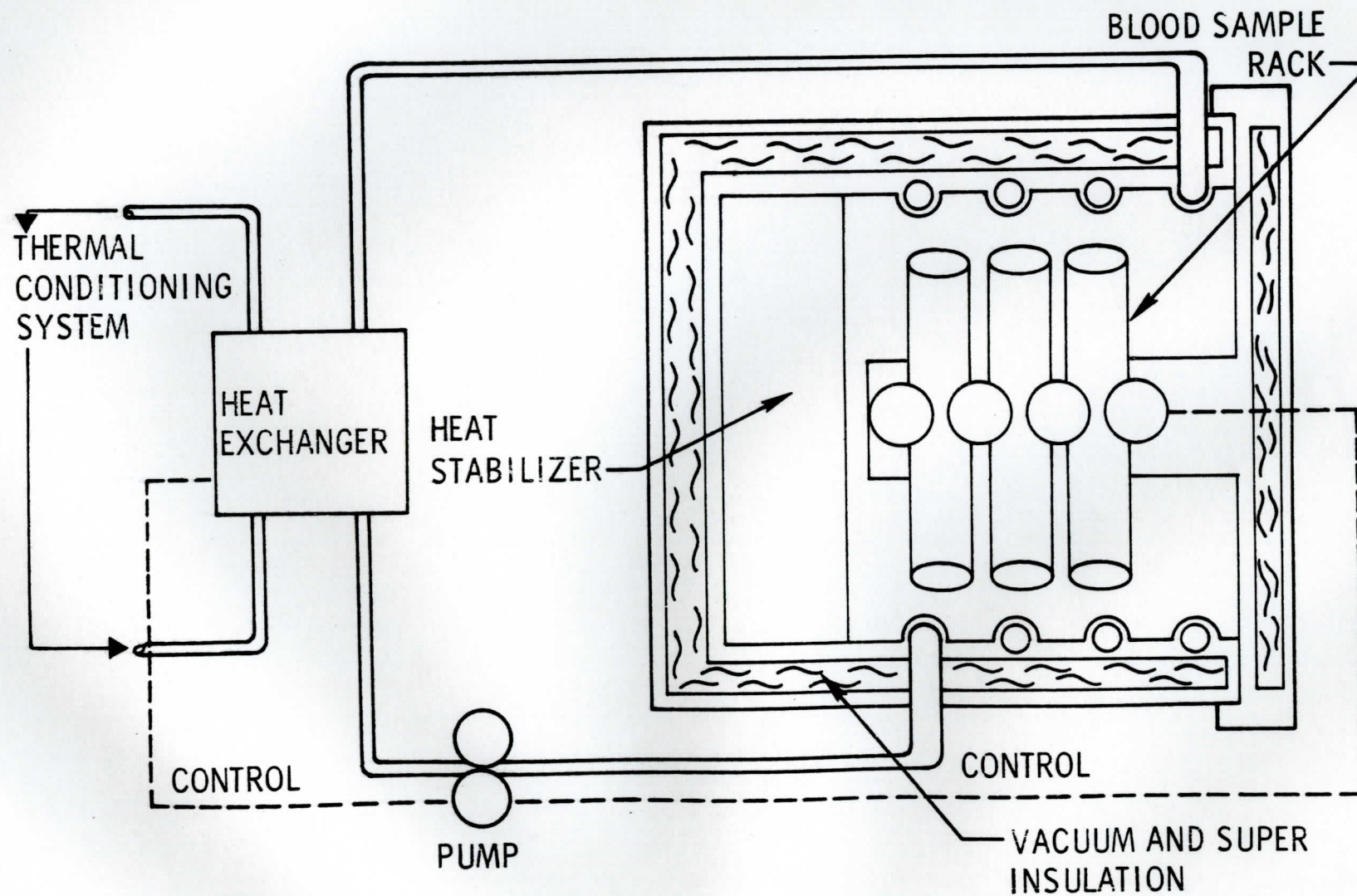
BLOOD PLASMA SPECIMEN PREPARATION - MISSION SYSTEM COMPARISON MATRIX

V096-2

EVALUATION CRITERIA	SYSTEM		
	FREEZE STORAGE (-20°C)	LYOPHILIZATION (-20°C)	FREEZE DRY (-5°C)
ANALYTICAL CAPABILITY	20	18	17
WEIGHT (LAUNCH-RE-ENTRY)	4	3	4
VOLUME (LAUNCH-RE-ENTRY)	4	5	4
HARDWARE STATUS	3	1	2
POWER	3	1	2
DEVELOPMENT COSTS	3	2	2
DEVELOPMENT TIME	3	2	2
EFFECT ON SCHEDULE	3	2	2
SAFETY	3	1	1
RELIABILITY	3	1	1
MAINTAINABILITY	3	1	1
EASE OF USE	3	1	1
QUALIFICATION TESTING	3	2	2
CREW TIME	3	1	1
CREW SKILL	3	1	1
TOTALS	64	42	43

RECOMMENDATION - FREEZE STORAGE

BLOOD PLASMA STORAGE SYSTEM (FROZEN)



URINE & FECAL SPECIMEN PREPARATION

MISSION SYSTEM COMPARISON MATRIX

EVALUATION CRITERIA	SYSTEM		
	LYOPHILIZATION (-20 C)	FREEZE DRY (-5 C)	VACUUM DIST (2 TO 5 C)
ANALYTICAL CAPABILITY	24	22	13
WEIGHT (LAUNCH & REENTRY)	3	4	6
VOLUME (LAUNCH & REENTRY)	5	4	6
HARDWARE STATUS	1	2	3
POWER	1	2	3
DEVELOPMENT COSTS	2	2	3
DEVELOPMENT TIME	3	3	3
EFFECT ON SCHEDULE	2	2	3
SAFETY	1	1	1
RELIABILITY	3	3	3
MAINTAINABILITY	2	2	3
EASE OF USE	1	1	3
QUALIFICATION TESTING	3	3	3
CREW TIME	2	2	3
CREW SKILL	2	2	3
TOTALS	55	55	59

SELECTION - IS ANALYTICAL CAPABILITY WORTH THE MISSION PENALTIES ?

BIOCHEMICAL SPECIMEN PRESERVATION AND RETURN

V080-5

MISSION REQUIREMENTS	MISSION TOTALS			
	LAUNCH		REENTRY	
	WEIGHT (LB)	VOLUME (CU FT)	WEIGHT (LB)	VOLUME (CU FT)
A - VACUUM DISTILLATION*	7.10	0.25	31.01	2.11
B - LYOPHILIZATION (-20°C)**	126.60	3.75	14.45	1.05
1. STORAGE AT 0-5°C	138.72	4.75	20.85	1.90
2. STORAGE AT -20°C	153.70	5.45	20.85	1.90
C - FREEZE DRYING (-5°C)***	117.10	3.75	14.45	1.05
1. STORAGE AT 0-5°C	128.90	4.75	20.85	1.90
2. STORAGE AT -20°C	139.60	5.45	20.85	1.90

*FREEZING & FREEZE STORAGE OF BLOOD PLASMA & VACUUM DISTILLATION AT 2-5°C OF TOTAL URINE & FECES WITH AMBIENT STORAGE OF DRY SPECIMENS

**LYOPHILIZATION OF TOTAL BLOOD PLASMA, 200 ML ALIQUOTS OF URINE DAILY, & TOTAL FECES WITH AMBIENT STORAGE OF DRY SPECIMENS

***FREEZE DRYING OF TOTAL BLOOD PLASMA, 200 ML ALIQUOTS OF URINE DAILY, & TOTAL FECES WITH AMBIENT STORAGE OF DRY SPECIMENS

SUMMARY CREW CONDITIONING TRADE STUDY

METHOD	EQUIPMENT	ITEM WT (LB)	POWER (WATTS)	TOTAL WT (UNMANNED LB)	VOLUME (CU FT)	
					STOWED	USE
1. CENTRIFUGATION	CENTRIFUGE	155	PEAK 436 AVG 275 MISS 5150	155	31.4	31.4
2. DRUGS	PILLS	1	0	1	0.2	0.2
3. EXERCISE	ERGOMETER	30	GEN 200	30	1.5	2.0
4. HYPOXIA	NONE	0	0	0	0	0
5. NEGATIVE PRESSURE	PANTS	10	200	25	3.2	
	BOOT	15	200	30	6.8	
6. OSCILLATION	TRAMPOLINE	5	0	5	22.3	
7. POSITIVE, PRESSURE GARMENTS	ANTI-G SUIT	10	186	25	4.7	
	PRESSURE CUFFS	2	50	2	--	0.1
	STOCKINGS	2	0	2	0.02	

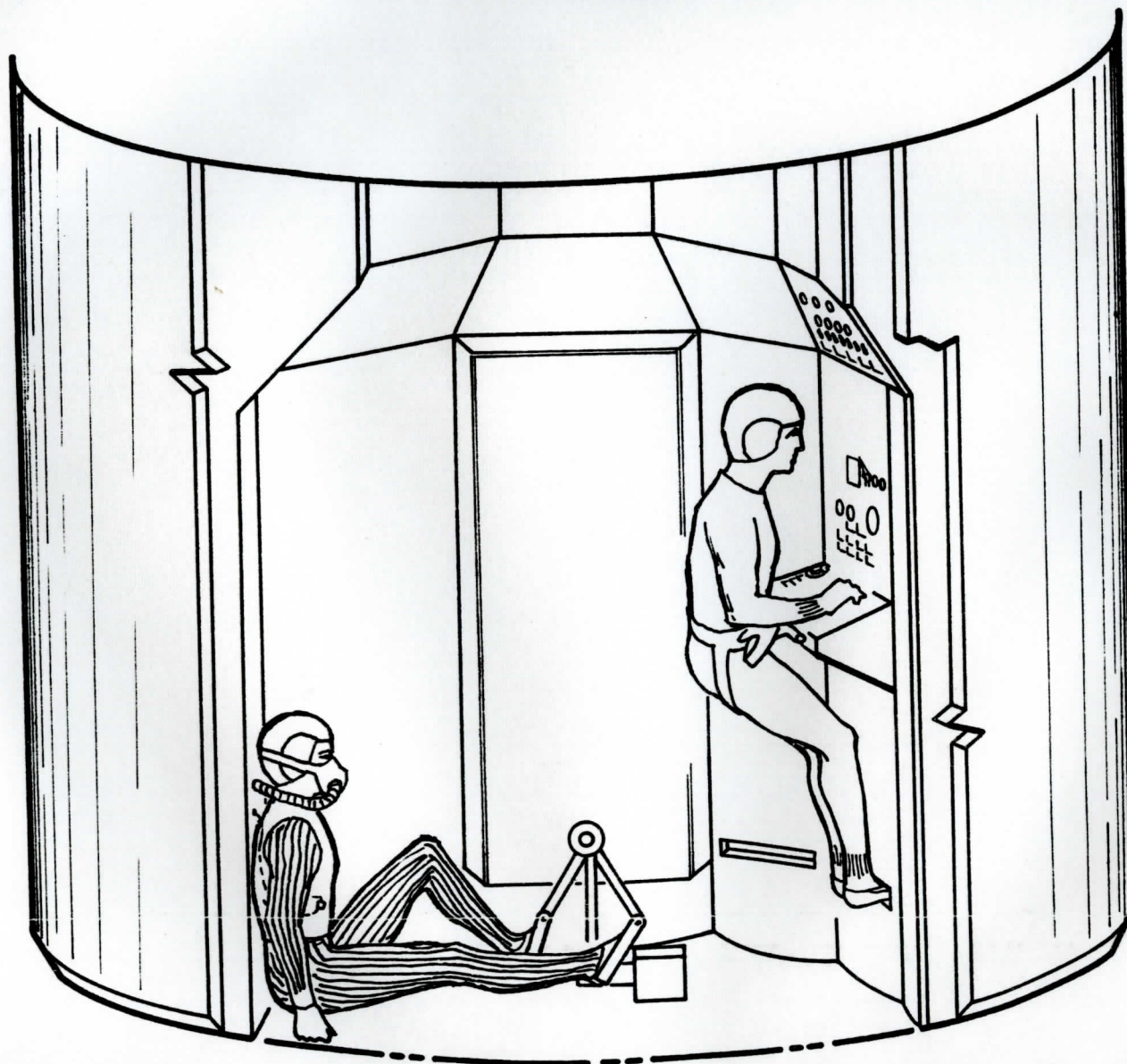
SUMMARY CREW CONDITIONING TRADE STUDY

METHOD	DEV RISK	RELIAB		SAFETY	MONITORING DIFFICULTY	CREW TIME LOST HR/ DAY/MO	MYOSKELETAL MAINT
		OPN	EFF				
1. CENTRIFUGATION	MEDIUM	0.99	0.5	MEDIUM LOW	MEDIUM	2.9	LOW
2. DRUGS	NONE	0.99	0.5	MEDIUM	HIGH	0.1	LOW
3. EXERCISE	LOW	0.99	0.9	HIGH	LOW	1.0	HIGH
4. HYPOXIA	NONE	0.99	0.9	MEDIUM LOW	LOW	0.0	LOW
5. NEGATIVE PRESSURE	MEDIUM	0.9	0.5	MEDIUM	LOW	0.3	LOW
	MEDIUM	0.9	0.5	MEDIUM MEDIUM LOW $\bar{C}^{DEEP}$	MEDIUM	8.0	LOW
6. OSCILLATION	LOW	0.99	0.6	MEDIUM	HIGH	1.0	MEDIUM
7. POSITIVE, PRESSURE GARMENTS	MEDIUM	0.99	0.9	HIGH	MEDIUM	2.6	LOW
	LOW	0.99	0.9	HIGH	LOW	0.5	LOW
	LOW	0.99	0.8	HIGH	LOW	0.3	LOW

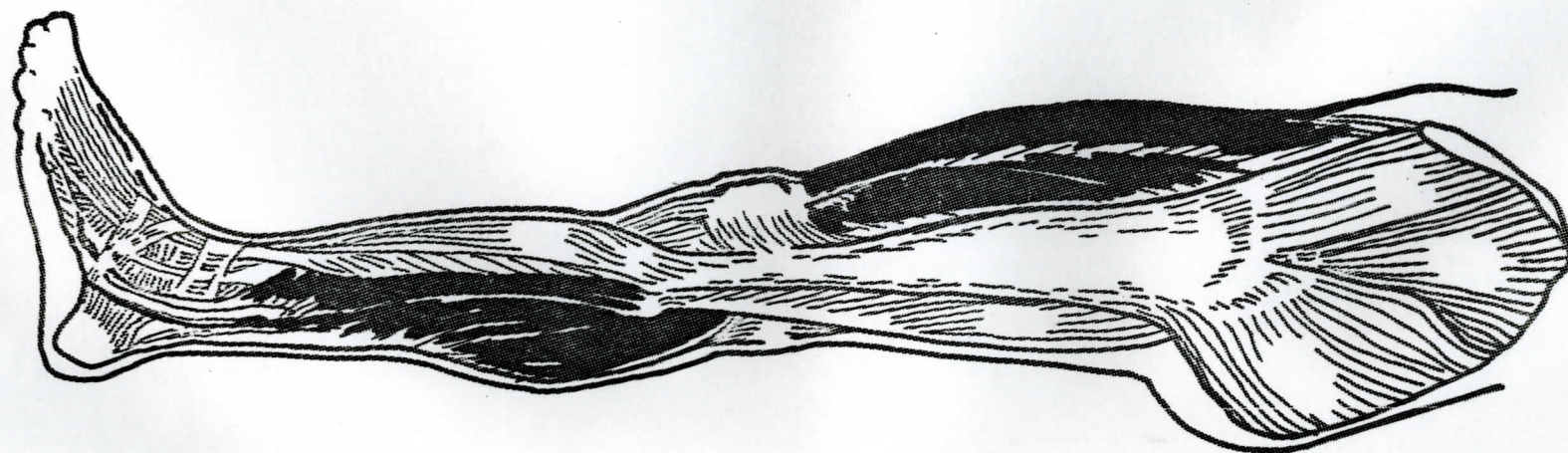
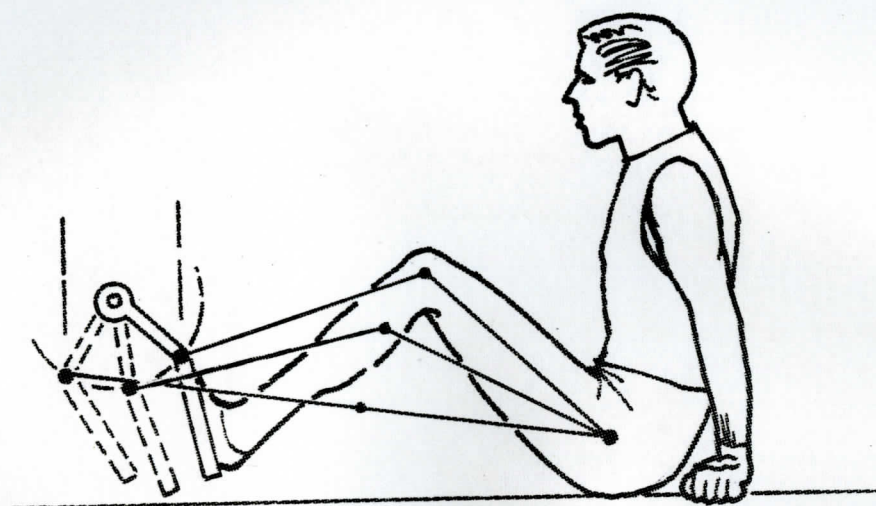
SUMMARY CREW CONDITIONING TRADE STUDY

METHOD	TISSUE PRESSURE	VASOMOTOR TONE	BLOOD VOLUME	CARDIAC OUTPUT	REMARKS
1. CENTRIFUGATION	LOW	MEDIUM	LOW	LOW	HIGH WT, VOL, POWER, LOW RETURN
2. DRUGS	LOW	MEDIUM	MEDIUM	MEDIUM	SIDE EFFECTS, SPECIFIC, COMPLEX, FAIR RETURN
3. EXERCISE	MEDIUM	MEDIUM	MEDIUM	HIGH	GOOD OVER ALL
4. HYPOXIA	LOW	MEDIUM	MEDIUM	MEDIUM	ACCLIMATIZATION TIME REQUIREMENTS INCOMPATIBLE C TRNG REQS, FAIR RETURN
5. NEGATIVE PRESSURE	LOW LOW	HIGH HIGH	MEDIUM MEDIUM	LOW LOW	FAIR CREW TIME COST HIGH QUESTIONABLE SAFETY FACTOR IF ASLEEP
6. OSCILLATION	LOW	MEDIUM	LOW	MEDIUM	HIGH VOL, FAIR RETURN VEHICLE STABILIZATION
7. POSITIVE, PRESSURE GARMENTS	MEDIUM MEDIUM MEDIUM	MEDIUM MEDIUM MEDIUM	MEDIUM MEDIUM MEDIUM	LOW LOW LOW	FAIR UNCOMFORTABLE FAIR

APOLLO ERGOMETER

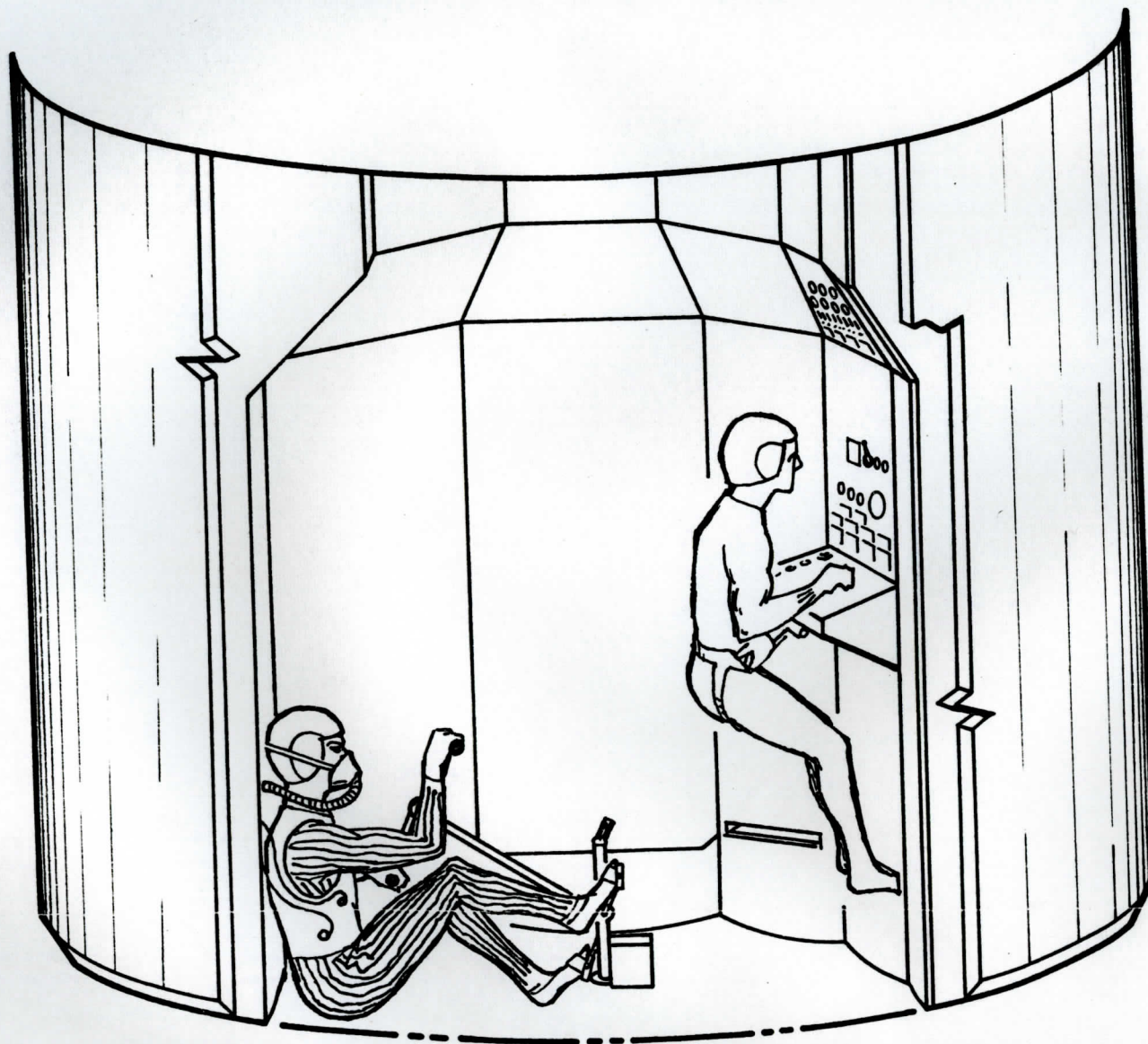


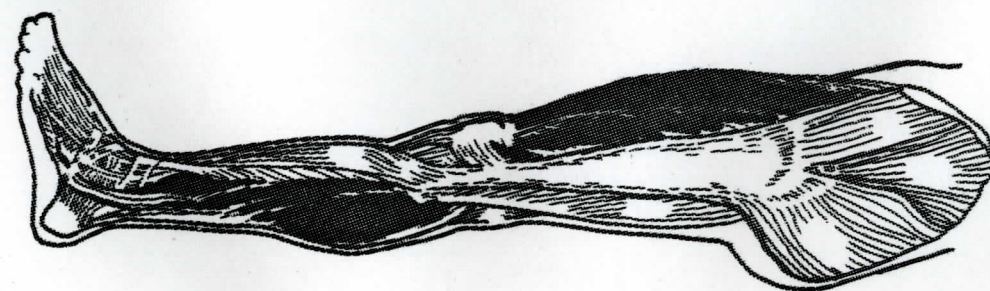
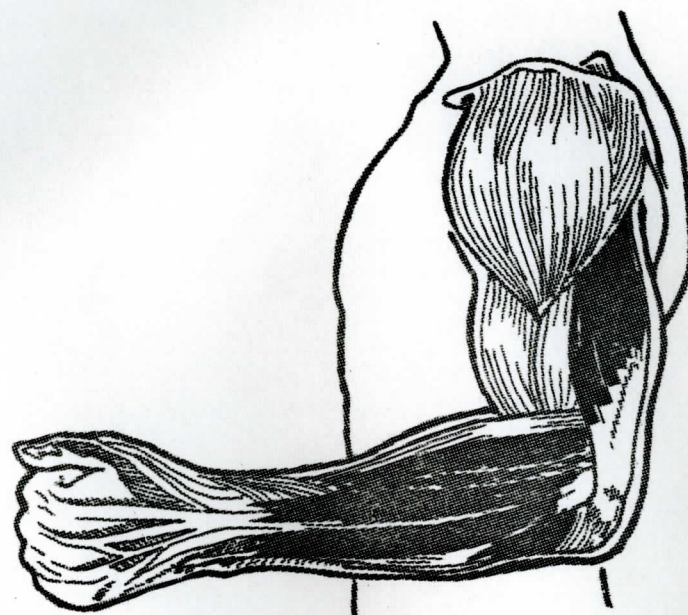
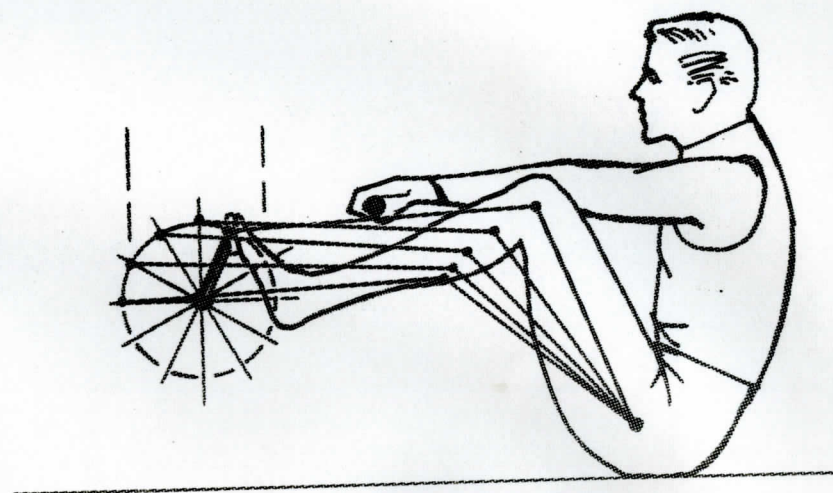
V084-9



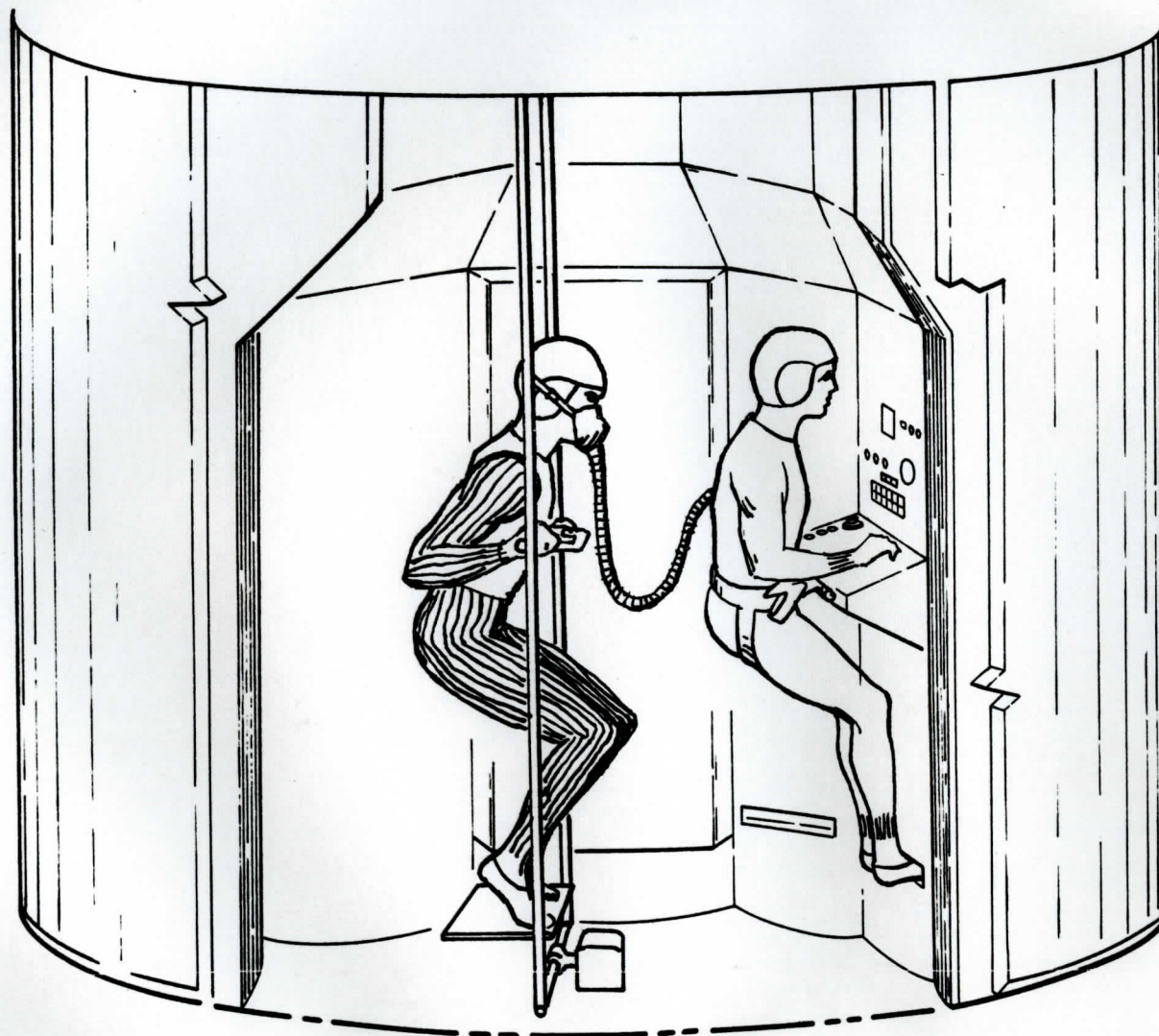
BICYCLE ERGOMETER

V084-6

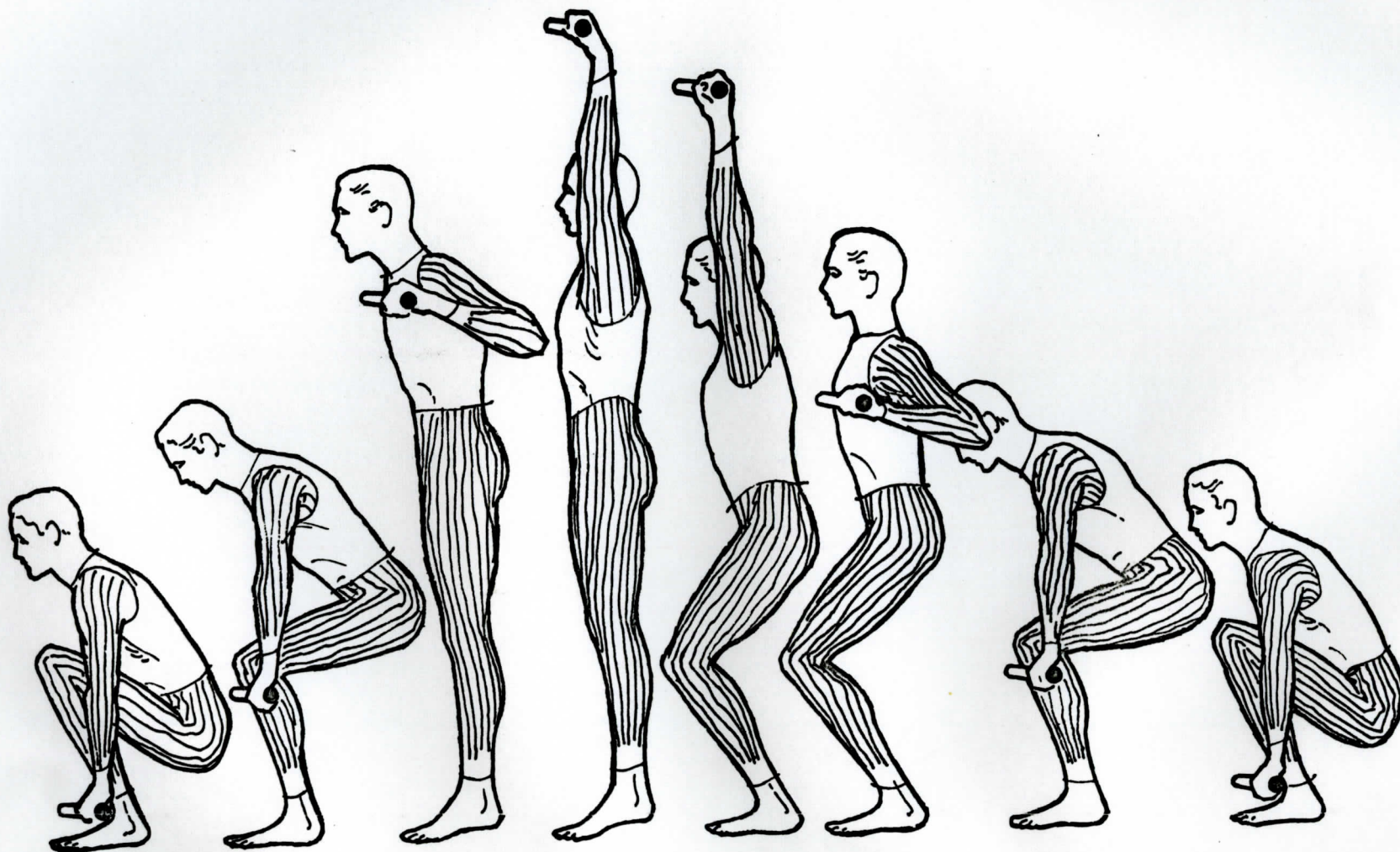




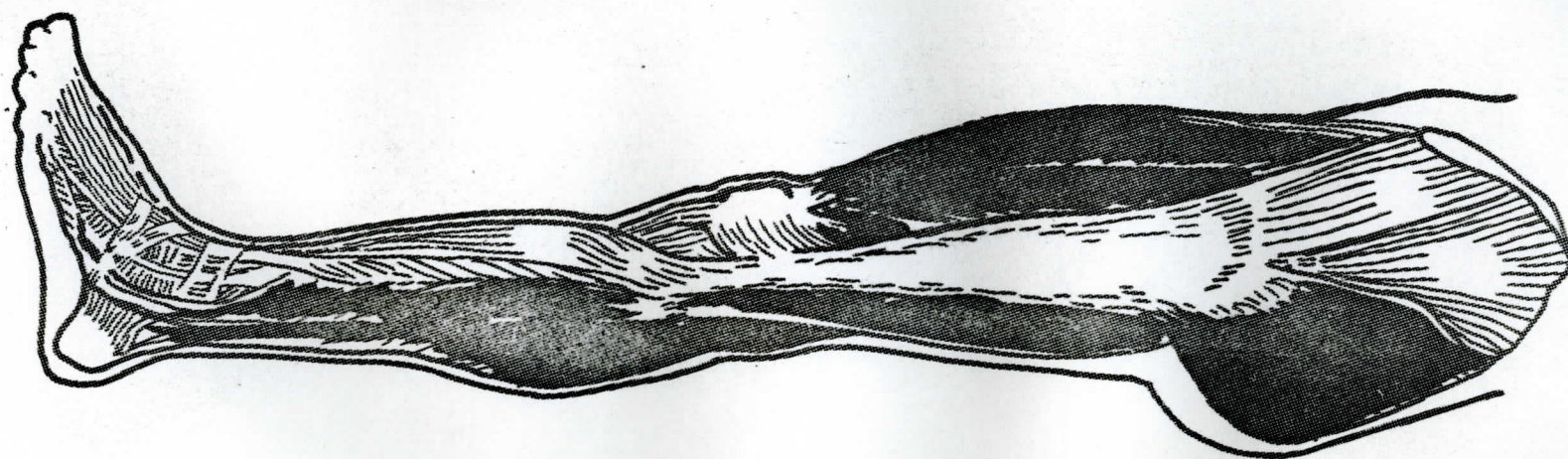
TOTAL-BODY ERGOMETER



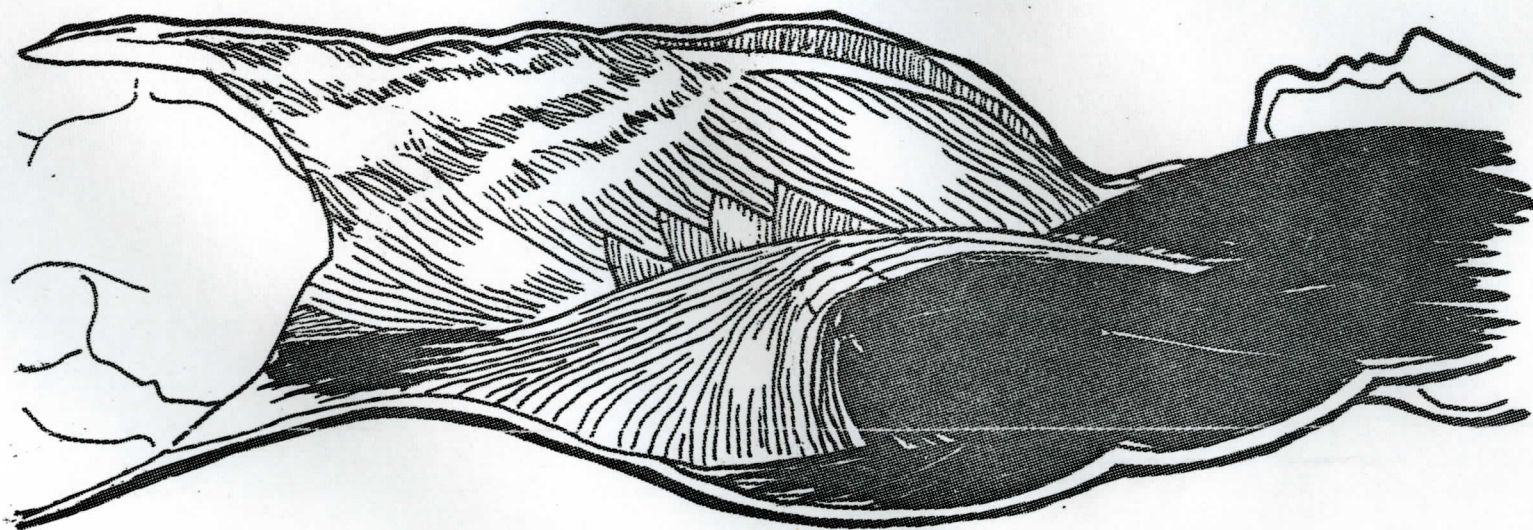
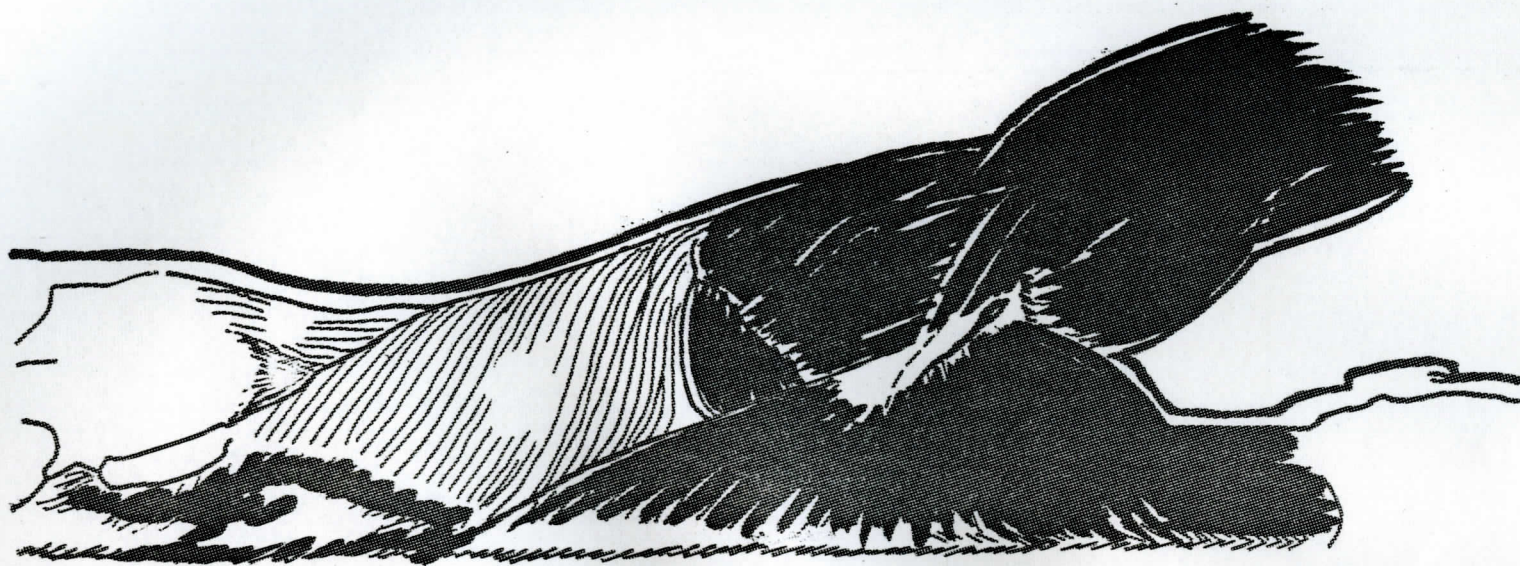
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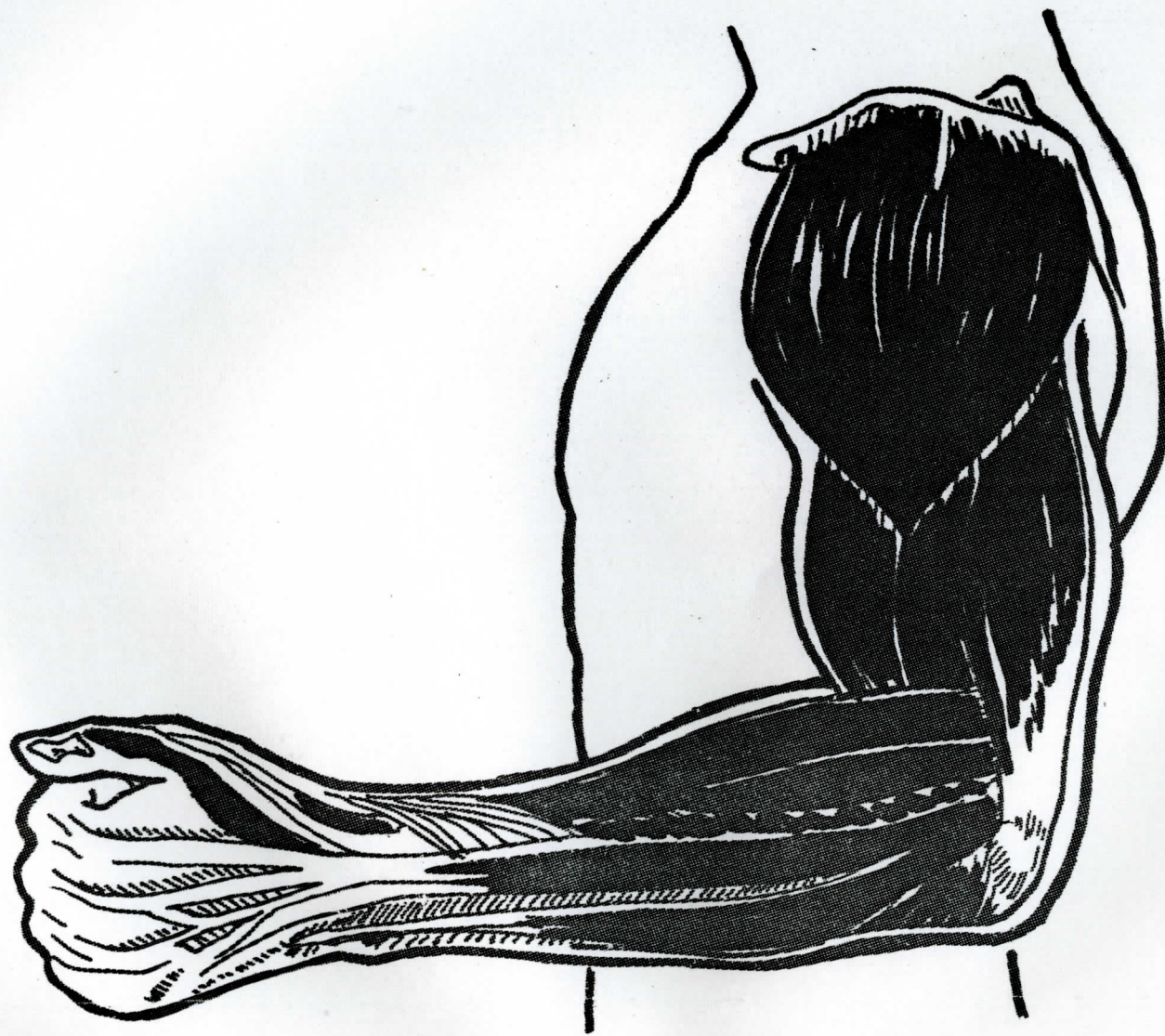
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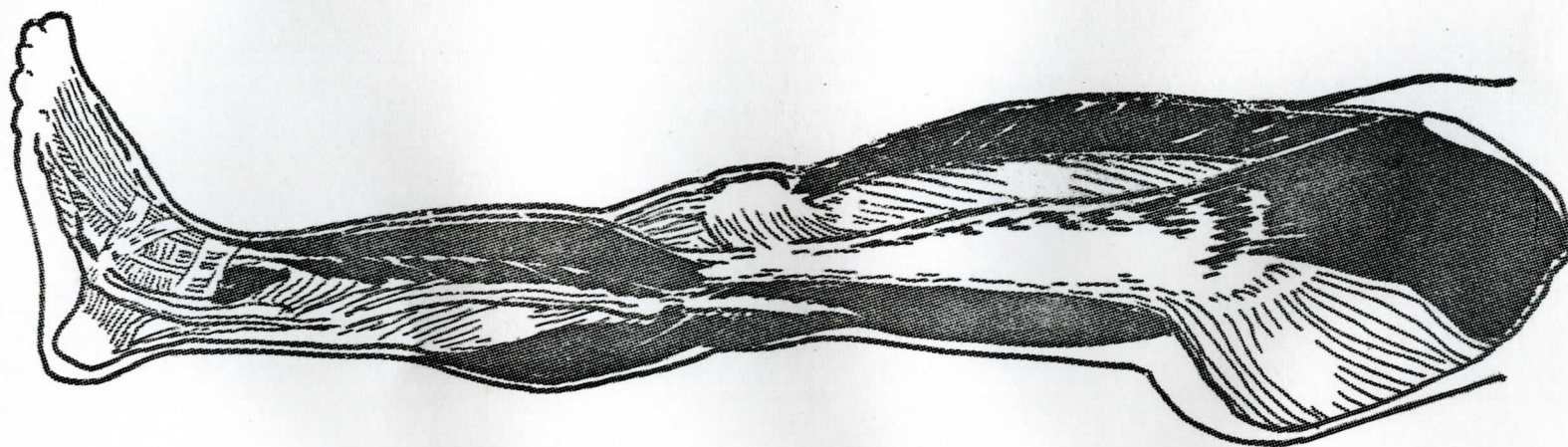
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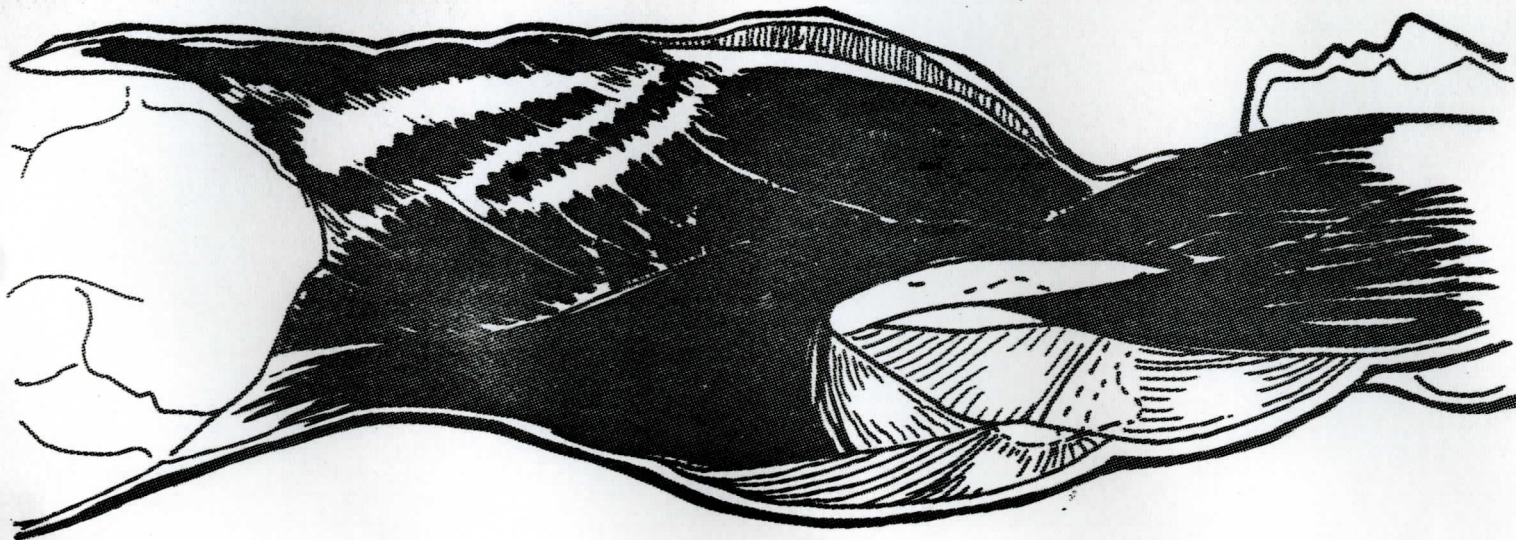
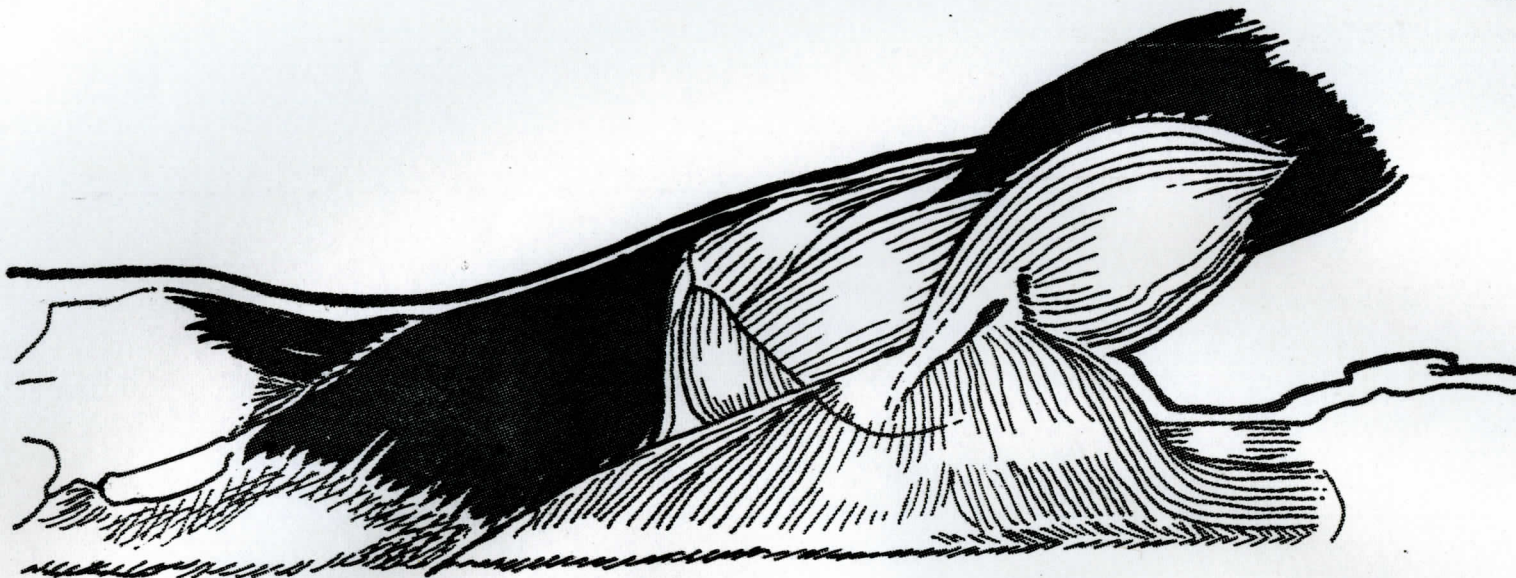
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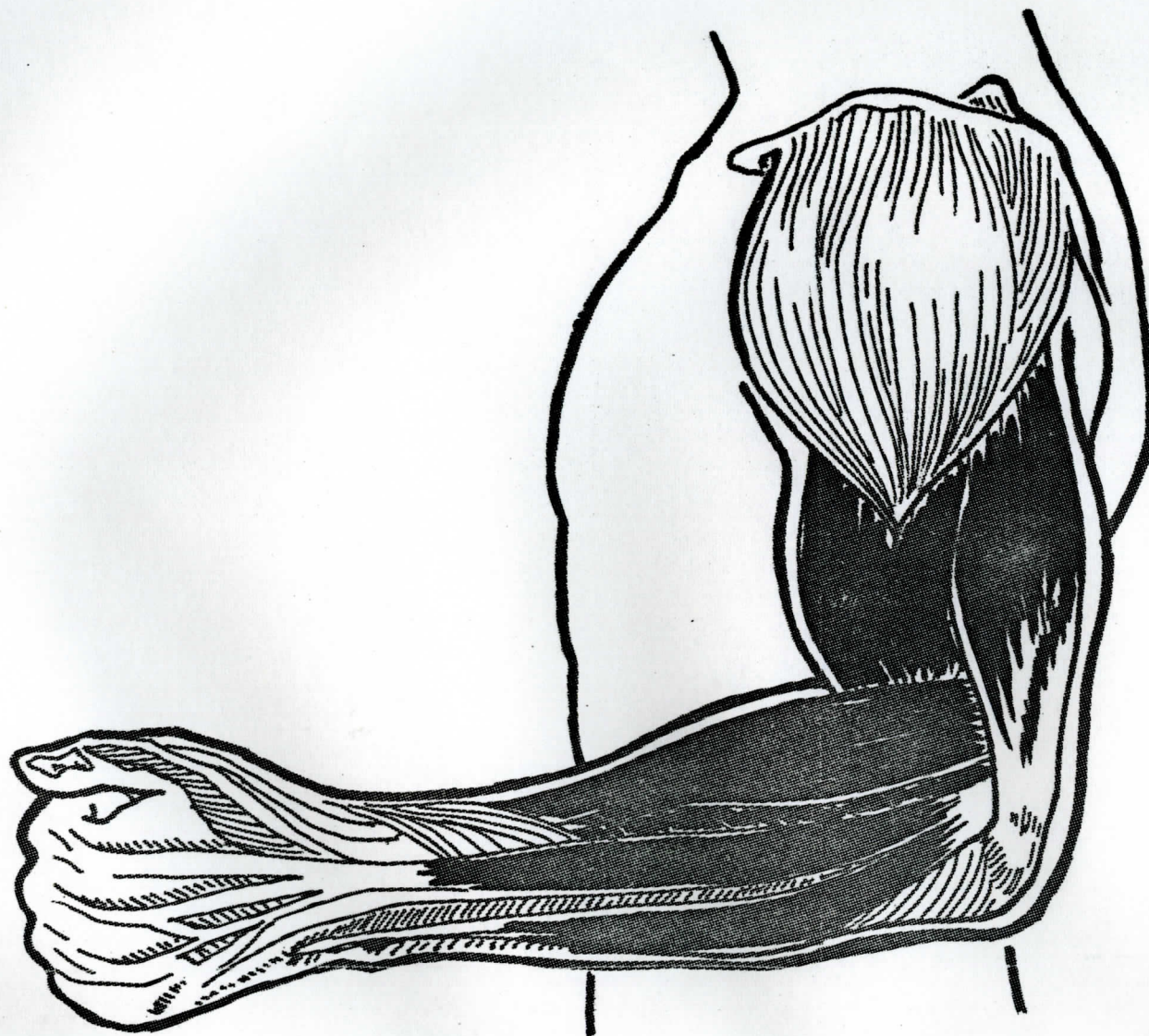
V085-6



V085-7



V085-8

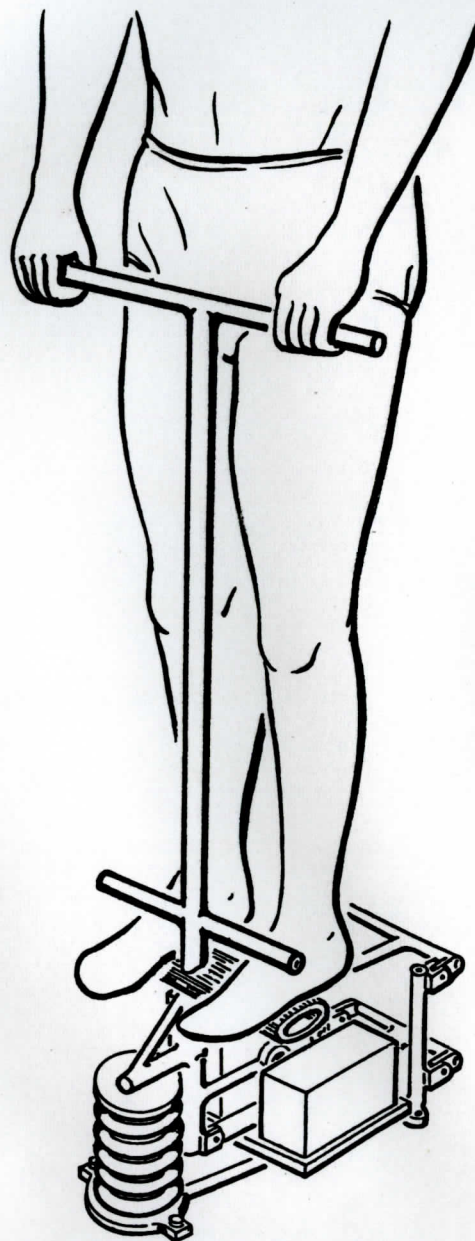


ISOTONIC CONDITIONING

ITEM	TBE	BE L + A	BE L	AE
MUSCULO-SKELETAL MASS STRENGTH ENDURANCE	VG	F	P	P
BALANCE - AGONIST/ ANTAGONIST	VG	P	P	P
CARDIOVASCULAR POWER RANGE (KCAL/HR)	VG 200-1350	G 150-850	G 150-800	P 100-350
CONTINGENCIE MODES	VG	F	P	P
TEST MODES	G	G	G	G
STRENGTH TEST/MODE	VG	G	F	F
WEIGHT - LB	15	29	24	23
VOLUME - CU FT	0.3	0.9	0.7	0.4
DEVELOPMENT RISK	LOW	LOW	LOW	LOW
POWER REQUIREMENT	-300	-250	-225	-70
RATING	1	2	3	4

V080-6

MASS DETERMINING DEVICE



CREW TEST & MONITORING SYSTEM REQUIREMENTS

V091-5

- **BASELINE MONITORING SYSTEM**

- **PROVIDE MISSION CONTROL WITH CREW STATUS**
- **PROVIDE FLIGHT SURGEON DIAGNOSTIC DATA IN EMERGENCIES**

- **TEST SYSTEM ON EARLY FLIGHTS**

- **DEFINE PHYSIOLOGICAL AND PERFORMANCE BASELINES**
- **EVALUATE CREW PROVISIONS**
- **OPERATIONAL MAN-EQUIPMENT DESIGN VALIDATION**
- **ESTABLISH CONFIDENCE IN BASELINE MONITORING SYSTEM**

CREW TEST AND MONITORING

	WEIGHT ALLOCATIONS IN:	AEROSPACE GROUND EQUIPMENT	TEST	CREW TRAINING
BASELINE	LAB MODULE SEGMENT	AUTOMATIC CHECKOUT	WITH LAB MODULE	INTEGRAL
MINIMUM 30-DAY TEST	CONTINGENCIES	COMPATIBLE CONSOLE	WITH LAB MODULE	INITIAL CREWS

BASELINE LABORATORY CREW TEST AND MONITORING

V086-8

	LABORATORY MODULE WEIGHT
CREW PHYSICAL CONDITIONING	30
BIOMEDICAL MONITORING DEVICES	
CARDIOTACHOMETER - EKG - VCG	10
ARTERIAL BLOOD PRESSURE - ORAL TEMPERATURE	1.5
RADIATION MONITORING SYSTEMS	50
	91.5

BIOMEDICAL CONTROL PANEL IN LAB MODULE CONTROLS AND DISPLAYS

STOWAGE IN FURNISHINGS WEIGHT

MINIMUM 30-DAY CREW TEST SYSTEM FOR EARLY FLIGHTS

V086-5

	ORBITING VEHICLE WEIGHT	GEMINI RETURN WEIGHT
CREW PERFORMANCE	36	
BODY MASS DETERMINING DEVICE	20	
INTEGRATED RESPIRATION, METABOLIC RATE, AND CARDIAC OUTPUT SYSTEM	40	
VENOUS PRESSURE	0.6	
ON-BOARD BIOCHEMICAL ANALYSIS (SYSTEM NO. 3)	15.5	
BLOOD PLASMA STORAGE (FROZEN)	7.1	7.41
URINE AND FECAL SAMPLES (VACUUM DRIED)	0	23.6
12 LB STOWAGE PROVISIONS IN FURNISHINGS WEIGHT	119.2	31.01

CREW RADIATION MONITOR

OBJECTIVES

- MISSION SUCCESS WITHOUT UNDUE INJURY TO CREW
- CONTRIBUTION PER MISSION TO "CAREER DOSE"; LIMITS NOT EXCEEDED
- ASSESSMENT OF EXTRAVEHICULAR MAN MADE RADIATION

REQUIREMENTS

- DOSE RATE & TOTAL DOSE BOTH AT SURFACE & AT DEPTH (SKIN & VITAL ORGANS AT DEPTHS)
- LINEAR ENERGY TRANSFER (RBE & Q.F. MEASUREMENTS)
EVA DOSE MEASUREMENT
- ALARM SYSTEM
 - IMPENDING SOLAR PROTRON EVENT -UTILIZING RADIOMETRIC, SPECTROMETRIC, OPTICAL MEASUREMENTS --- ETC. (GROUND, MOL, SATELLITES) --- ETC.
 - ANTICIPATED TOTAL DOSE RECEIVED DURING A FLARE
 - APPROACHING PREASSIGNED MISSION DOSE, TOTAL DOSE, OR DOSE RATE INCREASE
- ALLOWABLE DOSE LIMIT FOR ALARM (MISSION OBJECTIVES VS IMMEDIATE & DELAYED EFFECTS)

CREW RADIATION MONITOR

(CONT)

SENSITIVITY

- NORMAL MISSION DOSE RATE (SUGGESTED: 50R/30D OR 70 MR/HR)
- EMERGENCY DOSE RATE (SUGGESTED: 200R/30D OR 280 MR/HR)
- LOWER LIMIT DEPENDS ON MAXIMUM DOSE ONE IS WILLING TO NEGLECT IN CAREER DOSE

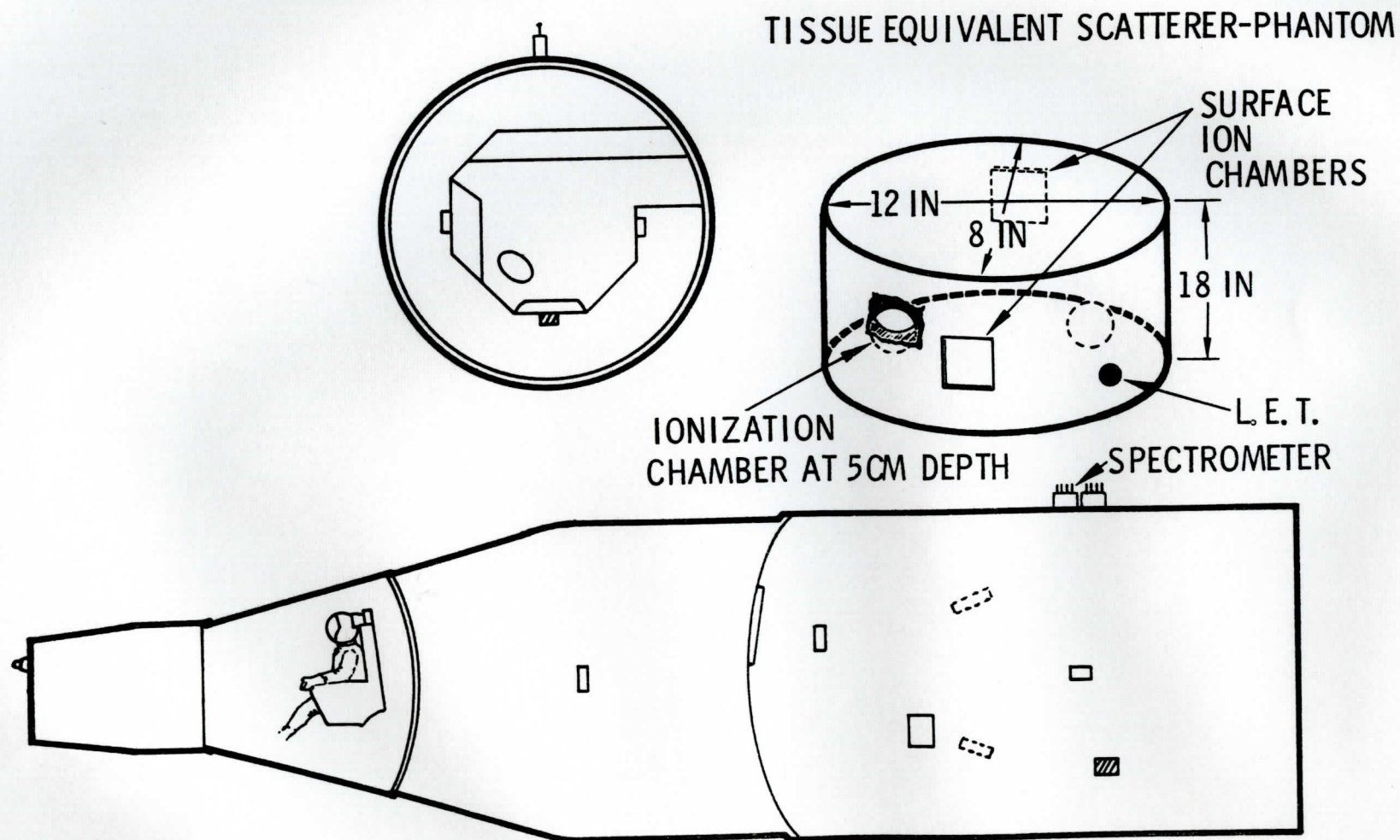
APPROACHES TO DOSIMETRY MEASUREMENTS

- CENTRAL MONITORING STATION - PROVIDES ALL MEASUREMENTS IN PHANTOM
30 - 40 LBS, 0.9 FT³, 3 W (WITHOUT SPECTROMETERS)
- MULTIPLE STATION MONITOR - SENSORS STRATEGICALLY LOCATED THROUGHOUT
VEHICLE 80 - 90 LBS, 1.5 FT³, 4 W (WITHOUT SPECTROMETERS)

SHIELDING CONSIDERATION

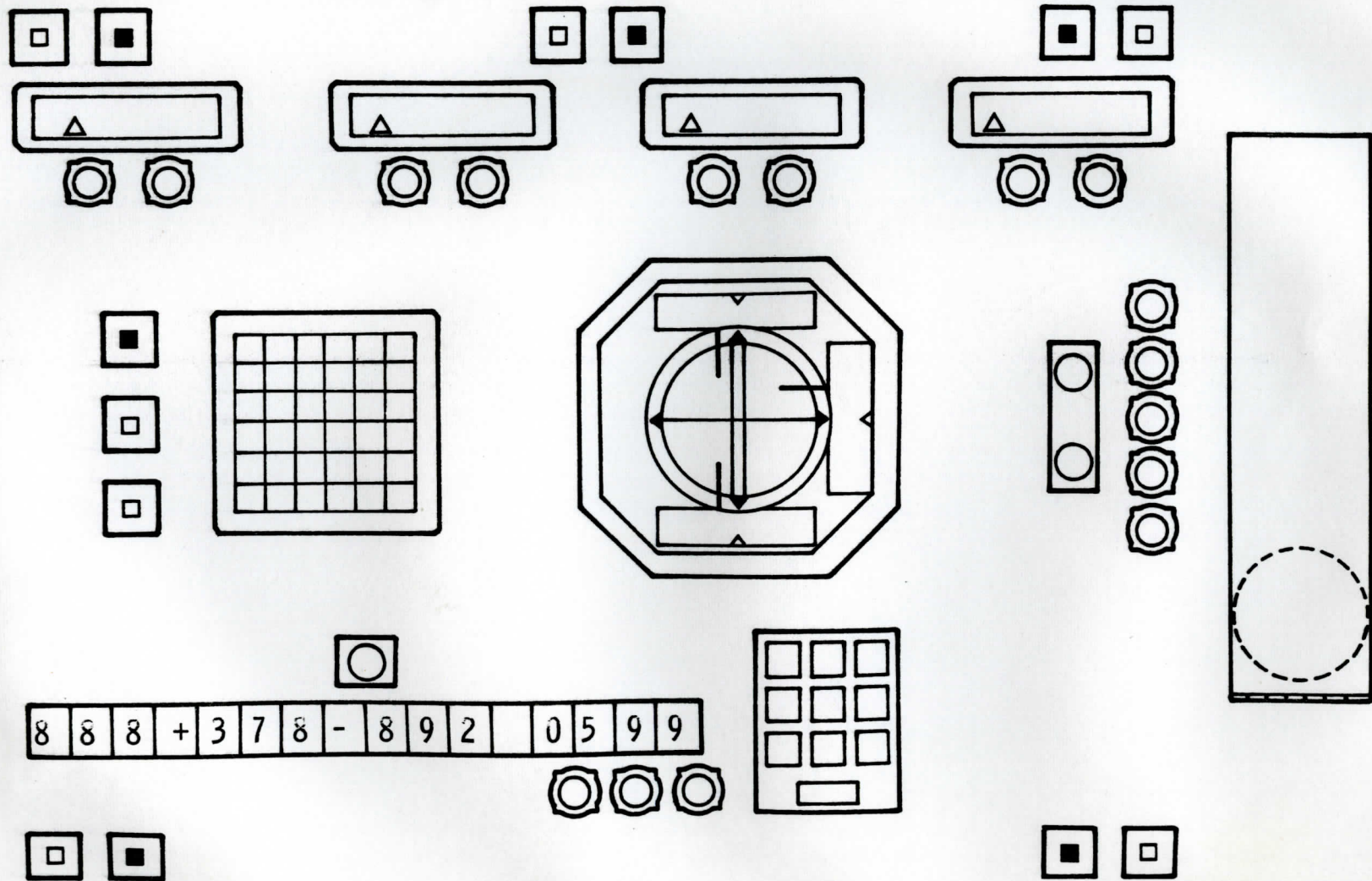
- NO STRUCTURAL ALTERATION OR ADDITIONAL WEIGHT (EXCEPT FOR PARTIAL BODY SHIELD)
- ARRANGEMENT OF INTERNAL EQUIPMENT & ITS COMPOSITION

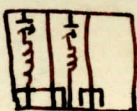
CREW RADIATION MONITORING



HUMAN PERFORMANCE

V080-6





7-0 x 10³
2 x 10³
120

TDRk - Telem -
dt Mech -
TDRk - Fixed Mass

Order Springs



MISSILE & SPACE SYSTEMS DIVISION/SPACE SYSTEMS CENTER

5301 BOLSA AVENUE, HUNTINGTON BEACH, CALIFORNIA - A DIVISION OF DOUGLAS AIRCRAFT CO. INC.