Lmit

REPORT NO. CASD-NAS 73-003
CONTRACT NAS 8-29150

LIFE SCIENCES PAYLOAD DEFINITION AND INTEGRATION STUDY (TASK C & D)

VOLUME IV PRELIMINARY EQUIPMENT ITEM SPECIFICATION CATALOG

GENERAL DYNAMICS
Convair Aerospace Division

VOLUME I	MANAGEMENT SUMMARY
VOLUME II	PAYLOAD DEFINITION, INTEGRATION, AND PLANNING STUDIES
VOLUME III	APPENDICES
VOLUME IV	PRELIMINARY EQUIPMENT ITEM SPECIFICATION CATALOG

REPORT NO. CASD-NAS73-003

LIFE SCIENCES PAYLOAD DEFINITION AND INTEGRATION STUDY (TASK C & D)

VOLUME IV • PRELIMINARY EQUIPMENT ITEM SPECIFICATION CATALOG

August 1973

Submitted to
National Aeronautics and Space Administration
GEORGE C. MARSHALL SPACE FLIGHT CENTER
Huntsville, Alabama

Prepared by
CONVAIR AEROSPACE DIVISION OF GENERAL DYNAMICS
San Diego, California

ACKNOWLEDGMENTS

This report consists of Volume I — Management Summary, Volume II — Payload Definition, Integration and Planning Studies, Volume III — Appendices, and Volume IV — Preliminary Equipment Item Specification Catalog.

The authors wish to express their appreciation to the entire Life Sciences Payload Integration Team composed of:

C. B. May, Contracting Officer's Representative, NASA/MSFC

R. W. Dunning	NASA/Headquarters
S. T. Taketa	NASA/Ames Research Center
J. A. Mason	NASA/Johnson Space Center

and to J. D. Hilchey, NASA/Marshall Space Flight Center, for their valuable assistance and cooperation throughout the entire course of this study.

The following General Dynamics Convair Aerospace personnel contributed to this program:

G. L. Drake (Contract Manager)
R. C. Armstrong (Convair Life Sciences Manager)
J. R. Murphy
F. G. Rivinius
E. J. Russ
W. G. Thomson
D. W. Vorbeck

Comments or requests for additional information should be directed to:

C. B. May
National Aeronautics and Space Administration
George C. Marshall Space Flight Center
Huntsville, Alabama 35812
Telephone: (205) 453-3431

or

G. L. Drake
Convair Aerospace Division of General Dynamics
P. O. Box 80847, Mail Zone 663-00
San Diego, California 92138
Telephone: (714) 277-8900, Ext. 1881

PRELIMINARY EQUIPMENT ITEM SPECIFICATION CATALOG

In the development of the Life Sciences Laboratory designs for the Sortie Module, the equipment item information listed in the Task A&B (NAS8-26468) computerized inventory was expanded. This expansion has taken the form of an equipment item specification sheet(s).

These sheets are intended for the designer and include all the detailed information presently available on each equipment item. These specification sheets list the purpose of the equipment item, and any specific technical requirements which can be identified. The status of similar hardware for ground use is stated with comments regarding modifications required to achieve spaceflight qualified hardware. Pertinent sketches, commercial catalog sheets or drawings of the applicable equipment are also included.

A number of equipment item specification sheets within this catalog contain only the equipment item name, number, and general use or information comment. Most of these items fall within one of these categories: (1) minimum design sensitive equipment, i.e., log books, film, chart paper, kits; (2) items basically the same as other described equipment, i.e., numerous and different measurement couplers; (3) NASA developed equipment for Skylab; and (4) experiment specific equipment, i.e., gas supply, manifold, sensors, ID tags.

The sheets are placed in numerical order in the catalog. Only the approximate 200 equipment items selected for the laboratories are listed; therefore, the numbers will not be consecutive because the total inventory contained approximately 380 equipment items.

A cross-index giving EI number, equipment name, and E.U. group is presented in the following table for added convenience.

E.I. NO.	NAME	E.U. NO.
1	Accelerometer	3
1A	Accelerometer Coupler	3
3B	Air Lock	11
3C	Adapters, TV - Microscope	1
6	Air Particle Sample Collector	61
7	Autoanalyzer, Multiple	5
8A	Analyzer, Atomic Absorption Spectrophotometer	5
11	Analyzer, General Spectrophotometer	5
13	Analyzer, Urine, Automatic	5
14	Anesthetizer, Invertebrates	4
14B	Antennas, Assorted	2
15	Anthropometric Grid	93
15A	Atmospheric Sampling, Manifold	5
15D	Audio Stereo Headset	91
16B	Audiometer	5
16D	Badges, Radiation	26
16E	Bags, Plastic	6
16F	Coupler, Ballisto-Cardiogram	31
18	Bench, Laminar Flow	4
18A	Laminar Flow Bench Liners	4
18B	Laminar Flow Bench Insert, Radiochemical	4
18C	Bicycle Ergometer	31
18D	Custom Bite Boards	12
19	Bench, General Experiments	5
19D	Body Mass Measurement	12
25	Cage, Invertebrates (Jars)	70
25B	Colony Chamber	60
26A	Cage, MMB, C/T	60
26B	Cage, MMB, Plant	50
28	Cage, MMB, Rat	40
28A	Cage, Monk, Macac	41
29	Cage, Plant (Pot)	50
30A	Cage, Rat	40
30B	Cage Shelf, Plant Seedlings	51
32	Camera, Cine	1
32A	Camera Controller	1
34	Camera, Plate Film	1
36	Camera, Iris, 35 mm	31
37	Camera, Video, B/W	1
38	Camera, Video, Color	1
38A	Camera, X-Y Drive	1
41	Centrifuge, Refrigerated, High Speed	4
42	Centrifuge, Micro	4

E.I. NO.	NAME	E.U. NO.
44	Chemicals	4
44A	Chemicals, Radioactive	4
45	Chemical Storage Cabinet	7
48	Vacuum Cleaner, General Laboratory	4
49A	Cleaner, Hand	6
50	Clinostat	5
50A	Commutator, Gas Manifold	5
50B	Compactor, Waste Solids	6
50C	Console, Behavioral Measurements	91
51	Computer, Digital	2
51D	Experimenter's Control Console	12
52	Cell Counter	5
53	Automatic Colony Counter	5
54	Bacterial Colony Counter	5
55A	Crew Mobility Aids	3
55B	Crew Restraints	3
56A	Data Management System, Buses	2
58	Data Management System, Digital Plotter, Printer	2
58A	Data Management System, Remote Control Station	2
58B	Data Management System, Remote Instrumentation Module	2
63B	Display-Keyboard, Portable	2
63G	Deionizer, Water	4
64	ECG Coupler	2
65	EEG Coupler	2
65B	Electrophysiology Backpack	12
65C	Electrophysiology Receiver	12
65D	Electrophysiology Display	12
66	EMG Coupler	2
69A	Electrometer	6
70	Electrophoresis Apparatus	4
76C	Film	1
76E	Filters, Video	1
76F	Flowmeter, Water Manifold	3
76G	Flowmeter, Ultrasonic	42
76H	Flowmeter Coupler	3
76J	Flowmeter, Gas	3
76K	Flowmeter, Doppler	31
76L	Blood Clot Fibrometer	5
77B	Freezer, Cryogenic	4
80	Freezer, General	4
81	Freezer, Low Temperature	4
83	Refrigerator (4°C)	4
84	Refrigerator, Radio Isotope Storage	4

E.I. NO.	NAME	E.U. NO.
85	Gas Analyzer, Automatic, Blood Gas	5
86	Gas Analyzer, CO_2 Specific	5
89	Gas Analyzer, Gas Chromatograph	5
90	Gas Analyzer, Mass Spectrometer	5
91	Gas Analyzer, Mass Spectrometer	5
93	Gas Analyzer, Water Vapor Specific	5
93A	Gas Supplies	3
97A	Hematocrit, Electronic	4
98A	Holding Unit, Invertebrates, Cells, and Tissues	60
98C	Holding Unit, Incubator - Invertebrates	70
100	Primate Metabolic Mass Balance Equipment	41
101	Holding Unit, Plants	50
103	Holding Unit, Small Vertebrates	40
104E	Coupler, Impedance Cardiogram	31
104F	Impedance Pneumograph	31
105	Kit, Bench Chem. Anal.	4
106	Kit, Hematology	4
106A	Kit, Clean-Up	6
108	Kit, Histology	4
109	Kit, Linear Measurement	6
110	Kit, Microbiology	4
110B	Kit, Organism Holding and Management	6
110C	Kit, Physiology	31
111	Kit, Plant Tools	51
112	Kit, Medical-Surgical	31
113	Kit, General Tool	6
113A	Kit, Tool - Insect Manipulation	70
114A	Kit, Microdissection	4
115	Kit, Veterinary	42
115F	Life Support and Protective System Test Unit	80
116	Log Books	1
118	Lyophilizer	4
118D	Manifold, Organism Water	40
118I	Manifold, Vacuum	80
119	MSI Task Simulator	91
119A	Teleoperator Control Console	11
121	Mass Measurement Device, Macro	4
122	Mass Measurement Device, Micro	4
122A	Mass, Test (Variable Size, Weight, Shape, etc.)	93
124	Media, Prepared	61
125B	Meters, Assorted	5
125C	Meter, AOTS	5
125D	Metabolic Analyzer	31

E.I. NO.	NAME	E.U. NO.
126	Microscope, Compound	1
126A	Microscope, Dissecting	4
126B	Microphone	5
126C	Microphone Amplifier	5
126G	Monitor, Video	1
126I	Mobility Unit - Protective Corridor	93
128	Millipore Filter	4
131D	Motorized Plant Growth Monitor	51
131E	Non-Visual Direction Indicator	12
131H	Optiscan-Field and Fixation Point Recorder	91
132	Oscilloscope	2
132A	Oscillator, VCO	42
133	Otolith Test Goggles	12
134B	Paper, Recording	1
138	pH Meter	5
138A	Photocells	2
138B	Phototransistor (Coupler)	2
139	Plethysmograph, Limb (including Coupler)	31
140	Coupler, Phono/Vibrocardiogram	31
142	Portable LSS	80
143C	Pump, Gas Circulating	51
143D	Catalytic Oxidizer System	4
143E	Pressure Cuff	42
143F	Pressure Cuff Pump	42
143G	Coupler - Pressure	2
144	Psychomotor Performance Console	91
144B	Psychogalvanometer, GSR	12
144C	Radiation Detector, Dosimeter	26
145	Radiation Detector, General	26
147	Radiation Counter, Biochemical Sample	26
149G	Isotope Source, Self Contained	26
150	Radiation Source Storage	26
150A	Recorder, Multichannel, Biomedical	1
150B	Cage Module Receiver, Compact, Biotelemetry	42
150D	Receiver	3
153	Recorder, Voice	12
153A	Rotating Litter Chair	12
153B	Sensors, Assorted	6
155A	Sensors, Implanted	42
156	Signal Conditioner	2
156B	Squibs, Fixative	51
156C	Squib Firing Apparatus	51
157	Sound Level Meter	5
159	Staining System, Bacteriological	4

E.I. NO.	NAME	E.U. NO.
165	Tool Sterilizer	6
167B	Storage, General	7
167C	Storage, Film	7
168A	Tags, I.D., Organism	6
172	Spacesuit	11
174	Tank, Vertebrate Water	40
175	Tank, Plant/Invert. Water	50
176	Tape, Video	2
176H	Taskboard, Force/Torque	91
177	Temp. Sensor, Body	42
179	Temperature Block	4
179A	Thermocouples	5
180	Timer, Event	2
180A	Trace Gas Concentrator	5
181B	Transducer, Plethysmograph	31
181C	Transducer, Blood Pressure	42
181D	Transducer, Pressure	2
181E	Video ID Date-Time System	1
181G	Trash Can	6
182J	Coupler, Vectorcardiogram	31
182K	Vision Tester	91
185	Voltmeter (VOM)	6
186	Volumetric Meas., Liquid	4
186A	Vomitus Bags & Holders	31
187A	Waste Storage System	3

#1 ACCELEROMETER

Purpose

This accelerometer is attached to appropriately-mounted individual organism cages to sense when the organism is active and to indicate the gross activity level. Acceleration in all three axes is desirable. These accelerometers are also used to monitor accelerations and vibrations to which human test subjects are exposed.

Requirements

Accuracy:	$\pm$ .0004 g
Freq. Resp.:	0 - 100 Hz

Hardware Status

This item is available and should be usable as is.

Technical Description

One model of an accelerometer which could possibly be used was chosen and is described on the following pages.

Weight:	0.2 lb
Volume:	0.001 ft^3
Power:	negl.

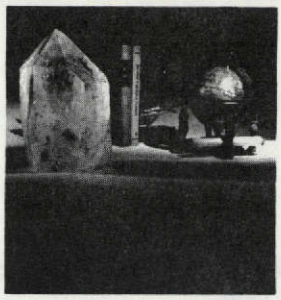
Cost - $0.7K

Development Time - Usable items available.

Comment

Acceleration measurements may be an undesirable way to monitor animal activity since a cage mounting design would be required to vibration isolate all adjacent cages from one another.

ENDEVCO PRODUCT DATA



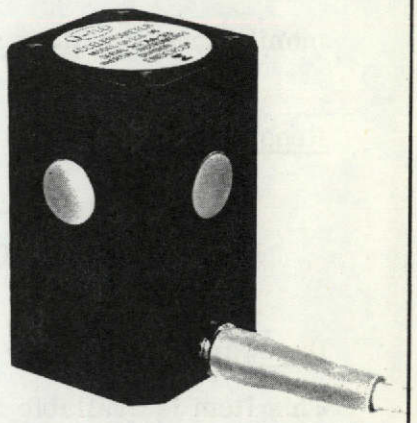
Q-FLEX MODEL QA-116-16

ULTRA SENSITIVE LINEAR ACCELEROMETER

The Model **QA-116-16** Q-Flex Accelerometer is a rugged ± 1g full scale 1 volt per g device for measuring infinitesimal steady state and low frequency acceleration with exacting accuracy. The ability to perform these measurements with high reliability and repeatability over a wide range of environmental variations makes the **QA-116-16** ideally suited for a multitude of subtle motion sensing applications.

Combining outstanding dynamic performance with the ability to withstand, without degradation, static overloads up to 100g and shocks up to 500 times full scale makes the **QA-116-16** a truly complementary addition to the list of desirable motion measuring instruments.

Typical applications for the **QA-116-16** include the measurement of earth motion, structural sway, building vibration, and other minute acceleration forces wherever ultra low resolution and high sensitivity are required.

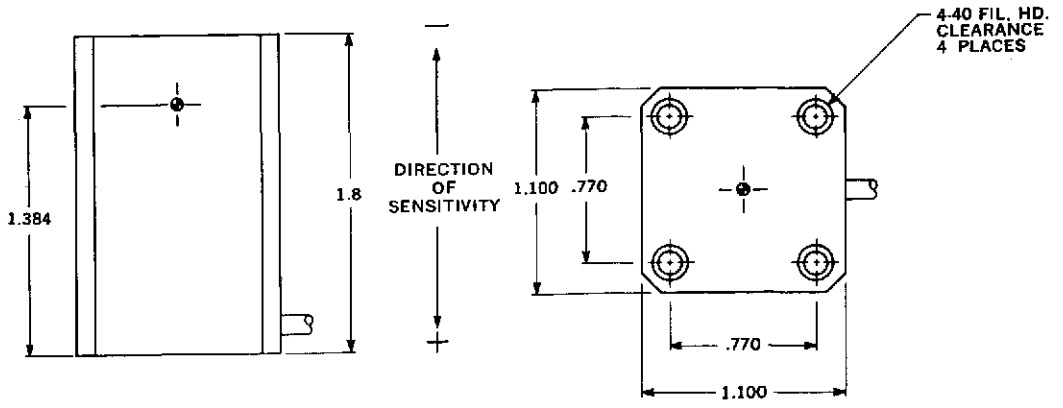


SPECIFICATIONS FOR THE MODEL QA-116-16 ACCELEROMETER

(TERMINOLOGY PER ISA RP 37.1)

Range (Full Scale)	±1g*
Sensitivity (Nominal)	1 Volt/g
Output Resistance (Nominal)	900 ohms
Frequency Response (±5%)	DC to 300 Hz
Natural Frequency (Nominal)	1000 Hz
Noise (Nominal): 0 - 10 Hz	100 microvolts rms
0 - 300 Hz	500 microvolts rms
300 - 10 KHz	3 mV rms
Broadband	5 mV rms
Excitation Voltage	28 VDC ±5%
Excitation Current	17 ma quiescent, 25 ma full scale
Sensitivity Shift With Excitation Voltage	0.005%/V
Zero Shift With Excitation Voltage	50 micro g/V
Resolution (DC)	0.000001g
Threshold (DC)	0.000001g
Linearity (DC)	0.01% of reading
Hysteresis (Less Than)	0.001% of full scale
Repeatability	0.03% of full scale
Zero Unbalance (Less Than)	0.05g
Damping (Approximate)	0.6
Thermal Zero Shift (Max.)	0.0002g/°F
Thermal Sensitivity Shift (Max.)	0.01%/°F
Transverse Sensitivity	0.002g/g

*Unit meets all specifications at input up to 3 times fullscale.



NOTES:
⊕ Represents CG of seismic mass
All dimensions are in inches

CHARACTERISTICS

ELECTRICAL

Connection	Integral 24 inch shielded four conductor cable, tinned leads
Grounding	Electronics are isolated from case 50 megohms at 50 vdc. Shield is common to case

PHYSICAL

Weight	3.6 ounces (excluding cable)
Sensing Element	Q-Flex
Mounting	Integral to case
Case Material	Stainless steel and anodized aluminum
Accessories Supplied	Mounting screws, instruction manual and calibration card

ENVIRONMENTAL

Temperature	−45°F to +185°F
Static Overload	100 g
Shock	500 g, 11 millisec half sine all axes
Vibration	50 g pk. random sine all axes
Humidity	Unit is epoxy sealed

Continued product improvement necessitates that Endevco Corporation reserve the right to modify these specifications and/or prices without notice.

RELIABILITY: Endevco maintains a program of constant surveillance over all products to ensure a high level of reliability. This program includes attention to reliability factors during product design, the support of stringent Quality Control requirements, and compulsory corrective action procedures. These measures, together with conservative specifications, have made the name Endevco synonymous with reliability.

PRICES: (F.O.B. Santa Ana) $650.00 each

Prices of ENDEVCO® products for export or purchased with intent to export beyond the territorial limits of the United States are subject to special quotation.

ENDEVCO — INERTIAL INSTRUMENT DIVISION 3015 SOUTH KILSON DRIVE • SANTA ANA, CALIFORNIA 92707 • TELEPHONE 714 540-2390

Akron, Ohio • Boston, Massachusetts • Chicago, Illinois • Dallas, Texas • Palo Alto, California • Philadelphia, Pennsylvania • Washington, D.C. West Palm Beach, Florida

Australia • Belgium • Canada • Denmark • England • France • Germany • Greece • Holland • India • Israel • Italy • Japan • Norway • Pakistan S. Africa • Sweden • Switzerland

DIVISION OF BECTON, DICKINSON AND COMPANY

TWX 910 588-3272 • CABLE: ENDEVCO

#1A ACCELEROMETER COUPLER

Comments

Coupler for EI #1. See E.I. 156, E.U. 2 for definition sheet.

#3B AIR LOCK

Comments

Part of spacecraft structure.

#3C ADAPTERS, TV - MICROSCOPE

Comments

To allow viewing the subject under the microscope with a TV camera.

#6 AIR PARTICLE SAMPLE COLLECTOR

Purpose

To obtain air particle and micro-organism samples for air quality determination.

Requirements

Particle size range not specified.

Hardware Status

Commercial models are available which, the reference below indicates, should be directly applicable to spacecraft use.

Technical Description per NASA CR 111794-2 (Biotechnology Study, Vol. II)

Air is drawn through a slit onto a rotating agar-layered petri dish.

Airflow at 1 ft^3/min.

Spring-driven, key-wound motor

1-hour sampling time

Weight:	6 lbs
Volume:	.03 ft^3
Power:	None if vented to space

Cost - Estimated development costs are $28K and unit cost is $4K.

Development Time -

1 year

Comments

NASA-LRC may have a patent on a more advanced particle collector design.

#7 AUTOANALYZER, MULTIPLE

Purpose

To perform various automatic analyses of blood and other fluids.

Requirements

No specific requirements have been defined. However, this unit might be similar to the Dupont 700 Automatic Clinical Analyzer. This analyzer measures blood, urine, or spinal fluid properties by means of specific enzymatic reactions together with light absorbance measurements. The analyzer will measure:

Total Protein (TP)
Pseudocholinesterase (PCHE)
Aspartate Aminotransferase (GOT)
Absorbance Test (ABS)
Alkaline Phosphatase (ALKP)
Glucose (GLUC)
Lactic Dehydrgenase (LDH)
Total Bilirubin (TBIL)
Urea Nitrogen (BUN)
Albumin (ALB)
Derebrospinal Fluid Protein
Saliclyate (SAL)
Alcohol (ALC)
Lactic Acid (LA)
Creatine Phosphokinase (CPK)
Hydroxybutyric Dehydrogenase (HBOH)
Calcium (CAL)
Others

The basic capacity is 30 different tests including those listed above.

Hardware Status

The Dupont 700 commercial unit is available and uses individual plastic packs for each test, in which the sample and reagents are sealed. Thus, this system may be adaptable to 0-g operation. However, the Dupont system contains a metering pump, diluent containers with free liquid surfaces, and uses gravity for flushing and mixing operations. Thus, considerable modification would be necessary for 0-g operation. Start-up amperage is approximately 18 amps (115 volt) and operating current is approximately 14 amps which is used mostly for the heaters to maintain the incubation chamber temperature at 37°C. The heater power could possibly be reduced by using the spacecraft coolant as a heating fluid.

Technical Description

Several catalog sheets describing the Dupont 700 Automatic Clinical Analyzer are attached. The Dupont commercial unit properties, and the estimated flight unit properties for a simplified version of the commercial unit are shown below:

Commercial Unit		Estimated Flight Unit	
Weight	= 1000 lbs	Weight	= 250 lbs
Maximum Power	= 2000 watts	Average Power	= 400 watts
Envelope Volume	= 60 ft^3	Volume	= 15 ft^3

Cost

Estimates are:

$700 K - development

$100 K - unit

$69.5K - commercial unit

Development Time

Two years.

#7-3

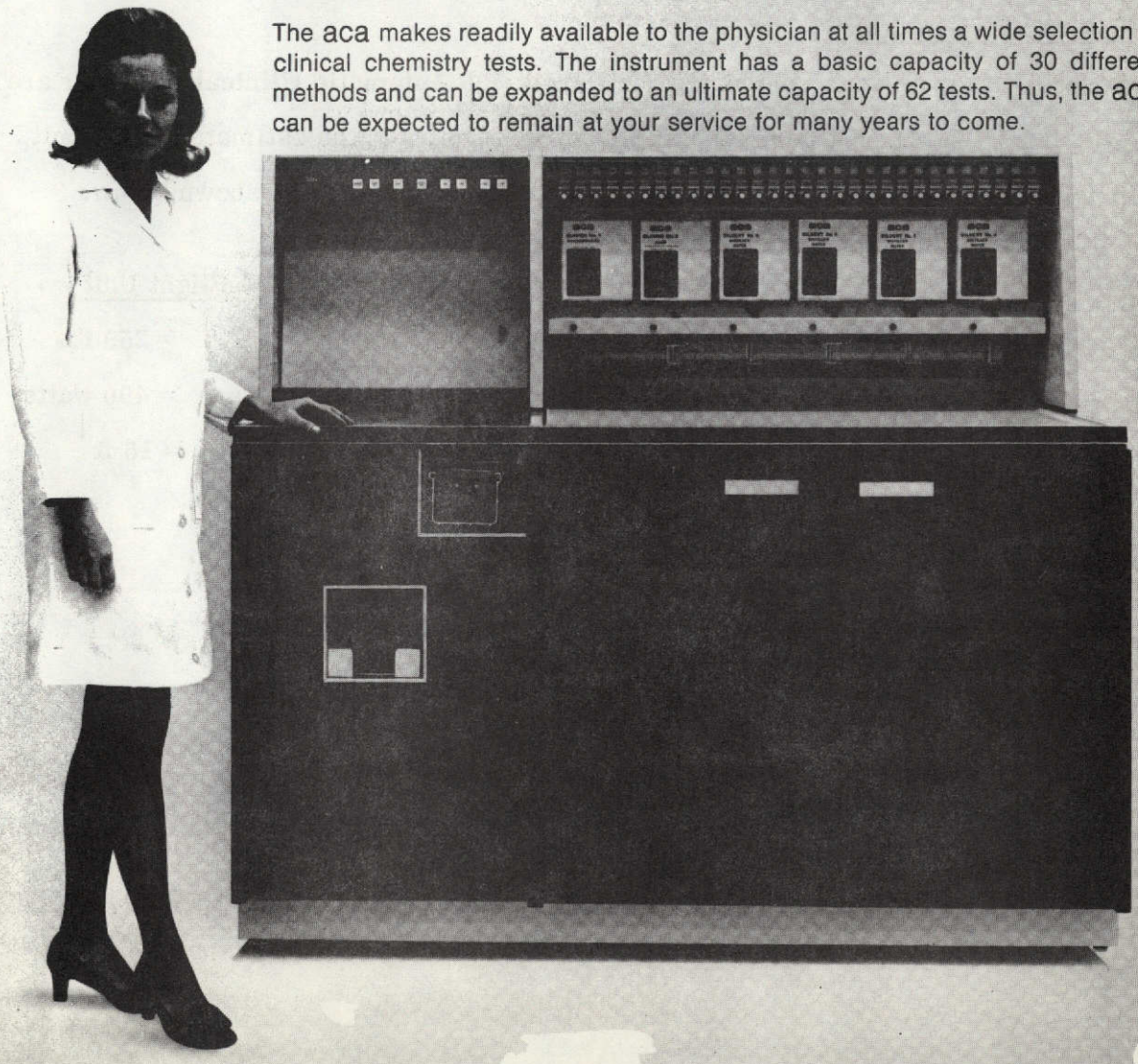
THE DU PONT aca AT YOUR SERVICE

The Automatic Clinical Analyzer (aca) represents a totally new concept in automated clinical chemistry derived from the combined chemical and engineering resources of the Du Pont Company. The primary emphasis in the aca system is placed on service to the physician and the patient. The instrument is designed to reduce to a minimum the time between sampling and transmittal of precise laboratory data.

Once installed in your laboratory, the aca is ready to go instantly—day or night—without waste of time or materials. The samples are processed discretely and consecutively in the order of your priority. Laboratory scheduling problems are greatly reduced. Test results from the initial specimen are available in about 7 minutes. The technologist selects only those tests specified for each sample and runs them in any order desired.

Designed for simplicity of operation, the aca requires minimal operator training. Once the samples and tests are placed in the instrument, no further attention is required. Test readings are automatically converted into the desired concentration units. Positive identification is assured since the numerical results on each sample are printed out on a separate report together with the test name and patient identification.

The aca makes readily available to the physician at all times a wide selection of clinical chemistry tests. The instrument has a basic capacity of 30 different methods and can be expanded to an ultimate capacity of 62 tests. Thus, the aca can be expected to remain at your service for many years to come.



PACK

The aca uses a disposable plastic pack which incorporates:

1. The exact reagent quantities required for a single determination;
2. Processing instructions coded for analyzer interpretation;
3. The test name to identify the method to the operator;
4. A flexible cuvette in which photometric analysis takes place;
5. A chromatographic column in some instances for removing interfering constituents from the test sample.

The plastic used in the analytic pack is a Du Pont Surlyn* ionomer with the following unique physical properties: optical clarity; chemical inertness; strength and heat sealing capability.

PACK HEADER

The header, to which the pack is attached, is used by the transport system as the means for carrying and positioning the pack throughout processing.

The header is a square bar constructed of rigid plastic and contains a precision cylindrical chamber. Processing instructions in binary code form are embossed on the header for interpretation by the analyzer. The name of the test is printed on the header to assure easy identification by the technologist.

The cylindrical chamber in the header permits the insertion of a chromatographic column to remove interfering substances from the sample. Gel filtration and ion exchange are column types currently employed.

GEL FILTRATION COLUMNS

Gel filtration columns provide a technique for the physical separation of compounds with differing molecular weights. The gel matrix retards small molecules while permitting large molecules to be eluted rapidly from the column. Removal of the interfering low molecular weight substrates from the sample is particularly important in the analysis of enzymes.

ION EXCHANGE COLUMNS

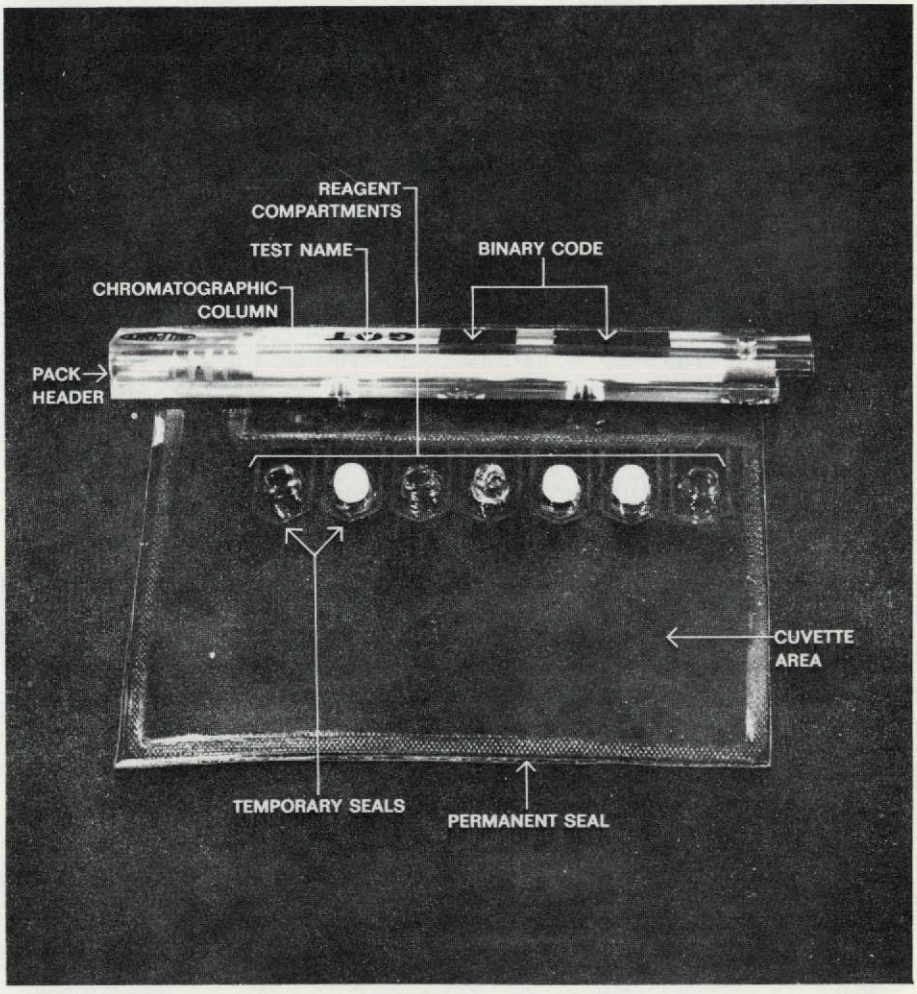
Anion and cation exchange columns provide a means of separating sample components according to electrical charge density. The process involves replacing unwanted ions in the sample with ions which will not adversely affect the reaction.

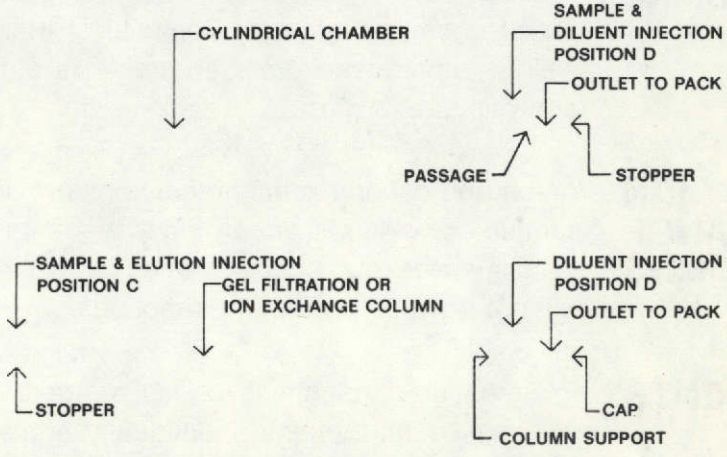
REAGENTS

Pre-measured quantities of test reagents are stored in the pack in seven compartments individually enclosed by temporary seals. During the processing of the pack the temporary seals are automatically opened by generating a hydrostatic pressure within the pack forcing the seals apart. Permanent seals are located around the perimeter of the pack and are as strong as the walls of the pack.

*"Surlyn" is Du Pont's registered trademark for its series of ionomer resins.

ANALYTICAL PACK





DILUENT SYSTEM

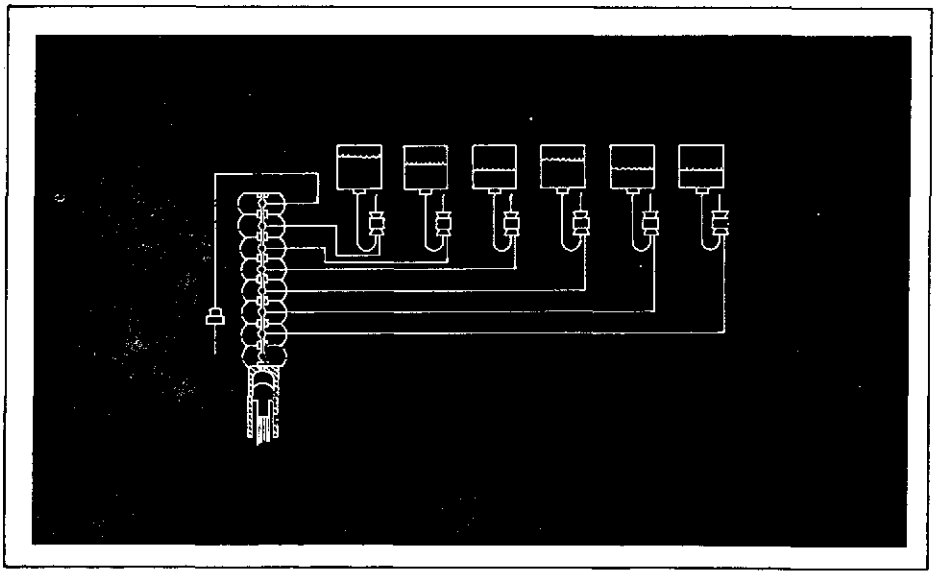
The diluent system has capacity for six different liquids, i.e., buffers, electrolyte solutions, distilled water, etc. The diluents are supplied in a disposable 4.0 liter corrugated box with a polyethylene bag liner. Each container has enough diluent for approximately 700 tests. A red light on the instrument indicates when the diluent supply is low and a new container is to be inserted. The diluent flows through a debubbler to eliminate entrapped air prior to entering the metering system.

FLUID METERING SYSTEM

The fluid metering unit consists of a piston pump and eight precision micro valves. The entire system, which has a capacity of 5.0 milliliters, is actuated and controlled by the built-in computer.

The flow rates and volumes are varied through the use of a computer-controlled stepping motor. Five microliters are drawn into or discharged from the pump for each step of the pump piston. Volumes are programmed in 20 microliter increments from 20 microliters to 3.0 milliliters.

Valve No. 1 serves as an outlet connecting the pump to the pack injection needle. Valves No. 2 through No. 7 are used for diluent supply and No. 8 is used in the water flush system.

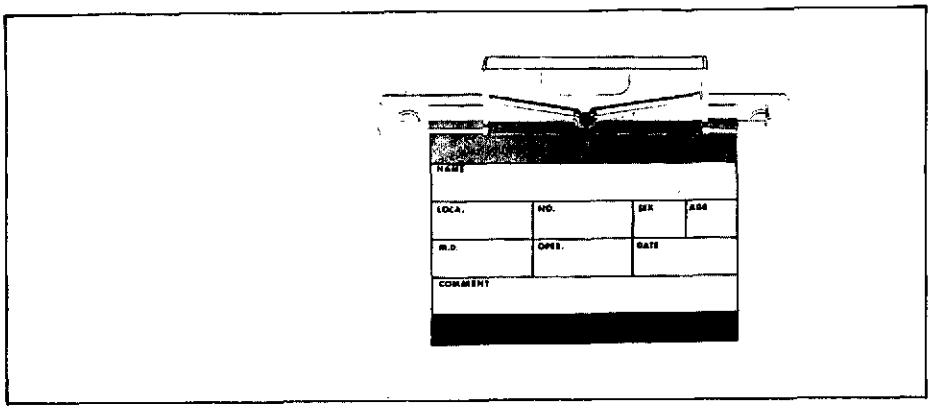


SAMPLE

A plastic sample cup is used to convey the test sample into the analyzer. Attached to the sample cup is the identification card consisting of a 3″ x 4″ plastic sheet on which the patient name and other identifying information can be written.

Most test packs are designed to analyze either serum or heparinized plasma. Other body fluids, e.g., urine and spinal fluid, may be

analyzed by certain methods. The individual method descriptions in the back of the brochure give the details concerning sample requirements for each method.



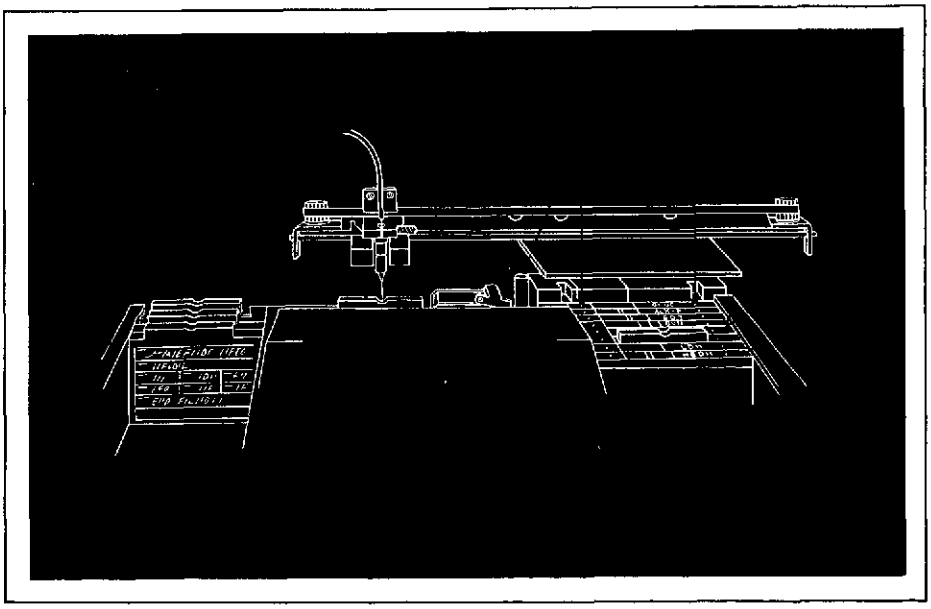
INPUT TRAY

Sample cups and packs are loaded into the input tray in sets, each set consisting of a single sample cup followed by the test packs in any desired sequence. A spring-loaded pack follower feeds the sample cup and packs into the filling station.

FILLING STATION

The sample cup first enters the pack filling station and then shifts left to position A. The packs following the sample move into the filling station one at a time for decoding and filling.

The binary code on the pack header identifies the test for the computer which provides the analyzer with information specifying: sample volume; diluent type; presence of chromatographic column; elution volume and processing cycle.



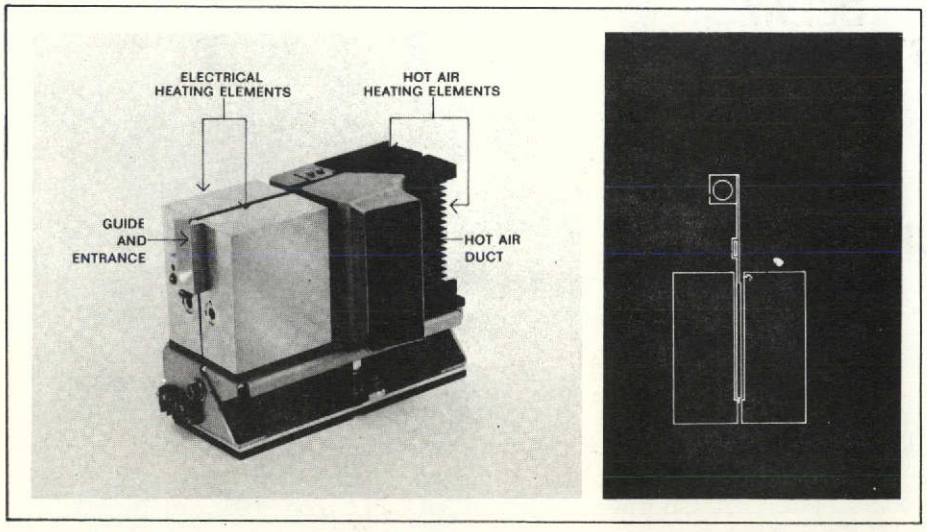
The filling instructions are automatically executed in the following sequence (see figure on previous page):

1. The needle moves to position B over the drain and flushes the system with the selected diluent;
2. The pump reverses and fills the system with the specified quantity of diluent;
3. The needle moves to position A and the sample intake occurs;
4. If a chromatographic column is used, the needle proceeds to position C of the pack header where the serum sample and the elution diluent are injected into the column;
5. After the separation is accomplished, the needle moves to position D of the pack header and injects the remaining diluent into the pack. If a column is not used, the needle bypasses position C and proceeds directly to position D and injects both the sample and diluent into the pack;
6. After the pack has been filled, the needle moves back to position B and the fluid system is flushed twice with distilled water.

At the conclusion of the filling cycle, the pack is moved to the right into the main processing section of the analyzer and the filling station either accepts a new pack or goes into "standby".

PREHEAT STATIONS

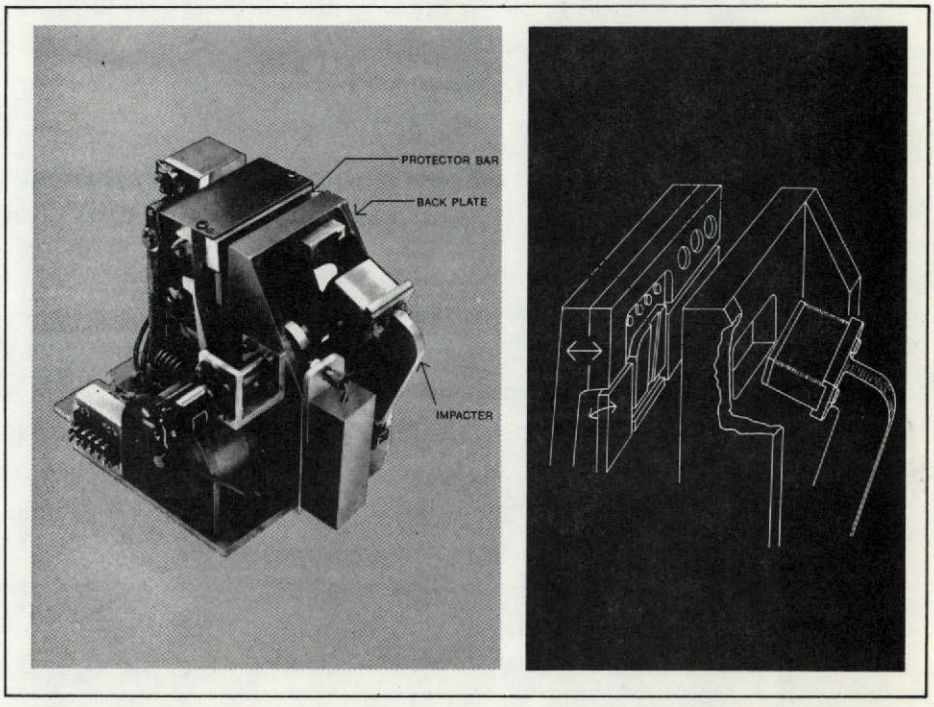
In the main processing unit the pack is first preheated to 37°C. in two successive heater stations. In both units heat transfer to the pack is accomplished via intimate contact between two metal plates, the first pair heated electrically and the second by air. Subsequently, the pack temperature is maintained by processing it at 37°C. in the carefully controlled environment of the analyzer. At the time of measurement the pack liquid temperature is 37°C. ±0.1°C.



BREAKER-MIXER I

In breaker-mixer I the first group of reagents is released from its storage position in the pack and mixed with the diluent/sample solution.

In the first operation the protector bar, which contains three cylindrical indentations to protect pack compartments 5, 6 and 7, is driven shut across the top of the pack. The impacter forces the fluid upward rupturing the temporary seals of unprotected compartments 1, 2, 3 and 4. The reagents are thoroughly blended with the main reaction fluid for 25 seconds by the oscillating action of the platens. At the completion of the cycle, the protector bar and platens open and the pack moves to the next station.



DELAY STATIONS

After leaving breaker-mixer I, the pack is indexed through five delay stations during which time there are no operations performed on the pack by the analyzer. This interval of 2 minutes, 55 seconds is used as reaction time or as a delay period to allow blank or side reactions to go to completion.

BREAKER-MIXER II

At breaker-mixer II the remaining reaction chemicals are released from compartments 5, 6 and 7, and mixed with the pack contents by a process similar to that of breaker-mixer I.

The action of breaker-mixer II may be programmed to allow either a 45.5 or 31.5 second interval between the release of the reagents and the start of the measurement period.

At the completion of this cycle, the pack advances to the photometer.

PHOTOMETER

The photometer station consists of an optical cuvette-forming device, light source, optical filters and a photometric system for making differential absorbance measurements sequentially.

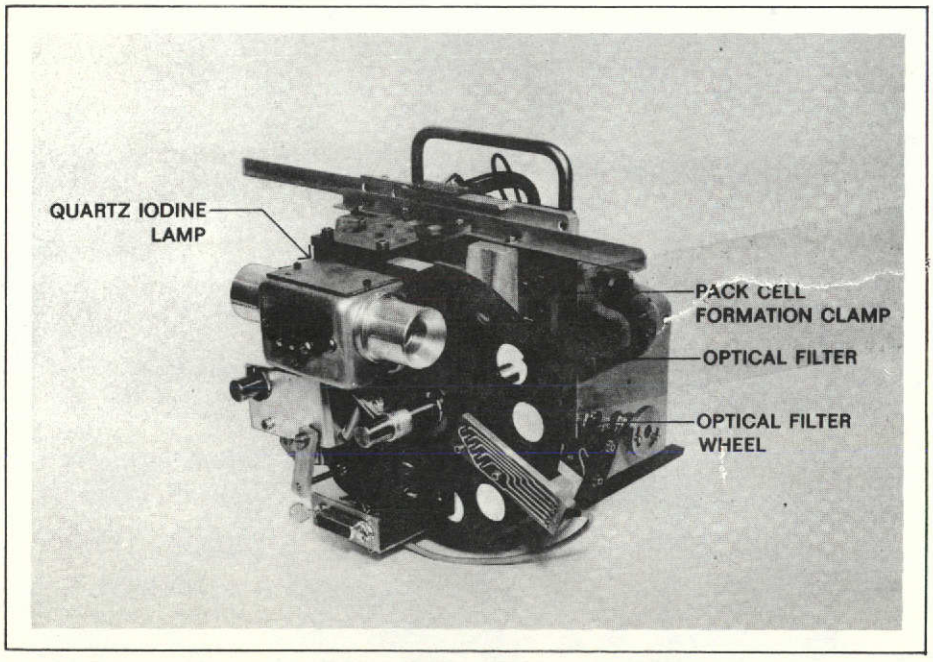
As the pack enters the photometer station, the computer provides the analyzer with information specifications on the test name, optical filter(s) selection, and analog-digital conversion factors. The photometer jaws close, generating hydraulic pressure within the pack to form a precision cuvette between quartz windows. At the same time, a wetting solution is applied to the surface of the quartz windows to eliminate the optical interface with the pack walls. The excess pack fluid is channeled to a pressure relief cell.

The photometric system consists of a quartz-iodine lamp, a selector wheel with space for 12 interference-type optical filters, a quartz beam splitter, quartz cell windows, a regulator phototube and measuring phototube.

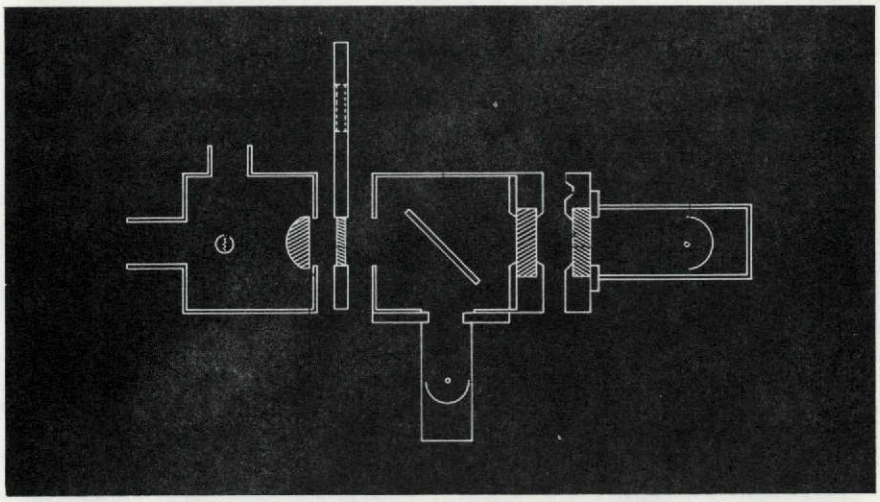
The beam splitter reflects a small portion of the monochromatic light from the filter to the regulating phototube. The output of this phototube is used to control the light source via a high speed solid-state regulator.

The major portion of the light passes through the one centimeter cell to the measurement phototube. The output from this phototube is amplified and then converted to digital readout form by the computer.

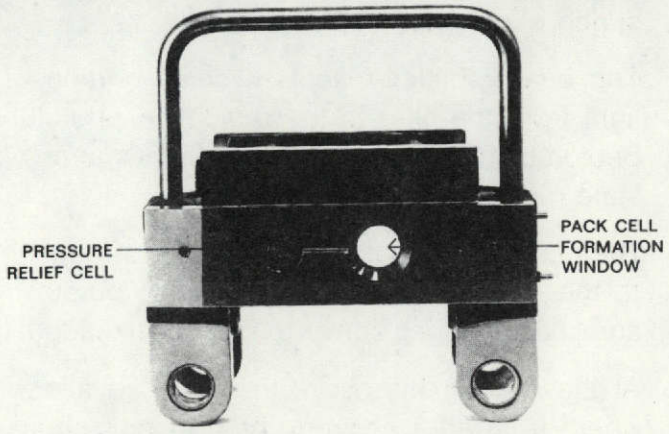
At the end of this cycle, the pack advances to the final position where it is removed from the transport chain.



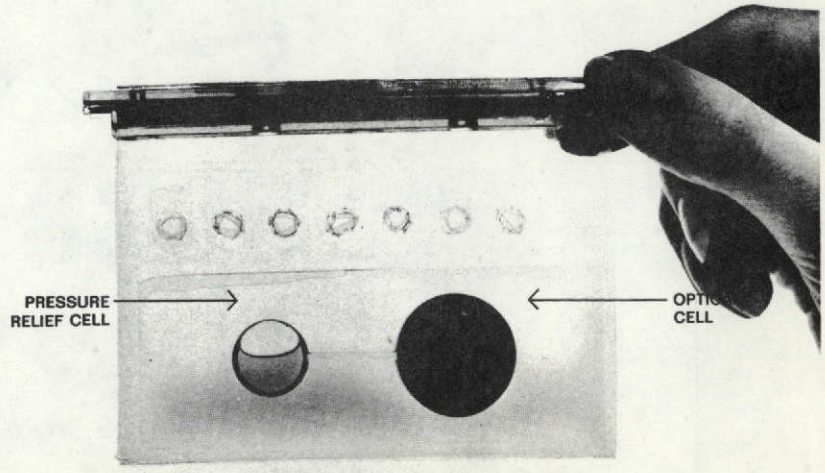
PHOTOMETER OPTICS

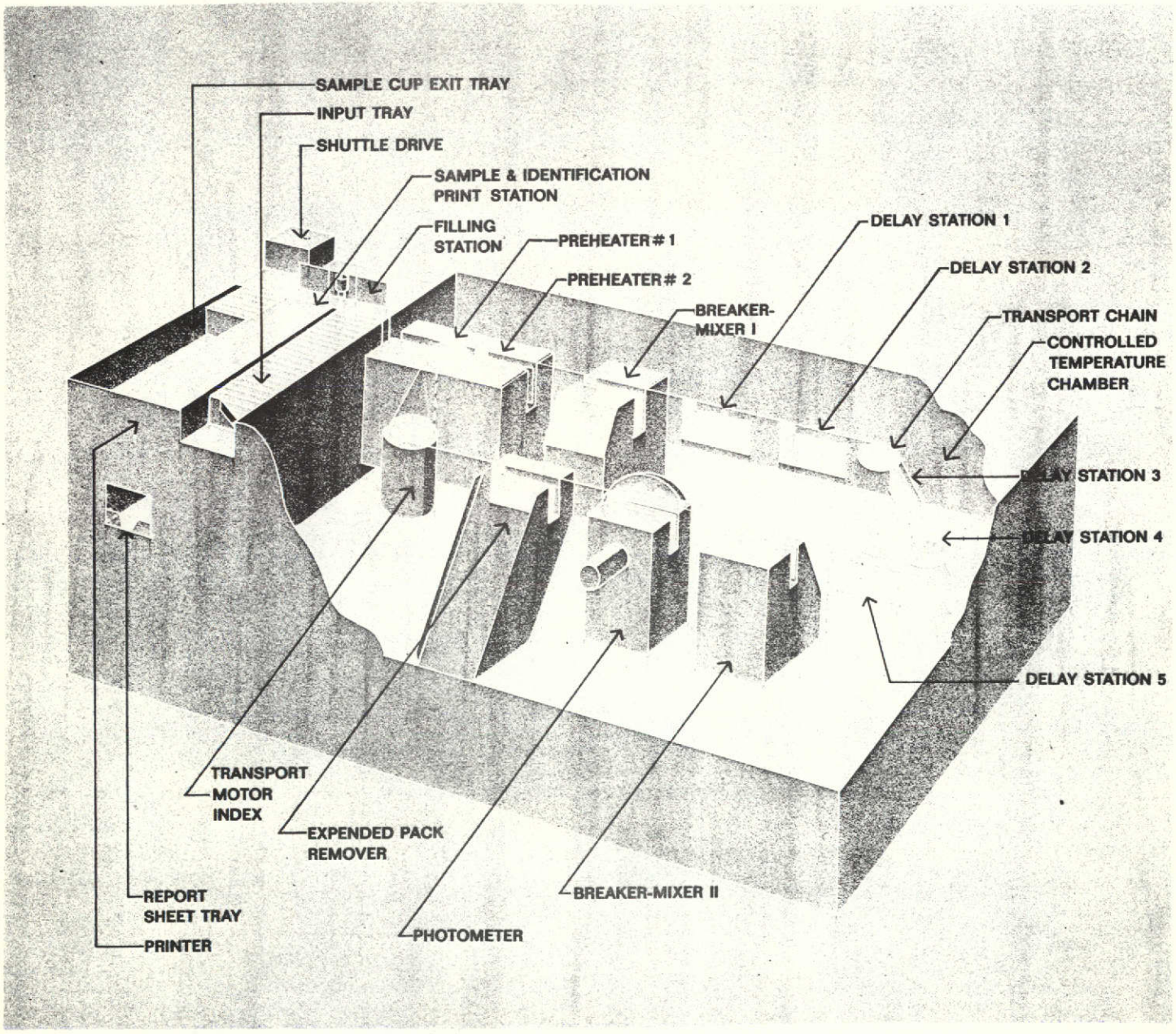


CELL FORMING DIE



FORMED OPTICAL CELL




SAMPLE CUP EXIT TRAY
INPUT TRAY
SHUTTLE DRIVE
SAMPLE & IDENTIFICATION PRINT STATION
FILLING STATION
PREHEATER # 1
PREHEATER # 2
BREAKER-MIXER I
DELAY STATION 1
DELAY STATION 2
TRANSPORT CHAIN
CONTROLLED TEMPERATURE CHAMBER
DELAY STATION 3
DELAY STATION 4
DELAY STATION 5
TRANSPORT MOTOR INDEX
EXPENDED PACK REMOVER
REPORT SHEET TRAY
PRINTER
PHOTOMETER
BREAKER-MIXER II

COMPUTER

A specially-designed computer in the aca monitors the test processing sequence of the analyzer. In the computer are stored instructions for operating each of the processing stations, e.g., breaker-mixers and photometer. When a pack first enters the filling station, the binary code on the header is interpreted to inform the computer of the type of test. The computer then selects the applicable set of instructions and subsequently controls all processing variables, such as type of diluent, interference filter, analog-to-digital conversion factors, etc.

In order to program an additional test method in the analyzer, it is necessary only to lace a single wire through a prescribed series of magnetic cores on each of two printed circuit boards. Thereafter, all steps in the analytical procedure are automatically controlled, irrespective of the complexity of the chemical reactions involved.

ERROR DETECTION

The self-check system of the computer detects deviations and errors in:

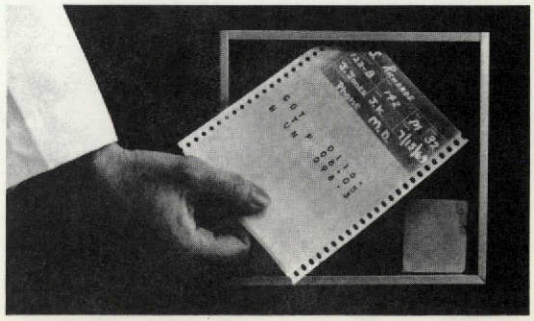
1. Analyzer processing temperature;
2. Total sample and diluent volume;
3. Optical cuvette formation;
4. Absorbance limits.

When an error is detected during processing, an alarm signal is given and/or an error code is printed on the report slip and displayed on the digital indicator.

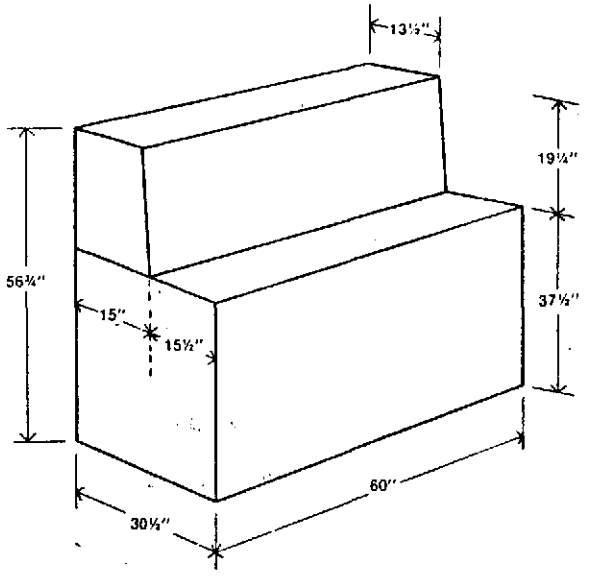
REPORTING SYSTEM

The reporting system generates an individual 4½″ x 6″ report slip for each sample, on which appear (1) a photographic reproduction of the information originally placed on the sample identification card, (2) the test name(s) and (3) numerical result(s) pertaining to that sample.

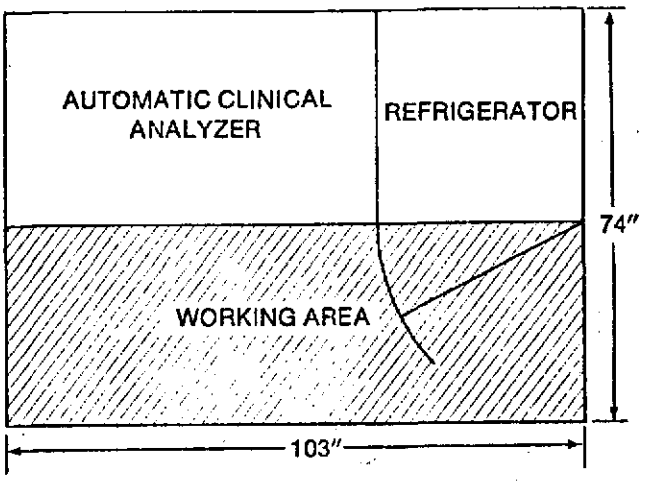
The photographic unit employs an ultraviolet light source which transmits the identification information to ultraviolet sensitive paper. The resulting image is permanent and does not fade with exposure to daylight.



AUTOMATIC CLINICAL ANALYZER



SUGGESTED FLOOR PLAN



SPECIFICATIONS

Dimensions: Width—60", Depth—30½", Height—56¾"

Doorway Dimensions: A 32" door casing is required for passageway of the aca, 36" door casing for passageway of the refrigerator.

Floor Space: In addition to the 38" x 66" space for the analyzer, a minimum of 3 feet should be allowed in front of the instrument for working area. A space easily accessible to the operator must be allocated for the refrigerated pack storage and dispenser unit, which is approximately 37" wide, 38" deep, and 75" high. The door swing will require 3 feet in the front.

Installation and service will require that, in addition to the width of the instrument, 3" be allowed on each side. Service will also require occasional access to the back of the instrument by moving it forward 2 feet.

For normal operation, the back of the instrument may be placed within 8 inches of the wall. This will allow adequate space for fan exhaust.

Weight: 1000 pounds.

aca Power Requirement: 115V, 60Hz, 20 Amps, Single Phase, Separate Circuit Required.

Refrigerator Power Requirements: 115 volts AC, 15 amps, 60Hz, grounded receptacle.

Room Temperature: Between 65°F and 85°F, with changes no greater than 5°F per hour at a relative humidity of 20 to 60 percent.

Water: Only highly purified water, supplied by Du Pont as required for aca system usage, may be used for the flushing system.

Drain: Liquid wastes from the flushing system accumulate in a 3-liter plastic bottle. Four hundred to five hundred test packs may be run before emptying the bottle. If preferred, the liquid wastes may be routed directly to a floor drain. Recommended but not required ½" I.D. minimum opening rising no more than 10" above the floor capable of at least 1 liter/hr. flow located at left rear of instrument.

Refer to other side for suggested floor plan.

#8A ANALYZER, ATOMIC ABSORPTION SPECTROPHOTOMETER

Purpose

To provide quantitativ determination of metallic and semimetallic elements in solutions and indicate concentration.

Requirements

Wavelength range	- 200-800 mμ
Modes of operation	- atomic absorption, flame emission, UV-visible spectrophoeometry
Wavelength readout	- digital counter
Counter accuracy	- ± 0.4 n.m.

Hardware Status

Commercial units available but flight modification required to minimize weight and volume with possible design modification of system for solution retention and introduction into the flame.

Technical Description

See attached sheets for standard laboratory unit descriptions.

Power:	110 watts
Weight:	80 lb
Dimensions:	4 cubic feet

Propane, N_2O and C_2H_2 required

See Bausch & Lomb AC2-20 and E.E.L. Model 140 literature (Arthur H. Thomas Co. Catalog 68, pp 960-961) and Beckman Model 979 (Beckman 1967/68, p. 213).

Cost		
	Development	$1200K
	Unit	$60K
	Commercial Model	$4K

Development Time

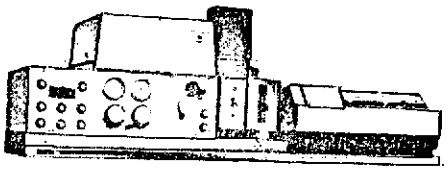
2-3 years

Atomic Absorption

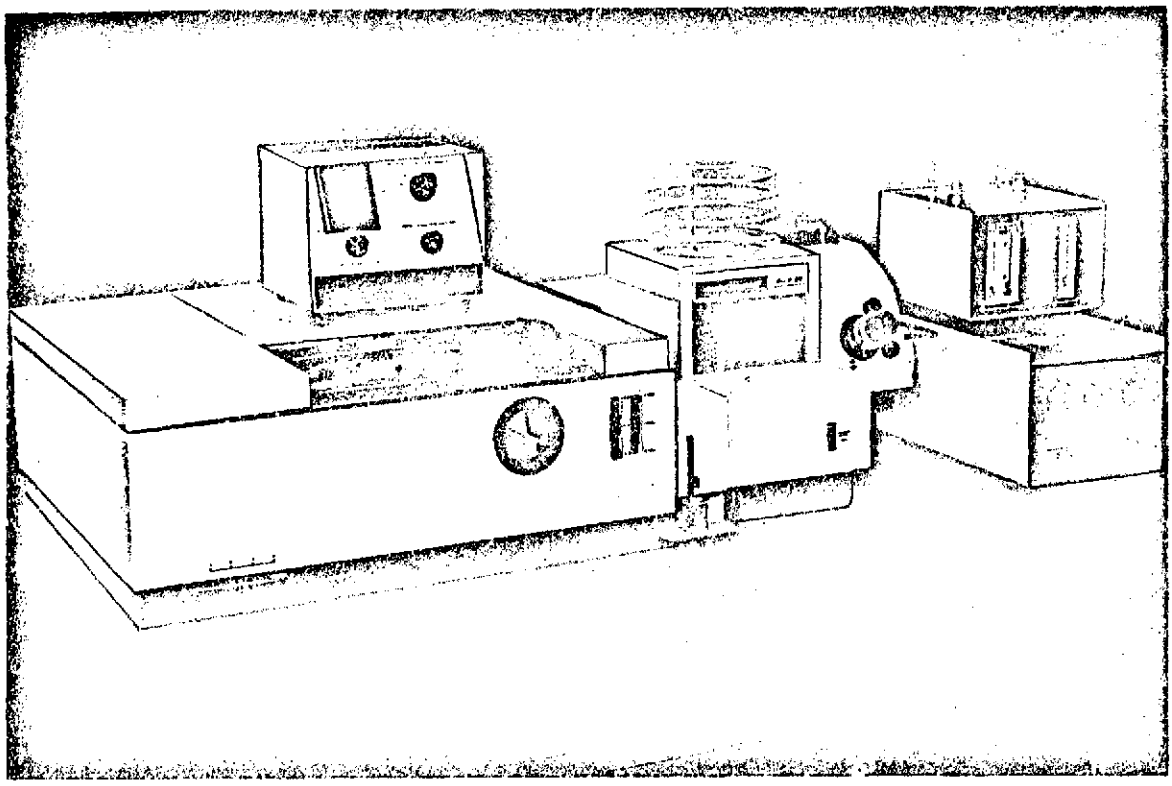
Five to twenty times greater sensitivity is achieved by Beckman atomic absorption instrumentation than by instruments produced by others. This remarkable performance stems from a number of advantages. Among the most significant, is a heating chamber in the laminar flow burner that dispels most of the solvent in the sample before analysis. Others include an f 4.5 optical system to provide a pencil-thin light beam that avoids the noise producing edges of the flame, multipath optics that permit the light beam to pass through the flame three times, and a turntable accessory that precisely controls dip time.

The 979 Atomic Absorption Spectrophotometer provides all these features and incorporates a grating monochromator for 0.2 mμ resolution at all wavelengths, accuracy of better than 0.5 mμ, and a wavelength range of 190-770 mμ.

Model 979 Atomic Absorption Spectrophotometer



Beckman/Spinco Div.



BAUSCH & LOMB AC2-20
ATOMIC ABSORPTION SPECTROPHOTOMETER

☐ no warm-up wait with 3-lamp system
☐ maximum safety – no flashback

AA technic has been shown to be highly specific for metallic element trace detection without spectral interference. Basic analytical system shown here features outstanding safety coupled with easy alignment and control.

Lamp supply powers three hollow cathode lamps simultaneously. Gas control unit has fast-acting toggle valves for rapid gas shutoff. Two flowmeters set flow of both fuel and support gas to burner and accommodate all common gases used in AA. Burner assembly features different heads with varied slot lengths and widths for use with several different gas mixtures. Vernier scales assure reproducible burner position settings. Massive burner head reduces turbulence, eliminates noise and flame distortion. Flame is ignited by safe, remote piezoelectric device. To handle sample, adjustable support gas powered aspirator sprays a fine mist of solution into mixing chamber.

High dispersion monochromator has two 1200 line/mm plane reflection gratings. Three separate dialable fixed slits (bandpasses) are easily selected by moving lever in front of instrument to desired slit width (choice of 0.2, 0.5, or 2.0 nm). Built-in dialable filters are selected by flick of lever. Direct photometric readout is presented in absorbance and transmittance on meter. Output signal is simultaneously converted to direct concentration readings by concentration computer, which has the capacity of a 2X or 5X meter scale expansion.

SPECIFICATIONS:

Modes of operation—atomic absorption, flame emission, UV-visible spectrophotometry
Wavelength range—190 to 800 nm (mμ)
Monochromator—Modified Czerny-Turner, Double Grating (1200 grooves/mm)
Reciprocal linear dispersion: 1.5 nm/mm over entire wavelength range. f number—f/10
Wavelength readout—digital counter
Wavelength counter accuracy—±0.4 nm
Wavelength settability—better than ±0.001 nm
Slits—0.2, 0.5, and 2.0 nm bandpass
Photometric System
- Amplifier linearity—better than 0.1% full scale
- Zero noise—less than 0.01% full scale
- Zero drift—less than 0.1% per day
- Scale expansion—100%, 10% transmittance; 0.0 to 2.0, 0.5 and 1.0 to 3.0 absorbance

Hollow Cathode Lamp Supply
- Type—all solid state, constant current, 3 channels
- Modes—modulated at 133 CPS and unmodulated
- Output—0-50 ma lamp current on all 3 channels
- Regulation—0.1% or better for rated line voltage range

Burner System
- Type—permits laminar flow with variable aspirator
- Burners—air/C_2H_2 (10 cm), N_2O/C_2H_2 (5 cm),* air-propane,* air/H_2 and 3 slot*
- Burner adjustments—
  - Vertical—0 to 27 mm, with calibrated scale
  - Lateral—±3.2 mm
  - Angular—−10° to +50° with anular scale

Electrical requirements—120 volts, 50/60 Hz, 120 watts, 1 amp. max.

*with use of accessory equipment

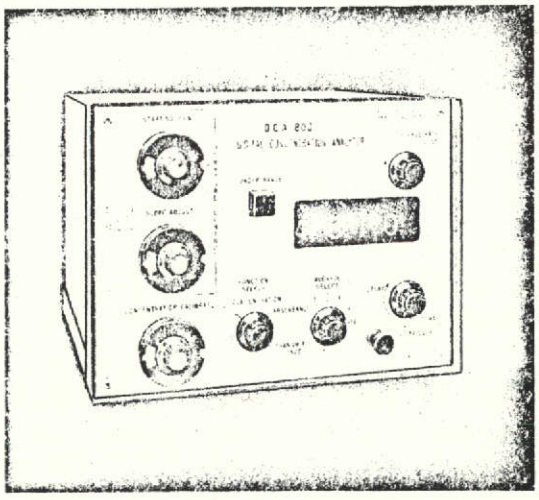
No. S6500-1—Bausch & Lomb Model AC2-20 Atomic Absorption Spectrophotometer, complete with concentration computer, burner for Air/C_2H_2; lamp power supply, 4-way gas control unit and all necessary plumbing and tubing, but without pressure regulators and hollow cathode lamps. Requires 120V, 50/60 Hz, 120 watts, 1 amp. max. Each..... **$6,280.00**

No. S6502-4—Signal Integrator. Self-contained plug-in unit attaches directly to VOM-5 recorder and provides exceptionally stable and noise-free recordings, particularly at higher scale expansion settings of recorder. Each ..... **$ 54.50**

No. S6502-8—Burner. For N_2O/C_2H_2. Each ... **95.00**
No. S6502-9—Burner. For Air/Propane. Each . **95.00**

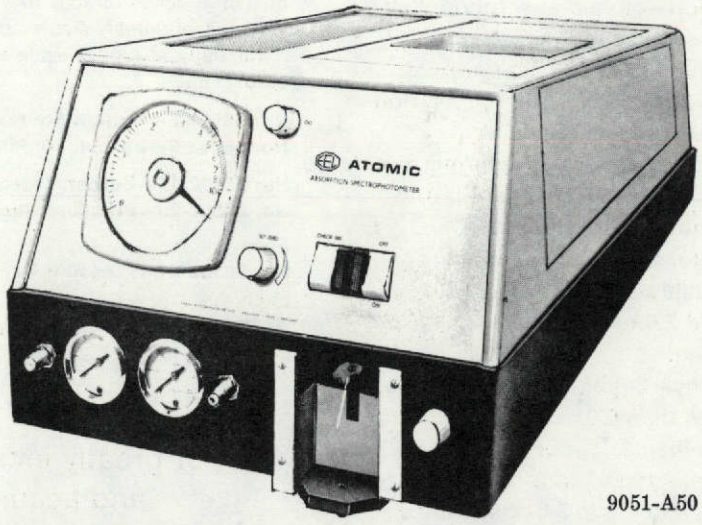
No. S6502-15—Burner. Three-slot. Each **130.00**
No. S6502-20—Pressure Regulator. For C_2H_2.
Each **$125.00**
No. S6502-21—Pressure Regulator. For N_2O.
Each **$135.00**
No. S6502-22—Pressure Regulator. For air.
Each **$125.00**

For greatly increased speed and accuracy . . .



No. R2910—T & T Digital Concentration Analyzer, Model DCA 800. Special purpose computer processes and converts input signals continuously at very high speed, provides either single readings or automatic concentration data averages. Sixteen readings can be taken or averaged in 15 seconds or less. Reading rate maximum is one per 0.2 second. Easily read data display features four digit numerical readout tubes. Unit permits simultaneous signal pickup for a computer or printer; under range indicator light allows detection of negative absorbance. Integrated circuits and modular construction provide easy maintenance. 110V, 60 Hz. Each **$2,316.00**

E.E.L. Atomic Absorption SPECTROPHOTOMETER



9051-A50

ATOMIC ABSORPTION SPECTROPHOTOMETER, E.E.L. Model 140. Single-beam system, highly stable in performance; a.c.-modulated for relative freedom from interference effects. Provides a simple, sensitive method for quantitative determination of more than 40* metallic and semimetallic elements, with an accuracy of ±1%. Atoms are dissociated from chemical bonds in an air-acetylene flame; spectral absorption is measured at characteristic wavelength emitted by a lamp with a tubular cathode of the element being measured. Compact instrument contains line-operated power supply, extremely quiet premix burner, grating monochromator, photomultiplier detector with amplifier, and meter readout.

The hollow cathode lamp produces a sharp resonance line which is selectively absorbed by atoms of the same element in the unexcited ground state achieved in the flame. Measured absorbance, relative to a standard, is commonly in direct proportion to concentration. Burner can be turned at an angle by a panel control to vary the absorption path length through the flame, permitting adjustment of standard reading to a convenient multiple of the logarithmic meter scale indication. Because of the specificity of the atomic absorption principle, preliminary chemical separation is ordinarily not required.

Useful for routine testing in clinical, industrial, agricultural, petrochemical, metallurgical and various other fields. Over 100 repetitive determinations can be performed in an hour. Changeover to analysis of a different element requires only 5 minutes.

Advantages Over Flame Emission Photometry. Many more elements can be analyzed by atomic absorption, because the method is not limited to atoms easily excitable at flame temperatures. In atomic absorption instruments the measured effect is produced by practically all of atoms of the elements being sought; these atoms are predominantly at the ground state produced by simple vaporization. In emission instruments, on the other hand, the measured effect is that of relatively few atoms which can be excited by the flame to the higher energy level required for detection.

Random energy transitions and slight variations in flame intensity contribute only a negligible effect on absorption readings. Serious errors can result from these causes, and from spectral and chemical interference, under conditions required for atomic excitation in emission studies of difficult elements.

Single Beam. Adequate for most commonly encountered applications. Less expensive than double beam instruments using more complex systems with increased optical path length to compensate for instability in earlier types of lamp. Double beam systems contribute no advantage over single beam toward compensating for instability and noise in the flame.

A.C. Signal System. Regulated power supply modulates light source at line frequency. Amplifier for the photodetector is tuned, in phase and frequency, to receive only the impulses originating from the lamp, while the d.c. signal produced by the unmodulated emission from the flame is rejected. Spectral interference from flame emission effects is thereby avoided.

Atomizer. Sample is aspirated uniformly into the long, tubular mixing chamber. Assembly is of corrosion-resistant metal. Large droplets are drained off before reaching flame. Drainage tube has vented water trap, maintaining constant pressure in mixing chamber and functioning as safety valve in event of flashback. Sample platform, with recess for centering beaker, is easily raised with one hand to bring sample to aspirator tip.

Burner. Air-acetylene type. Tubular, stainless steel, with slot 0.37 mm wide × 100 mm long, producing long, thin flame which is steady and quiet. Panel control turns burner at an angle to the optical axis to change the path length through the flame. A 30-fold adjustment in sensitivity can be obtained by this means to accommodate a wide range of sample concentrations. Burner rotation also simplifies calibration by allowing meter reading to be related to standard concentration by a convenient factor. Burner height can also be varied.

Flame is adjusted by two needle valve controls on front panel, with acetylene and air gauges reading 0-30 p.s.i. in 1 p.s.i. divisions. Requires acetylene cylinder with 2-stage regulator supplying 4 liters per minute at 15 p.s.i., and air compressor providing 7 liters per minute at 15 p.s.i.

Available on special order are interchangeable burners for particular requirements: air-propane/butane burner, for elements which ionize too readily in the hotter acetylene flame; nitrous oxide-acetylene burner for elements which are difficult to dissociate; and a high-solids air-acetylene burner for samples which might tend to clog the narrower slit of the standard burner.

* Twenty additional elements can be determined by using an interchangeable accessory nitrous oxide-acetylene burner.

E.E.L. Atomic Absorption Spectrophotometer *(continued)*

Range. The following table indicates approximate concentration limits for practical measurement of a number of elements at the wavelength shown. Analytical resolution (AR), the approximate difference in concentration definitely measurable by the Model 140, is the lower limit of practical range. It does not express lower concentration limit as the more optimistic theoretical sensitivity value commonly specified, but gives a realistic measure of the practical capability of the instrument.

Range can usually be extended by rotating burner to shorten path length, by using a less sensitive resonance line, or by substituting burner of different type. Results shown are those obtained with the air-acetylene burner regularly included with the Model 140 except as indicated. The nitrous oxide-acetylene burner is available on special order. Solvent is either water (W) or a 1:1 mixture of 2-propanol and water (A).

Element	Wavelength (mμ)	Range (ppm)	Resolution (AR) (ppm)	Solvent
Aluminum*	396.2	500	5	A
Antimony	231.1	250	7.5	W
Barium*	553.6	150	2	A
Bismuth	223.1	100	2.5	W
Cadmium	228.8	6	0.1	W
Calcium	422.7	20	0.25	W
Chromium	357.9	60	1	W
Cobalt	240.7	100	2.5	W
Copper	324.7	15	0.25	W
Gold	242.8	100	2	W
Indium	304.0	200	5	W
Iron	248.3	100	2.5	W
Lead	283.3	150	2.5	W
Lithium	670.8	6	0.1	W
Magnesium	285.2	2	0.05	W
Manganese	279.5	15	0.3	W
Mercury	253.7	500	10	W
Molybdenum	313.3	500	5	W
Nickel	341.5	150	2	W
Palladium	340.4	200	5	W
Platinum	265.9	500	10	W
Potassium	766.5	6	0.1	W
Rhodium	343.5	200	5	W
Scandium*	391.2	1000	10	W
Silver	328.1	10	0.2	W
Sodium	589.0	3	0.05	W
Strontium	460.7	25	0.5	W
Tin*	286.3	2000	25	W
Titanium*	364.3	4000	50	A
Tungsten*	294.7	3000	50	A
Vanadium*	318.4	500	10	A
Zinc	213.9	5	0.1	W

Light Sources. Stable, sharp-line spectral output is produced by gas-filled lamps, with hollow cathode of the desired element. Also available are lamps with multi-element cathode, offering obvious versatility and economy. Self-centering, spring-loaded mount takes any of the lamps, which can be interchanged quickly and easily. Lens focuses beam on flame. Constant voltage transformer provides stabilized, a.c.-modulated input; current is adjusted by a 5-position switch according to specific requirement of lamp being used.

Monochromator. Isolates resonance line in beam transmitted by the flame. Czerny-Turner arrangement, with replica grating of 14,600 lines per inch, silica lenses and windows throughout, front-silvered mirrors. Wavelength range is 200-1000 mμ, but is effectively limited by range of photomultiplier. Wavelength selector setting is indicated on 3-digit counter. Side panel knob adjusts width of entrance slit.

* Using N_2O burner.

Photomultiplier. Range 200-800 mμ. Solid-state, Zener-stabilized amplifier is tuned to lamp modulation to detect only the resonance line signal originating from the lamp. Extraneous signals produced in the flame are ignored. Zero and infinity adjustment controls are on front panel.

Readout. Front panel meter has absorbance scale, 7¼ inches long, graduated logarithmically from 0 to 10 in 72 divisions, with infinity check line. Terminals permit connection to a potentiometric recorder with full scale span of 1, 5, or 10 mv; a trimming potentiometer is provided for recorder zeroing.

Housing. Glass-fiber reinforced plastic. Overall 24½ × 15½ × 11¼ inches high.

Major Accessories

(Not included with complete spectrophotometer)

Recorder Scale Expander. Improves sensitivity by increasing output voltage over continuously adjustable range, up to 5×. Battery-operated. Plugs into recorder socket on Model 140.

Lamp Conditioner. Keeps lamps in warmed-up readiness; maintains good condition of seldom-used lamps; also, with current reversed, reactivates lamps which have deteriorated by prolonged disuse. Has four independently controlled lamp positions.

Emission Unit. Allows use of Model 140 for emission measurements, as recommended by manufacturer for determination of sodium, potassium and lithium, which ionize readily and yield higher sensitivity by emission than by atomic absorption method. Modulates the d.c. flame emission signal for detection by the photomultiplier amplifier. Plugs into photomultiplier lead. Switch restores normal atomic absorption mode without disconnection of emission unit.

Methods Manual. Includes complete procedures for various specific fields of analysis, together with typical calibration curves, for over 30 elements, including all those in Concentration Limits table, plus beryllium and thallium.

9051-A50. SPECTROPHOTOMETER, Atomic Absorption, E.E.L. Model 140-ER, range 200 to 800 mμ, as described. Includes air-acetylene burner, lamp connector cable, recorder socket with connector plug, filter holder with red filter, Allen wrench for burner adjustment, and dust cover. For 115 volts, 60 cycles, a.c. *Without hollow cathode lamp or air pump*..... 3275.00

NOTE—Available for other voltage and cycle requirements on special order.

#11 ANALYZER, GENERAL SPECTROPHOTOMETER

Purpose

The primary use of this instrument in the biolaboratory is for spectral analysis of gases and liquids. It can also be used to determine the spectral properties of solids or light sources.

Requirements

1. The frequency range required is from 250 to 2500 nm (2500 to 25000 Å).
2. Accuracy: Approx. ± 0.4 nm.

Hardware Status

Many ground-type units are available. All would require modification to at least reduce weight, power and volume. A "Cary" brand unit is recommended by UCSD consultants or some modified version with similar resolution characteristics. Data on the ground unit is attached.

A flight-type unit is being developed under the IMBLMS study which provides measurements from 200 to 700 nm. The properties of this unit are summarized below. It alone would probably not satisfy the requirements of the maximum payload biolaboratory.

Technical Description

IMBLMS Unit -

Freq. range:	200-700 nm ± 0.5 nm
Photometric accuracy:	± 0.3%
Bandwidths of 0.5 and 5.0 nm	
Purpose:	Analysis of hemoglobin, SGOT, SGPT, Alkaline phosphatase, plasma proteins

Weight	4.5 kg, 10 lb
Volume:	0.014 m^3, 0.5 ft^3
Power:	20 watts
Data:	No data display or recording provided

Estimates for Comprehensive Flight Unit -

Weight:	300 lbs
Power:	450 watts
Volume:	10 ft^3
Fluid Interface:	Coolant required in Cary unit for lamp temperature control (equivalent to about 2 liters/min).

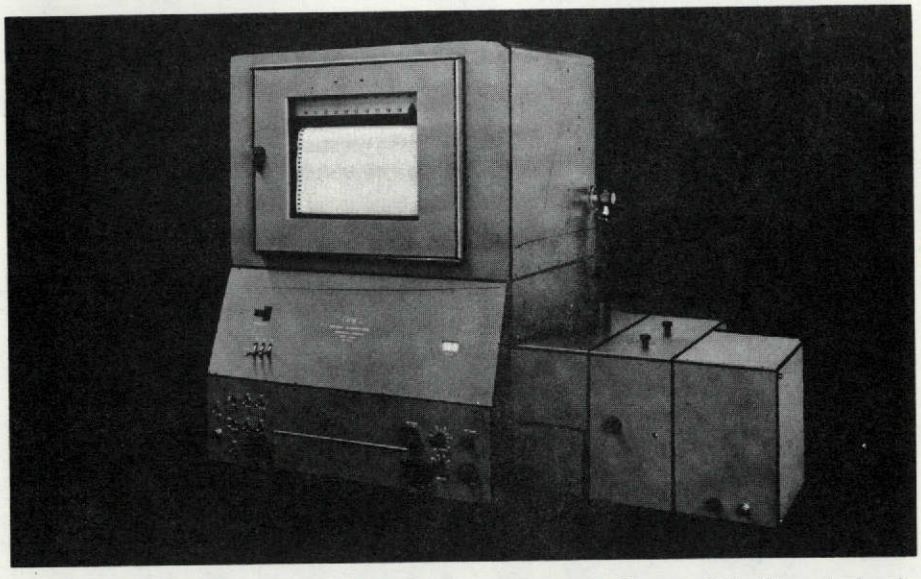
Cost

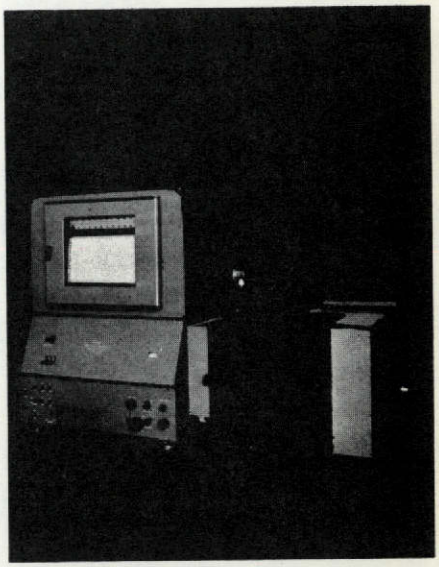
Development Cost	$350K
Unit Cost	$50K

Development Time

Two to three years.

CARY 14 Recording Spectrophotometer





Because of built-in versatility and a variety of accessories and modifications, the CARY 14 has proved of value in almost all areas of spectrophotometry. The standard instrument can be used for fixed-wavelength kinetic studies, or for recording absorbance or transmittance spectra, linearly in wavelength. It provides excellent performance for measurements made over the wavelength range 1860A to 2.65 μ. Accessories are available for flame, fluorescence, reflectance and other studies. Standard modifications are available for near infrared studies of heated or photosensitive samples, or for scanning samples up to 1000°C with no loss of photometric accuracy.

PERFORMANCE

Wavelength Range: 1860A-2.65 μ.

Wavelength Accuracy: Better than 4A throughout most of range.

Wavelength Reproducibility: Better than 0.5A.

Resolving Power: 1A in most of UV-visible range; 3A in near infrared range.

Photometric Accuracy: Within 0.002 abs at 1.0 abs; 0.005 at 2.0 abs. 0.0005 abs with expanded scale.

Photometric Reproducibility: 0.002 abs on standard range, 0.0005 abs with 0-0.1 scale.

Photometric Ranges: Selection of absorbance or transmittance scales available. Standard unit equipped with dual 0-1, 1-2 absorbance slidewire with automatic range change.

Dual Range Recorder: Takes advantage of the greater photometric accuracy of the flicker-beam photometer. With the automatic range change, absorbance scale and chart are effectively 20 in. (50 cm) wide.

Zero Stability: Less than 0.001 abs per hour drift.

Light Purity: Stray light is less than 0.0001% between 2400A and 5000A, and 0.1% at range limits.

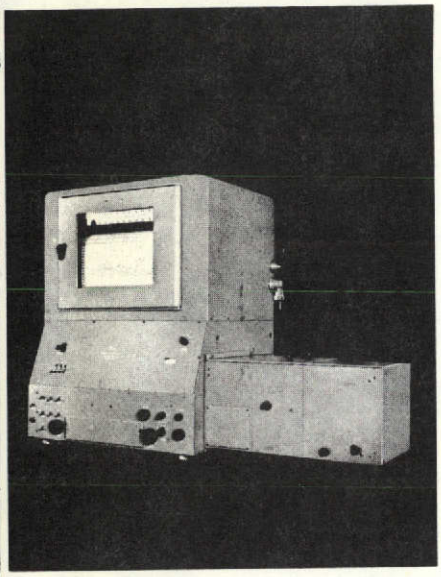
General Construction: The CARY 14 is housed in an aluminum alloy case finished with gray baked epoxy. It occupies a space 47 in. (118 cm) long, 30 in. (75 cm) wide and 35 in. (88 cm) high and weighs about 600 pounds (270 kg).

Utilities: The CARY 14 operates from 115V, 50 or 60 Hz; no batteries are necessary. The maximum current consumed is 8 A. The accuracy of the instrument is not impaired by voltage variations of ±10% or frequency variations of ±1%. For voltage or frequency variations outside this range, consult the factory. The hydrogen and infrared lamps require a reliable source of cooling water at the rate of ½ gal (2 liters) per minute.

If you wish to use the instrument below 2000A, the monochromator, detector and sample compartments should be purged with dry nitrogen gas.

CARY 14H

The CARY 14H, a special modification of the CARY 14, enables the operator to accurately record samples at high temperatures. Particularly designed for the study of fused salts, it is ideally suited to all high temperature applications. The large cell area, small beam dimensions and mode of operation extend its usefulness to many other applications, including photoreaction studies, Zeeman effect measurements, high-pressure work, radiation studies, light-scattering properties and work with odd-shaped samples. Performance specifications are identical with the CARY 14, except in cell radiation: Photometric error of absorption measurements due to thermal radiation from cells up to 1000°C is less than 0.001 abs at zero. Cells with temperatures above 1000°C may be used at some sacrifice of signal-to-noise ratio. Resolving power is 1.5A over most of the UV-visible range; 4A in near infrared range. Stray light is less than 0.001% over most of the range, 0.1% at range limits.



CARY 14R

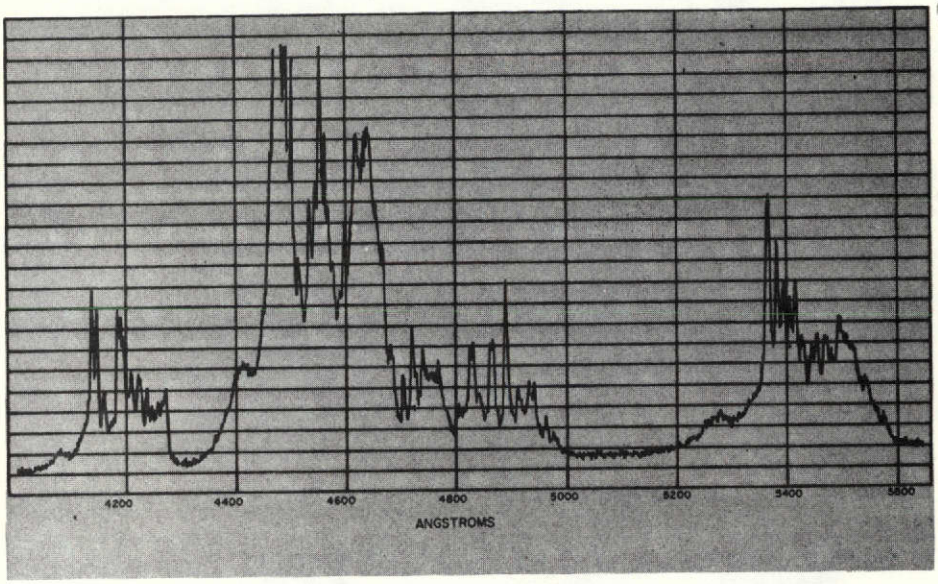
The CARY 14R permits near infrared analysis of heat-sensitive or photosensitive samples which should not be exposed to undispersed radiation. Operational specifications are the same as for the CARY 14.

CARY 14RI

The CARY 14RI is similar in purpose and characteristics to the 14R except for use of Infrasil transmission optics which allow operation from 2250A to 3.0 μ. Moreover, for improved resolution and greater energy in the near infrared, the grating blaze has been changed from 3000A to 7500A. Specifically designed for studies extending into the near infrared, several applications may be found in the solid-state field; for example, many semiconductors have absorption edges in the near infrared. Most lasers, including gas lasers, emit in this region, and the related absorption and fluorescence phenomena require measurement in the near infrared.

Resolution is better than:

1 cm^{-1} from 1.5 to 3 μ;
2 cm^{-1} to 0.9 μ;



Powdered Holmium Oxide Spectrum

This spectrum of powdered holmium oxide illustrates the sharpness of peaks provided by a molecule in an ordered and rigid state. As with some gases most of the bands observed cannot be completely resolved by the instrument. It illustrates the high resolution capabilities of the CARY 14 under low light level conditions such as in micro samples or low transmission. Instrument conditions are as follows: Sample: Powdered Holmium Oxide (Ho_2O_3). Slit: 1/3 height. Gain: Tap 5. Slit Control: 50.

1A throughout the visible region.
Because of optimized near infrared performance, this necessarily leads to some degradation of the ultraviolet performance.

In the ultraviolet, resolution at a fixed signal-to-noise ratio is reduced because of the characteristically low grating efficiency on the short wavelength side of the blaze. It reaches a minimum at about 40% of the blaze wavelength. Below 3500A the CARY 14RI spectral slitwidths may be two to five times greater than those for the standard CARY 14.

These resolution values may be obtained with a one-second period and with a signal-to-rms-noise ratio of 1000.

Stray light limits: 0.0001% in visible region;
0.0002% at 1.7 μ;
0.02% at 2.8 μ and 2300A.

All other specifications are the same as the CARY 14 Recording Spectrophotometer.

Chart Speed Inches/Min	5	4	3	2	1.33	1
Scan Speed Angstroms Per Sec	Angstroms Per Division					
.5	2	2.5	3.3	5	7.5	10
2.5	10	12.5	16.6	25	37.5	50
5	20	25	33.3	50	75	100
10	40	50	66.6	100	150	200
25	100	125	166	250	375	500
50	200	250	333	500	750	1000
100	400	500	666	1000	1500	2000
500	2000	2500	3333	5000	7500	10000

SPEED AND VERSATILITY

The table shows the wide range of spectral displays attainable with the various scanning speeds and chart speeds provided on the CARY 14, 14H, 14R and 14RI. Good resolution and accuracy are attainable at fast speeds.

#13 ANALYZER, URINE, AUTOMATIC

Comments

Part of autoanalyzer, E.I. 7.

#14 ANESTHETIZER, INVERTEBRATES

Purpose

This device will be used to render invertebrate organisms (such as vinegar gnats) insensible in order to facilitate handling.

Requirements

1. Use of CO_2 system preferred due to safety and ease of integration into EC/LSS.
2. Must be capable of introducing CO_2 at various locations around the laboratory.
3. Maximum capacity: Assume 6,000 cc/day. (This will approximately anesthetize organisms in 10, 300 cc containers. This assumes 200 cc of air volume per container and 2 air volume purges to reach 90% CO_2.)
4. CO_2 concentration required: 90%.

Hardware Status

This item involves the use of a standard gas bottle, valve and plumbing components. They will not require major modification.

Technical Description

One design would utilize a CO_2 bottle, regulator, valves and other plumbing. An alternate CO_2 source would be the CO_2 accumulator in the CO_2 concentration portion of the EC/LS oxygen reclamation system. The critical temperature of CO_2 is 88.4° F and since the storage vessel could conceivably reach this temperature, supercritical storage conditions were assumed.

For one year's operation:

1.	CO_2 weight:	8.8 lbs
2.	Total weight	20 lbs

3. Size: 8" diameter x 16" long (0.47 ft^3)

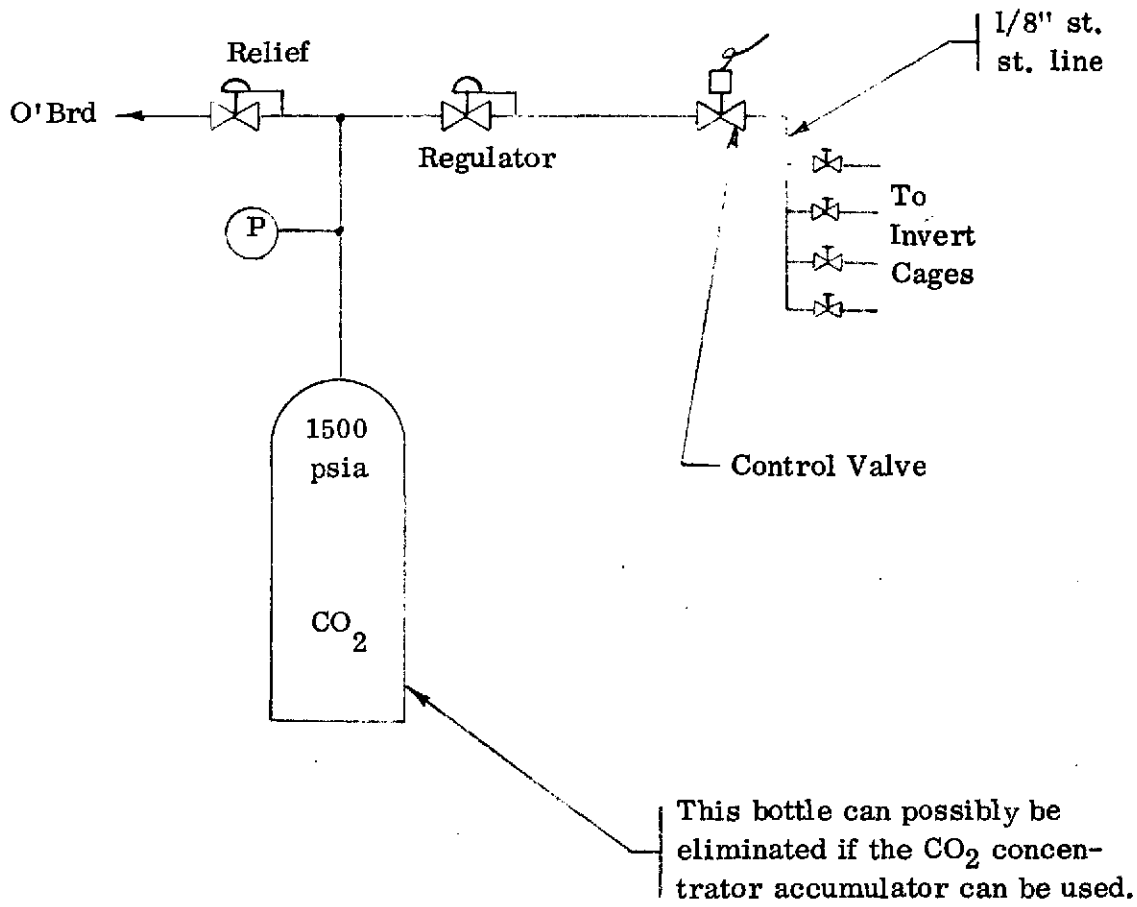
4. Power: 0

5. Pressure vessel pressure: 1500 psia

Cost:

The cost of a spherical flight type storage vessel, valves and plumbing is estimated at $5 K.

Development Time: One year.



Instrumentation

1. Vessel pressure.

2. Flow indicator.

14B ANTENNAS, ASSORTED

Purpose

These antennas are specialized units required for the transmission and reception of biotelemetry signals and reception of electromagnetic field monitoring signals.

Requirements

UHF and VHF types consisting of low profile and conical omnidirectional configurations. These antennas must interface with cage module systems (cage units) and be adaptable to microbackpacks.

Hardware Status

Commercial units are available for specialized biotelemetry applications and will require little or no modification. In some cases, VHF whip type antennas may be used. Commercial units may only require insulating coatings for use on an organism within a metallic cage unit.

Technical Description

Low profile or conical omnidirectional antennas tunable to telemetry frequencies of 80 to 300 mHz.

Weight (for several)	0.1 lb
Power	0
Volume (for several)	0.001 cu. ft.

Cost

Development	$20 K
Flight Unit	$1.0K
Commercial Units	$.01-1.0 K

Development Time

One year.

#15 ANTHROPOMETRIC GRID

Purpose

These grids will be used for automatic or remote vertebrate anthropometric measurements. Grids may be integral with the organism cage and will provide measurements through the use of video or other types of cameras and optical elements.

Requirements

Small Grids:	5 x 15 cm spaced @ 1 mm
Medium Sized Grids	50 x 75 cm spaced @ 2 mm
Large Grids:	2 x 2 m spaced @ 5 mm

Hardware Status

Ground equipment should be usable with minimum modification.

Technical Description

Estimated properties for 10 grids are:

Weight:	4 lbs
Power:	0
Volume:	0.1 ft^3

Cost

Estimated @ $10K development, $1K unit (for 10)

Development Time

Negl.

#15A ATMOSPHERIC SAMPLING, MANIFOLD

Comments

Gas sampling manifold for periodic sampling of cage and cage module atmospheres.

Laboratory specific.

#15D AUDIO STEREO HEADSET

Comments

Earphones for various MSI hearing tests.

#16B AUDIOMETER

Purpose

To provide a frequency source, adjustable in both frequency and amplitude, for earphones or bone vibrators during audible and bone conduction tests.

Requirements

Frequency: Adjustable in octaves from 125 to 8000 Hz

Attenuator: Continuously adjustable in 1 db steps

Hardware Status

Audiometer, Model 3120 AC by the Lafayette Instrument Co. will meet most of the requirements. Unit must be ruggedized, set up for 28 VDC power and packaged on a smaller case. In addition, unit must be capable of interfacing with the Data Management computer, to allow remote control of the instrument.

Technical Description

Flight Unit - Preliminary Estimate

Size	.15 cubic feet
Weight	10 lbs
Power	25 W

Cost

Development	$35K
Unit	$5K
Commercial Model	$0.4K

Development Time

2 years

Lafayette INSTRUMENT COMPANY

P. O. BOX 1279 • 52 BY-PASS • LAFAYETTE, INDIANA 47902 • SH 2-7937

3120-AC—AUDIOMETER — Price $440.00

Dual-Choice Tone Interrupter—This combination control may be used in two ways—continually-on, manually-off tone, or continually-off, manually-on tone. Rise and decay of tone (.1 second) allows very accurate evaluations.

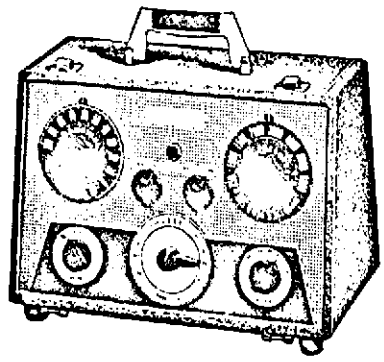
Continuously Variable Attenuator—Measures decibels in single steps. Five-decibel available on order. Silent attenuation with no electronic or mechanical "clicks."

Frequency dial can be turned continuously from right-to-left or left-to-right —no end-stop at either end of scale.

All octave frequencies from 125 to 8,000 cycles per second are provided for, plus intermediate frequencies from 750 to 6,000 cycles.

Uniform Zero Reference on Loss Scale—Applies to both air and bone conduction receivers. This eliminates the possibility of errors on bone conduction tests.

Double earphones, masking, microphone and bone vibrator are standard equipment.



MODEL 3120AC

#16D BADGES, RADIATION

Comments

Radiation Exposure Badges. Standard film type.

#16E BAGS, PLASTIC

Comments

Gas Permeable, for waste sterilization and storage.

#16F COUPLER, BALLISTO-CARDIOGRAM

Comments

See E.I. 156 definition sheet, E.U. 2.

#18 BENCH, LAMINAR FLOW

Purpose

This bench is basically a glove box with a relatively high air flow for control of particulate and gaseous contaminants within. It will be used by the crewmen for a variety of procedures to be performed on the organisms and specimens. A movable bench design would facilitate organism manipulations at the cage site and is a desirable feature, especially for a maximum biolaboratory.

Requirements

1. Hermetically sealed bench.
2. Viewing window and glove ports.
3. A mobile bench should be designed to mate with the cage modules containing the organisms to be handled within the bench.
4. Internal pressure should be equal to cabin pressure or a few inches of water less than cabin pressure.
5. Desirable facilities to be provided as part of the bench:
   a. Electrical power outlet.
   b. Connection to data management system.
   c. Holddowns for tools, bottles, etc.
   d. Fixed and possibly portable work lamps.
   e. Provision for wiping, cleaning, and sterilizing internal surfaces.
   f. Provision for signal conditioners, oscilloscope, and other electronics.
   g. Airlock for material and specimen transfer.

Hardware Status

This is a conceptual design item. Preliminary designs and mockups of such an item have been made at Convair.

Technical Description

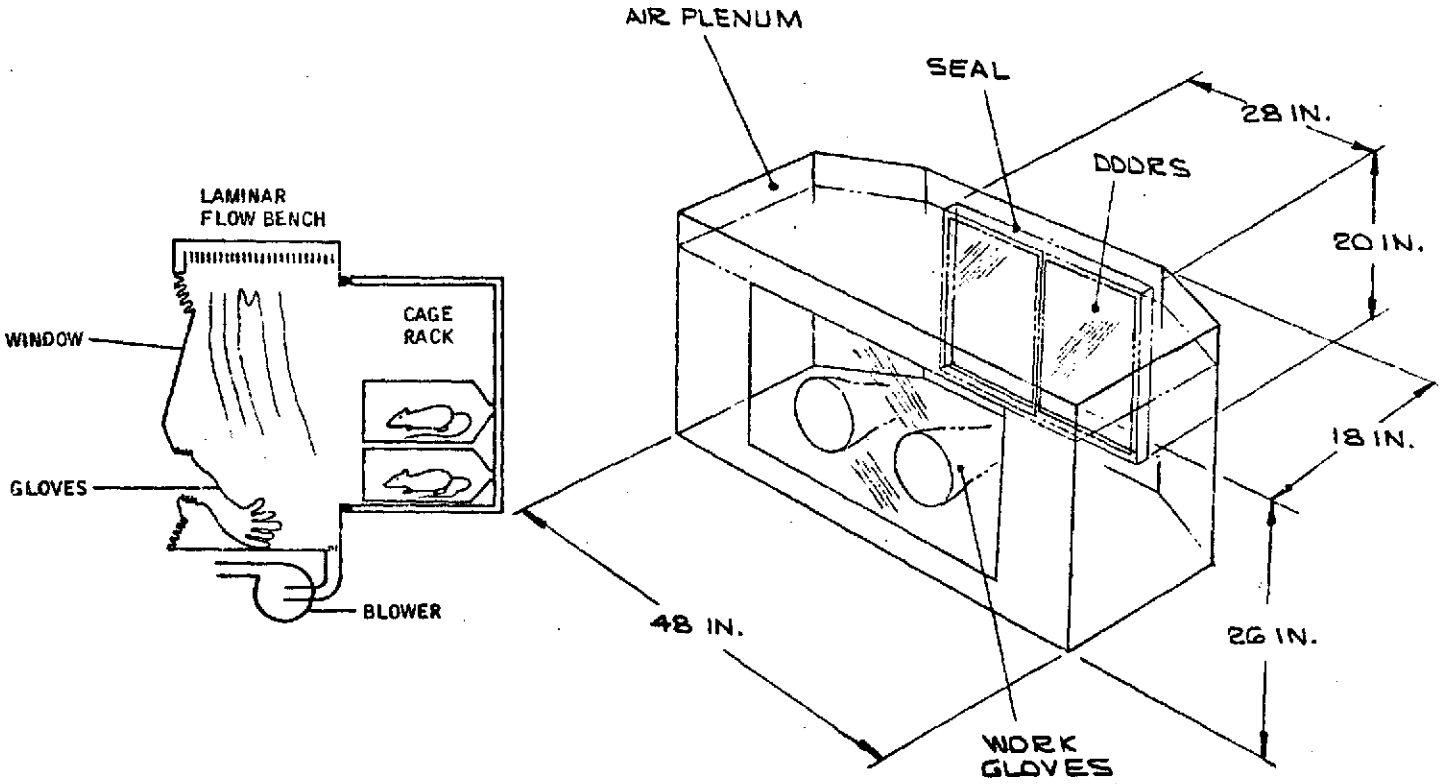
1.	Internal dimensions:	16 x 24 x 48 inches
2.	Estimated weight:	200 lbs
3.	Estimated maximum power:	100 watts when operational
4.	Estimated external dimensions:	5 x 2.5 x 1.3 ft (16.25 ft^3) (Does not include clearances and space for operator.)

Cost

Estimated at:

R&D:	$2000 K
Fabrication:	$25K

Development Time: Two years.



#18A LAMINAR FLOW BENCH LINERS

Purpose:

A liner on the inside of the laminar flow bench to prevent cross-contamination from one experiment worksite (e.g., cage module) to another. It can be removed and disposed of when changing worksites.

Requirements:

1. Provide a sealable opening in the back side (cage module side) of the liner the same size as the laminar flow bench opening.
2. Provide lightweight surgical gloves in the front side of the liner.
3. Provide an appropriate seal at the liner/laminar flow blower interface at the base of the liner.
4. Be easily and quickly attachable, removable and disposable.

Hardware Status:

Conceptual design item.

Technical Description:

Weight: 2 pounds

Volume: 0.2 cubic feet

Power: 0 watts

Cost:

Development costs: $100K

Unit costs: $1K

Development Time:

Approximately 2 years

#18B LAMINAR FLOW BENCH INSERT, RADIOCHEMICAL

Purpose:

An insert for EI 18, laminar flow bench, that provides radiation protection when handling radiochemicals and radioisotopes.

Requirements:

1. Compatible with the requirements of EI 18A, laminar flow bench liners.
2. Provide radiation protection for the crew and other organisms outside of the laminar flow bench.

Hardware Status:

Conceptual design item.

Technical Description:

Weight: 50 pounds

Volume: 2 cubic feet

Power: 0 watts

Cost:

Development cost: included as part of the development costs of EI 18A - Bench liners, LFB

Unit - cost: $6K

Development Time:

Approximately 2 years

#18C BICYCLE ERGOMETER

Comments

Developed for Skylab. Volume shown is envelope required when in use.

#18D CUSTOM BITE BOARDS

Comments

Stainless steel bite boards with cast materials of each subject's dental impressions to precisely and comfortably position the head.

#19 BENCH, GENERAL EXPERIMENTS

Purpose

To provide work area for preparation of experiments, experiment maintenance operations, special observations, and preparations for return to earth.

Requirements

This work area will require equipment tie-downs and space for tool kits, general-purpose instrumentation, and maintenance materials.

Work area:	tbd
Rack area:	tbd
Utilities:	Electrical; 28 VDC, 400 Hz AC, 60 Hz AC
	Vacuum; 10^{-6} mm Hg
	Pneumatics; 50 psig
	Gases; N_2, O_2, and CO_2

Hardware Status

To be designed with emphasis on human factors and gravity independence.

Technical Description

Estimated flight unit properties are:

Weight:	100 lbs
Volume	9 ft^3
Power	50 w

Cost

Estimated flight item costs are:

Developent:	$100K
Unit:	$ 10K

DEVELOPMENT TIME

1-2 years

#19D BODY MASS MEASUREMENT

Comments

Mass Measurement Device, for human subjects. Envelope volume shown when in use.

Skylab equipment.

#25 CAGE, INVERTEBRATES (JARS)

PURPOSE

To hold and support invertebrate colonies in controlled environments.

REQUIREMENTS

Pressure of 14.7 psia
Single-pass air supply to avoid common use by several cages
Individual anesthetizing CO_2 lines
Mechanical attachment and plug-in system

Screened access port using penetrable elastic webbing to allow insertion and manipulation of a tube for removing or emplacing an anesthetized individual organism.

HARDWARE STATUS

The cage is a conceptual design item incorporating existing laboratory techniques for anesthetizing and manipulating invertebrates.

TECHNICAL DESCRIPTION

Volume:	5-50 in^3
Weight:	.2 - 2.0 lb
Power:	None

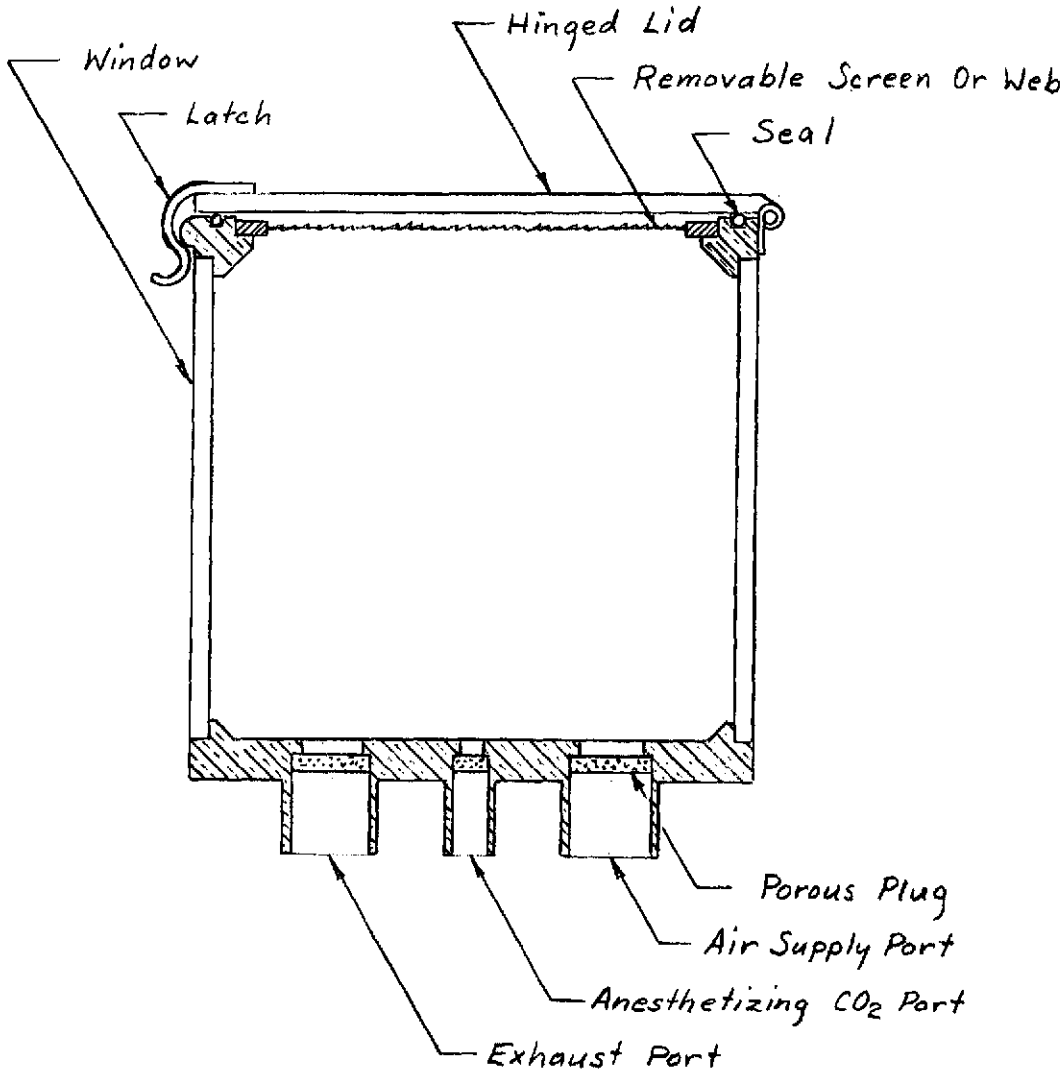
COST

Estimated flight costs are:

Development	$50K
Unit	$ 1K (for 32 items)

DEVELOPMENT TIME

6 months



CAGE, INVERTEBRATES

25B COLONY CHAMBER

Purpose

To provide for culture growth in liquid media.

Requirements

TBD.

Hardware Status

Conceptual design item.

Technical Description

A preliminary concept of this device utilizes a membrane for separation of the liquid media from the oxygen environment needed for growth. The estimated properties of this device are:

Weight:	2 lbs
Volume:	0.1 ft^3
Power:	0

Cost

Preliminary estimates are:

Development Cost:	$200K
Unit Cost	$5K

Development Time

1-2 years.

#26A CAGE, MMB*, C/T

PURPOSE:

This enclosure is to hold liquid broths in which cells and tissues are growing and measure carbon dioxide and oxygen exchange rates to determine growth rates.

REQUIREMENTS:

1. Size: approx. 500 cc
2. Gas production rates: tbd
3. Liquid agitation required
4. O_2 and CO_2 measurements required

HARDWARE STATUS:

Conceptual design item

TECHNICAL DESCRIPTION:

Basis: Jar configuration with membrane for gas/liquid separation and batch gas analysis, see sketch.

* mmb = metabolic mass balance

1. Size: Envelope approximately 10 cm dia. x 12 cm long (3.94" dia. x 4.72")

2. Wt. 1.5 lbs.

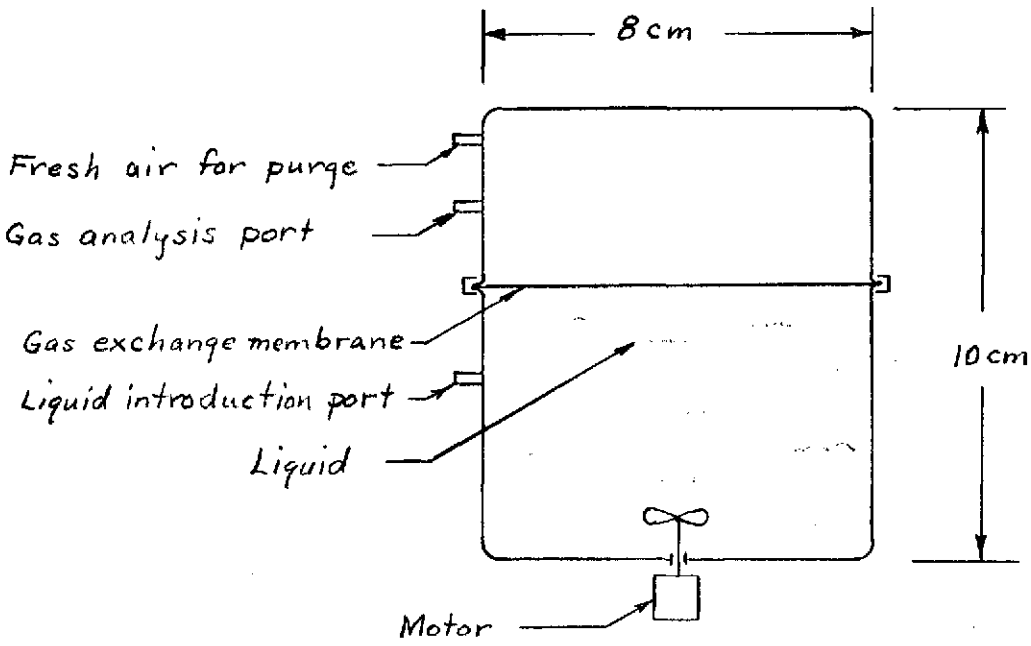
3. Power 5 watts

COST:

Estimated @ $1K unit

$100K development

DEVELOPMENT TIME: 1 year



Wt. (empty) = 1 lb.

Wt. (full) = 1.5 lbs.

Power = 5 watts

#26B CAGE, MMB*, PLANT

Purpose

To allow plant O_2 consumption to be determined during experiments of growth transients in roots exposed to weightless environment.

Requirements

1. Sealed chamber.
2. Temperature, pressure, relative humidity, and pO_2 sensors.
3. Noise and vibration isolation.
4. Light for photography.

Hardware Status

Detail design required.

Technical Description (Estimate)

Envelope	- 20 in. dia., 15 in. high
Weight	- 25 lb.
Power	- 30 w

Cost

Estimated flight item costs are $1000K development, and 10K unit.

Development Time

1-2 years

*MMB = Metabolic Mass Balance

#28 CAGE, MMB, RAT

PURPOSE:

This cage houses the organism and incorporates measurements which allow a metabolic balance to be observed.

REQUIREMENTS:

1. To measure the following approximate metabolic quantities:
   a. O_2 consumption: 12.6 l/day (0.0397 lb/day)
   b. CO_2 production: 10.71 l/day (0.0464 lb/day) (RQ = 0.85)

   NOTE: In addition to long term integrated values, some experiments require breath-by-breath measurements on restrained animals.

   c. Urine output: 0.020 l/day (0.045 lb/day)
   d. Water consumption: 0.050 l/day (0.11 lb/day).
   e. Perspiration/Respiration: 0.038 l/day (0.082 lb/day).
   f. Food consumption.
2. Compatibility with holding unit, Item #103.

HARDWARE STATUS:

Conceptual design item.

TECHNICAL DESCRIPTION:

Estimated flight unit properties are:

Weight:	5 lbs
Power:	20 watts
Volume:	1 ft^3

COST:

Estimated flight item costs are:

Development:	$1000 K
Unit:	$10 K

DEVELOPMENT TIME: 3-4 yrs

#28A CAGE, MONK, MACAC

Purpose

To support hemodynamic and metabolic tests of Macaca monkeys weighing from 16 to 20 pounds.

Requirements

Specimen Freedom - moderate restraint in separate, closed modules.

Metabolic Measurements - each animal:

Total nutrient intake	-
Waste production	- urine, 1.0 lb/day; feces,
Oxygen consumption	- 0.5 lb/day
CO_2 production	- 0.6 lb/day
Heat production	- 100 BTU/hr
Insensible water loss	- 0.6 lb/day
Body mass	- 16-20 lb

Cardiovascular and Hemodynamic Measurements:

Systemic and pulmonary blood pressure

Hemoglobin level

Arterial and mixed venous oxygen tension

Total blood volume

Plasma protein level

Electrocardiogram

Cardiac output

Operational Constraints:

Minimum transient accelerations

No periodic cues which occur at multiples or submultiples of the 24-hour day

Live subject return

Operation in normal gravity and independent of gravity

Hardware Status - Extensive conceptual and detail design required.

Technical Description

Dimensions	- 2 x 2 x 5 ft (20 ft^3) per animal
Weight	- 400 lb per animal (packing density of 20 lb/ft^3)
Power	- 300 w avg. per animal
Interfaces	- To satisfy test and life support requirements

These values were based on preliminary NASA estimates. They appear to include provision for EC/LSS support.

Preliminary Estimates for Flight Unit with central EC/LSS (not included below) and local ventilation provisions (included below) are:

Weight	250 lbs
Power	100 watts
Volume	20 ft^3

Cost

Estimated Flight Item costs are:

Development	$400K
Unit	$25K

Development Time

1 year

#29 CAGE, PLANT (POT)

Purpose

To hold plants and seedlings

Requirements

Vented pots shielded from air impingement

Sealed pots (Lexan and/or glass may be required)

Instrumentation to monitor temperature, pressure, light intensity, accelerations may be required.

Photography capability

Sizes from 200 cc to 12,000 cc including head room.

Hardware Status

Conceptual Design Item

Technical Description

Estimated properties for 16 pots are:

Weight: 10 lbs

Power: 0

Volume: 2 ft^3

Cost

Estimated costs are $100K development, $1K unit

Development Time

1 year

#30A CAGE, RAT

Purpose

House single animals in zero-g or 1-g unrestrained.

Requirements

Volume: approx. 4,250 cc (0.15 ft^3)

At least one transparent side

Orientation screen required

Waste management capability

Air circulation

Hardware Status: Conceptual design item.

Technical Description

This unit must be compatible with the 8-cage hermetically sealed holding unit, Item #103. A preliminary concept is shown in the accompanying picture.

Weight	5.1 lbs
Power	9 watts
Volume	0.25 ft^3

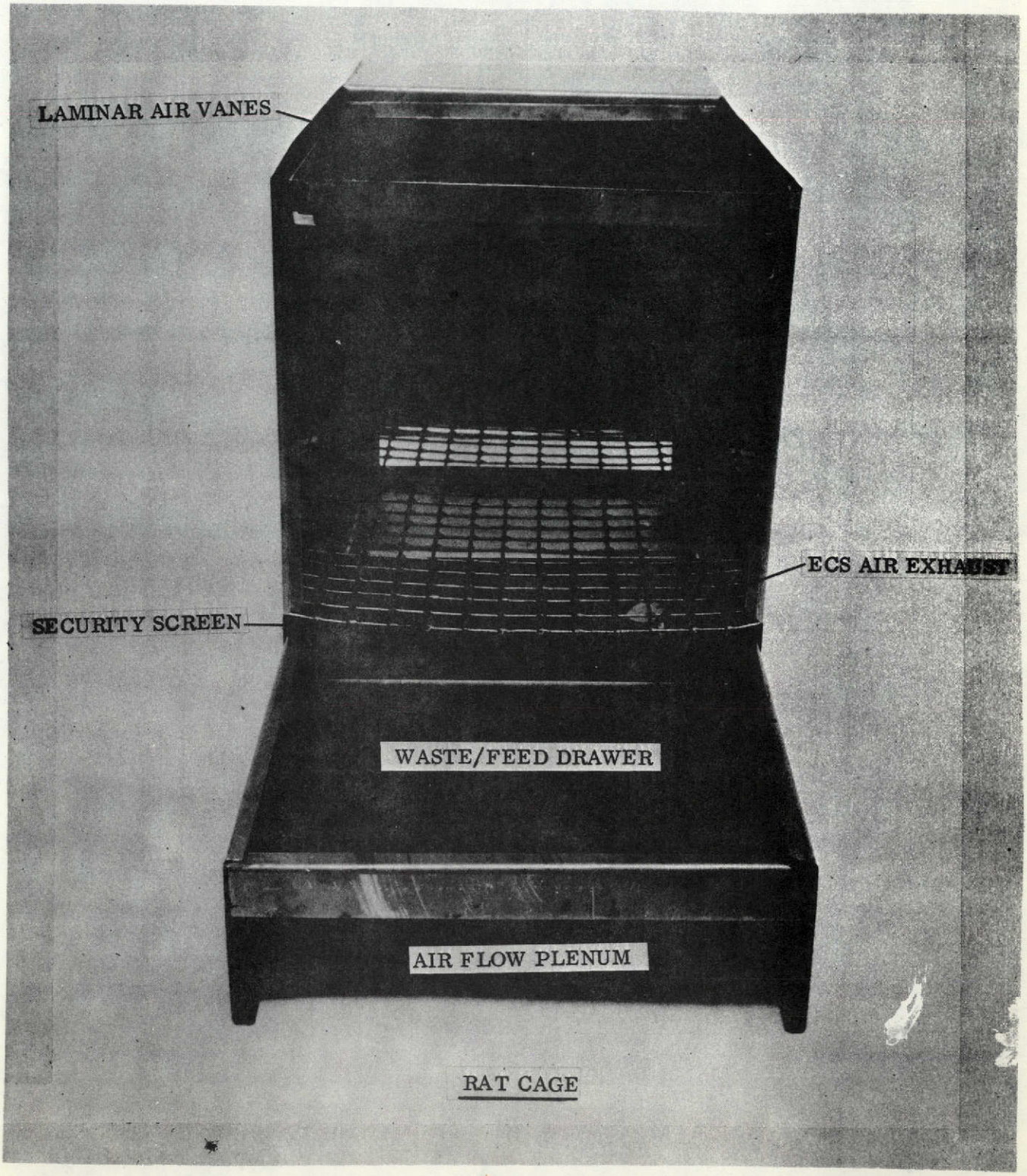
Cost Estimated flight item costs are:

Development	$100K
Unit	$1K

Development Time

3 yrs (in conjunction with holding unit).

#30A-2



RAT CAGE

#30B CAGE SHELF, PLANT SEEDLINGS

Comments

Shelf for holding unit to support plants. With required clamps and brackets.

32 CAMERA, CINE

Purpose

The camera is needed to provide adaquate visual records such as; photomicrography, time-lapse records, photomicroscopy and general experiment documentation.

Requirements

Operation Mode:	Variable frame rate or single frame "Pulse" operation under remote control
Film Size:	16 or 35 mm
Lens Selection:	"C" Mount lens system; Standard zoom lens as a minimum.
Exposure System:	Automatic or manual
Film Capacity:	50, 100 or 200 ft. rolls

Hardware Status

Existing model of the "Beaulieu R16B "Automatic" by "Cinema Beaulieu" Corp. would perform the operations as specified. This model is a 16 mm camera, with electric drive, through the lens viewing and exposure control, variable speed(2-64 F.P.S), pulse mode with external control and various film magazines available. It will accept a wide variety of 'C" mount lens systems, has rechargeable battery and sound synchronization.

This camera will require a specific lens selection, modifications to the battery charger to allow it to operate on 28 VDC and, if it is to be used on the Mini payload, a sealed container for safe operation in the 3.5 psi oxygen environment.

Technical Description

Size	(Envelope) 11" x 11" x 4" (0.28 ft^3)	
Weight	7-8 pounds	
Power	(Recharge) 10 watts or less	
Cost	$2500 - $3000	
	Mini payload container	$10,000
	(for oxygen atmosphere protection)	

Development Time — 1 - 2 years

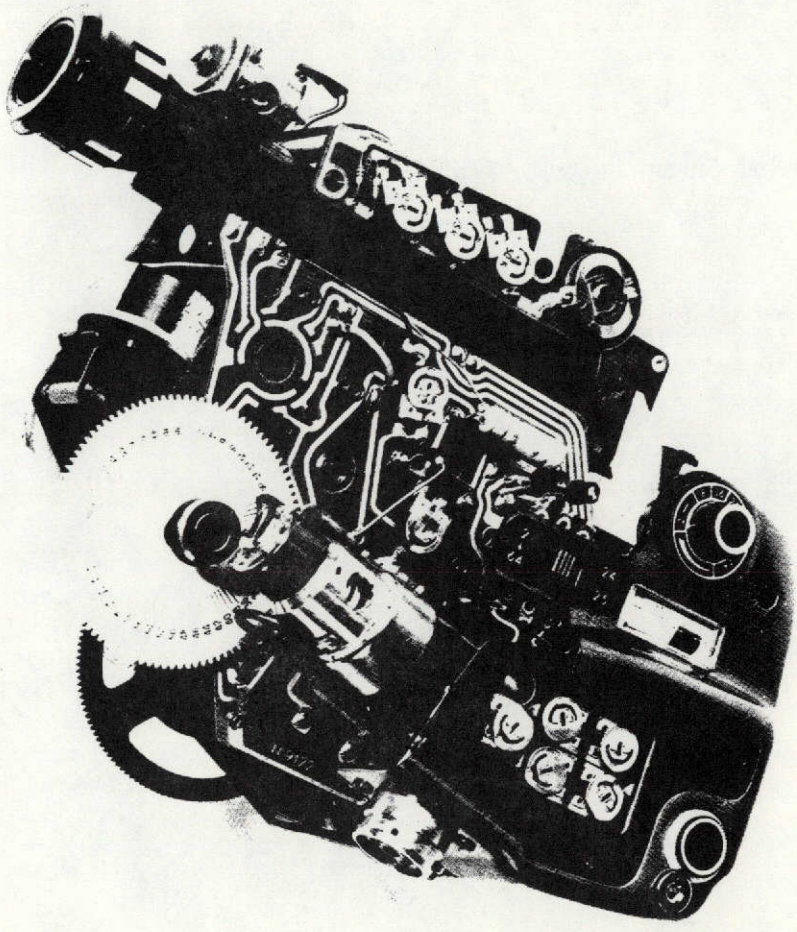
Cost

Development	$150K
Unit	$ 20K

Basic principle of BEAULIEU electronic regulation

Should the motor's speed drop, the e.m.f. delivered by a dynamo coupled to the motor also drops; at this instant a transistorized amplifier delivers a higher current to the motor, thus enabling it to resume its selected speed.

Naturally, this feedback system acts in the opposite way should the motor's speed increase. This regulation control occurs within a few thousandths of a second—and acts continuously, thus ensuring completely even film transport.



#32A CAMERA CONTROLLER

Purpose

This is an electronic device used to control the operation of the video cameras throughout the laboratories.

This item is considered to be an SRT item, and a discussion of it is included in the SRT section of this report under the title: Video Data Control Unit Development.

Requirements

The life sciences laboratories contain upto 14 video cameras which monitor various organisms and research phenomena. Most of these cameras operate automatically according to a predetermined data acquisition schedule. This device issues commands to these cameras and processes the data received. Processing includes tagging the data with time and identification, and transferring data to recording devices or monitors. As many as 8 of the cameras operate in a time lapse mode of operation, and take a still picture of an organism every 10 seconds. The data processing for this mode of operation requires digitizing the analog video signal and recording it at a slower rate than it is generated. The camera controller unit must be thoroughly integrated with the supporting spacecraft DMS. It must also be compatible with the video camera mechanical drive systems, the cameras, and the associated electronic systems.

Hardware Status

SRT item.

Technical Description

Estimated flight unit properties are:

Weight:	30 lbs
Volume:	1 ft^3
Average Power:	200 watts

#32A CAMERA CONTROLLER (Cont'd)

Cost

Estimated costs are:

Development Cost:	$3000 K
Unit Cost:	$150K

Development Time

2-3 years

#34 CAMERA, PLATE FILM

PURPOSE:

To provide still photographic coverage of the various biological experiments on the midi payload. Photographs taken will be used for experiment guidance and for primary documentation.

REQUIREMENTS:

Simple to operate, reliable over experiment life and to use general purpose film. Be capable of hand held operation for experiment set up documentation as well as for stand-mounted primary coverage of plant and animal dissection. Be able to use high resolution glass plate film, standard $2\frac{1}{4}$" by $2\frac{3}{4}$" roll or cut film, 70 mm roll film and polaroid film. System must also have adequate choice of lens and shutter combinations available.

HARDWARE STATUS

All hardware of proposed camera exists and has been used for several years.

TECHNICAL DESCRIPTION:

Graflex XL System. Consists of camera body with interchangeable lens - shutter systems and a film holding system for various types of film. Polaroid film back adapter is same graflex unit as used on Bausch and Lomb. Photo binocular microscope, item (126) and on Oscilloscope camera, part of oscilloscope system item (132). Polaroid MP-3 work board and camera mounting system. Used for high resolution medium magnification photos of experimental dissections.

Camera weight 5 lbs.

Work board (with lights) 20 lbs.

COST:

Preliminary estimate for flight item:

Development:	$20K
Unit:	$5K

#36 CAMERA, IRIS, 35 mm

Comments

Special camera for human iris photography during tests on human eye movement.

37 CAMERA, VIDEO, B/W

Purpose

To provide a means of activity monitoring, experiment data acquisition, etc. The system will be interfaced with a 40 input video multiplexer to permit the monitoring of 40 similar video cameras.

Requirements.

Visual Response	-	Approximate human eye
Video Output	-	Constant with light level changes of 10-10,000 ft-candles
		1.4 V. P-P composite, conforms to EIA RS-170 standard.
Weight	-	Camera and control-unit less than 12 lbs.
Power	-	28 VDC - less than 20 W.

Hardware Status

Currently developed Model ED 6038A TV Instrumentation Camera, by General Electrodynamics Corp. is adequate for task. This unit is space vehicle qualified and operates from 28 VDC

Technical Description

Camera:	Weight	1.2 lbs.
	Size	1.5" Dia., 6" L. (0.006 ft^3)
Control Unit:	Weight	8.5 lbs.
	Size	4.8"H, 6.5" W, 5.5" D (0.1 ft^3)
	Power	15 W, 28 VDC
Cost		$10,000

Development Time: Nil

Comments

Number of scan lines required for experiment resolution will determine if 1/2" vidicon (500 lines) or 1" vidicon (700 lines) is needed.

MINIATURE

Three actual size photographs on succeeding pages tell how small the camera really is. What they cannot tell is that the ED 6038 A camera head weighs only 14 ounces and the ED 6038 A-1 camera head weight is 48 ounces. The control unit has a depth of 6½ inches and weighs 8¼ pounds.

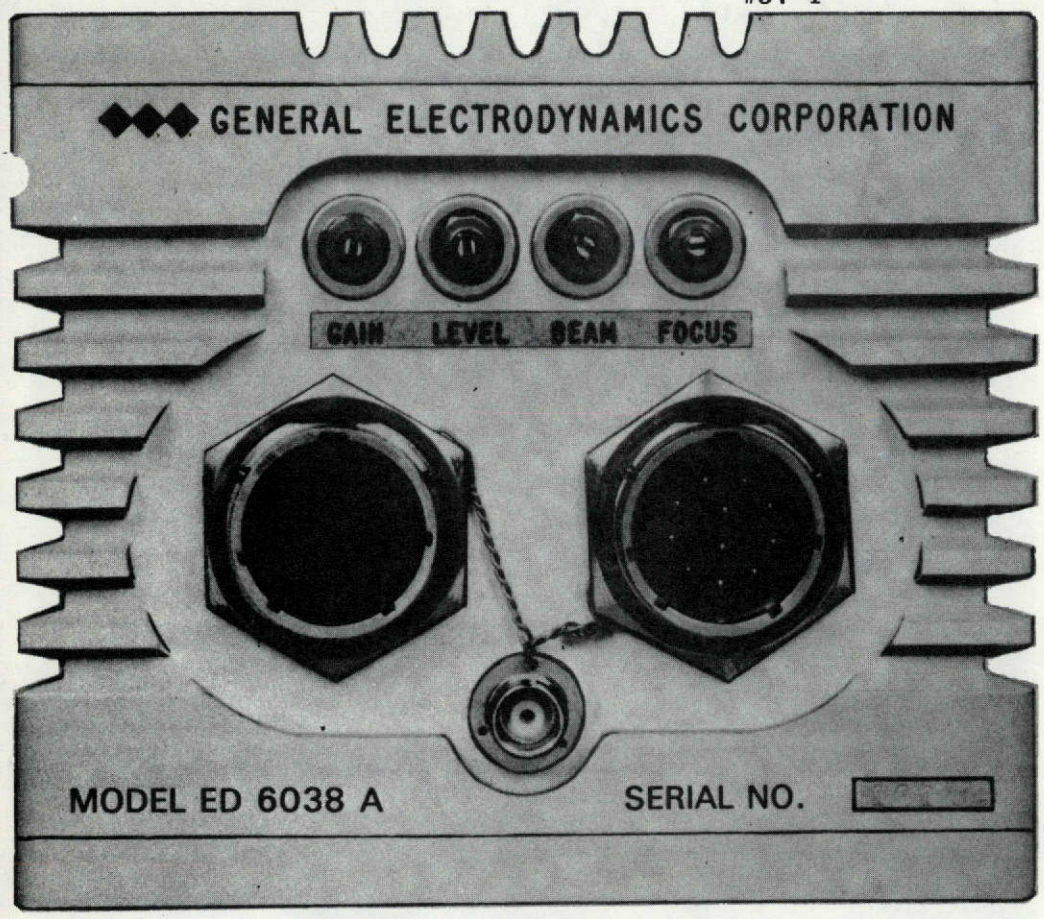
RUGGED

Look at the environment in which this camera will operate:

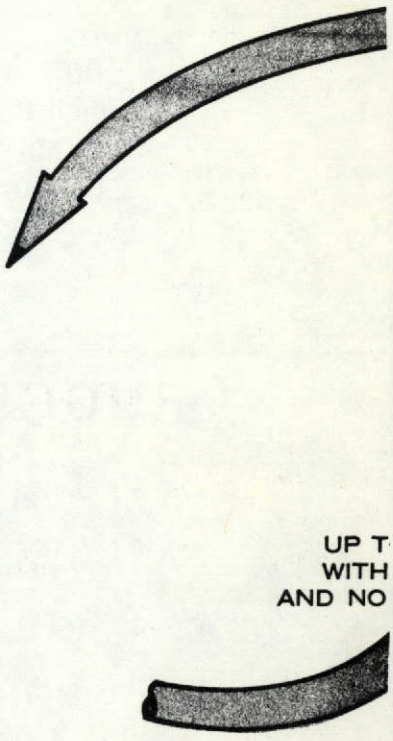
Vibration	20 cps — 2 kc random distribution 20 G's RMS in each of three axes 60 G's RMS for three seconds, in each of three axes
Shock	100 G's for 11 ms
Temperature	–10°C to +71°C, Operating
Relative Humidity	100%
Explosive atmosphere	
Ambient acoustical noise	More than 175 db overall sound pressure level
Altitude	Space Environment

VERSATILE

General Electrodynamics Corporation's total electro-optical capability enables it to quickly engineer most application requirements where instrumentation television is indicated. Our Electronic Tube Division supplies the "eye" for this camera. All you have to tell us is what the "eye" must see.

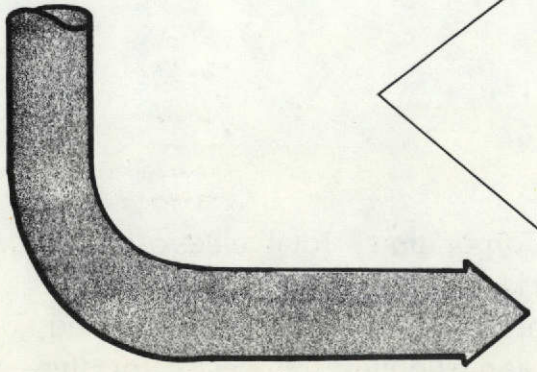


(ACTUAL SIZE)



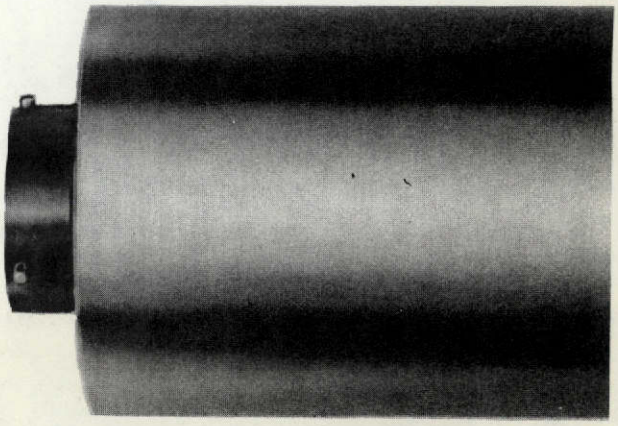
UP T
WITH
AND NO

UP
TO
150
feet



COMPLETELY
INTERCHANGEABLE
ONLY NECESSITATES SWEEP
ADJUSTMENT IN CONTROL BOX

ED 6038 A-1 U

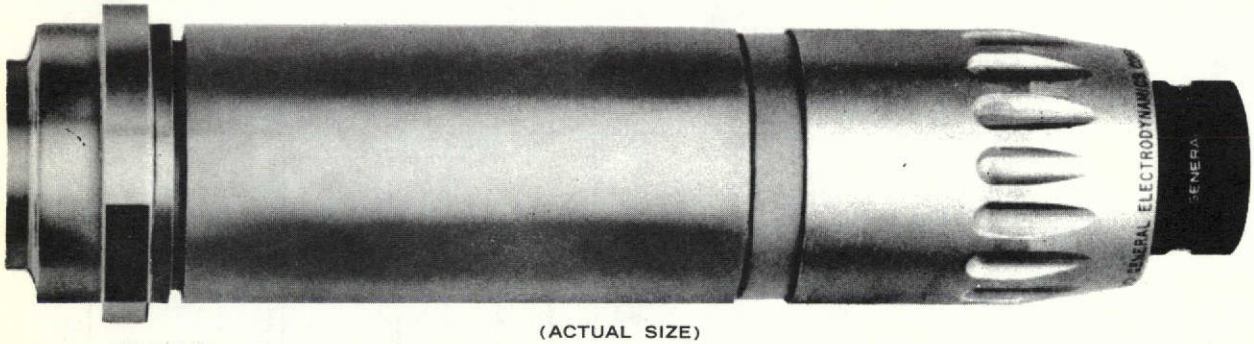


24 to 36 V.D.C.
15 watts

COMPOSITE VIDEO SIGNAL
CONFORMS TO EIA
STANDARD RS-170

1500 feet
G-59
INE AMPLIFIERS

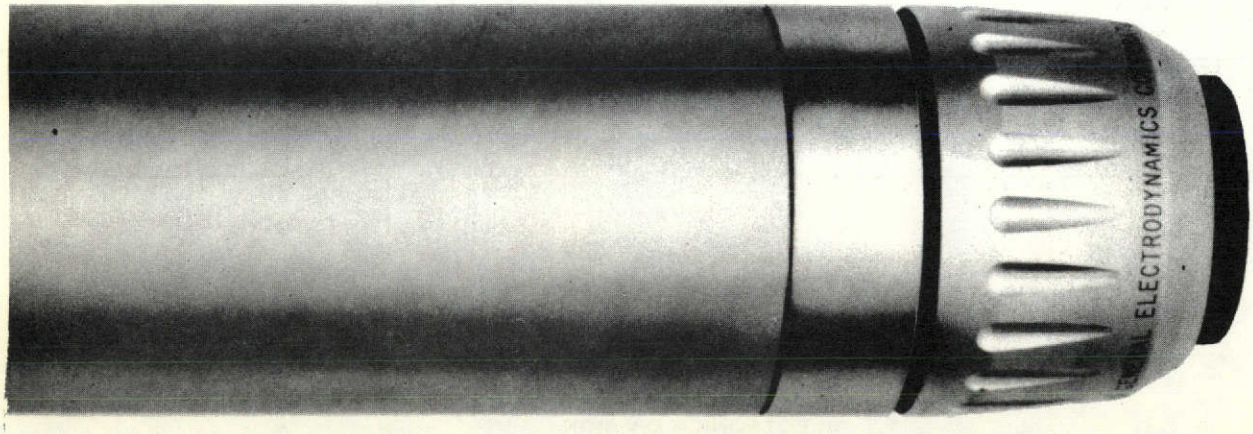
ED 6038 A USES ½-INCH TD 1305 VIDICON 500 TV LINES RESOLUTION



"D" MOUNT LENS

(ACTUAL SIZE)

ES 1-INCH TD1339 VIDICON 700 TV LINES RESOLUTION



"C" MOUNT LENS

(ACTUAL SIZE)

FEATURES

Electrostatic Focus Vidicon Tube
Sampling of yoke currents assures vidicon protection from sweep failure.
Plug-in printed circuits
Solid state system
Reliable, detailed pictures under adverse environmental conditions.

ACCESSORIES

LENSES

5.5 mm	f/1.8	(GEC 1499)
10 mm	f/1.8	(GEC 2035)
25 mm	f/1.4	(GEC 2036)
38 mm	f/2.8	(GEC 2037)
75 mm	f/4.2	(GEC 2038)

HEAD MOUNT MODEL MD 380

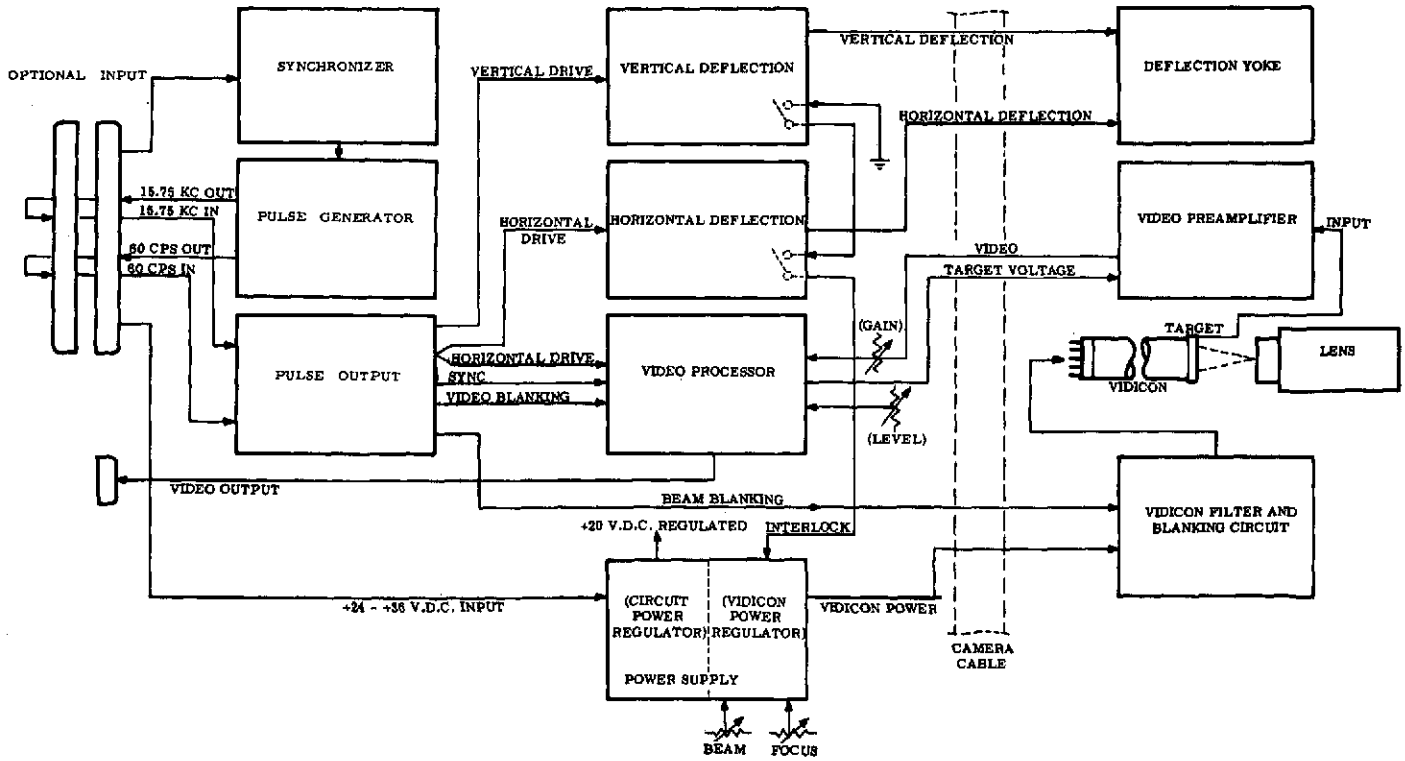
SPECIFICATIONS

Horizontal Scanning Frequency.....15,750 cps
Vertical Scanning Frequency.....60 cps
Interlace..... 2:1 30 fr/sec
Aspect Ratio, Height to Width.....3:4
Sweep Linearity.....Better than ± 1%
Sync and Blanking.....Standard Broadcast EIA

Video Output.....1.4 V PP composite into 75-ohm load
Automatic Constant Video Output ..10—10,000 ft. candle
Usable Pictures.....obtained with 1 ft. candle
Color Response.....Approximates human eye
Grey Scale Reproduction.....10 steps
Keyed Clamp.....Provides constant black level

Voltage Regulation holds picture stable over 24 to 36 VDC
Input Power.....24 to 36 VDC, 15 watts

BLOCK DIAGRAM



ELECTRONICS DIVISION
GENERAL ELECTRODYNAMICS CORPORATION, GARLAND, TEXAS 75040
P. O. BOX 798 A/C 214 276-1161

38 CAMERA, VIDEO/COLOR

Purpose

To provide color video observations of experimental animals, setups, etc. for storage via video-tape for delayed transmission, or direct transmission to the principal investigator on earth.

Requirements

Resolution:	350 lines or better
Lens:	Standard 16 mm, 'C' mount
Color System:	Color wheel or 3 vidicon system

Hardware Status

Existing 3 vidieon cameras can fulfill the purpose for 350 line resolution picture. They will have to have a 28 VDC power supply developed for them. To provide for high resolution color images, a new design will have to be developed using 800 or 1200 line vidicons and a 10 - 20 M Hz information bandwidth. Alternately, a color wheel approach for slow or non-moving subjects might be developed, with perhaps 0.5 sec per filter exposure time and a video disc recorder system on the ground to be used to reassemble the color picture for viewing. This (color wheel) system would be especially useful for color TV microscopy.

Technical Requirements

Weight		80 lbs.
Size	Camera	8" H, 8" W, 22" D (0.81 ft^3)
	Control Unit	9" H, 19" W, 18" D (1.78 ft^3)
Power		150 Watts
Cost		$20,000

(Above data for a COHU Company, Model 1000 color TV camera, control system, model 1900, and model 9800 RGBM Color Encoder)

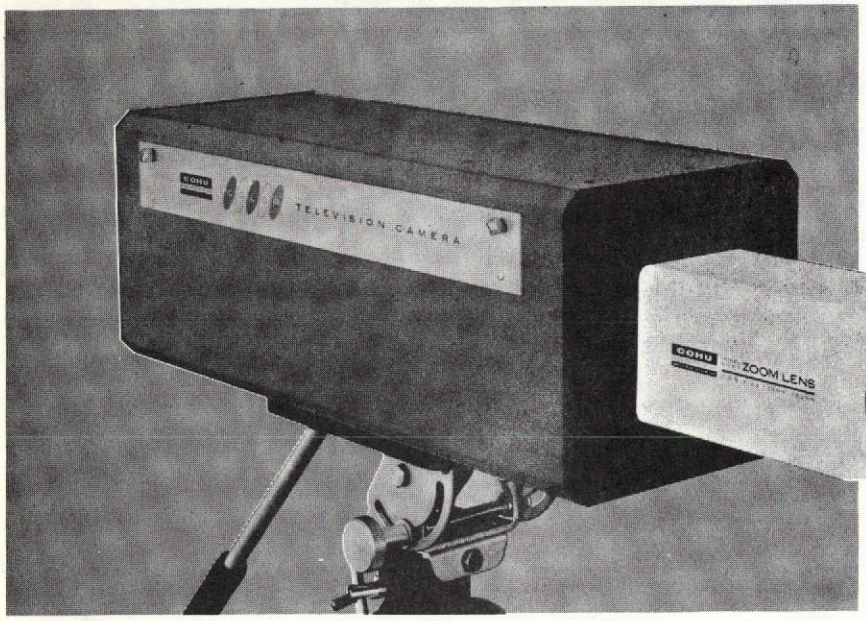
Development Time — 2 -3 years (for a new design system)

COST

DEVELOPMENT	300K
UNIT	100K

#38-3

6-440 (10-15-67)



1000 Series Color Television System

COHU
ELECTRONICS, INC
SAN DIEGO DIVISION

THE COHU 1000 SERIES COLOR TELEVISION CAMERA contains a precision optical system consisting basically of two Petzval lenses. The lenses (object and image) are symmetrical about a common stop and have the advantage of being completely free from coma and distortion. Addition of field flatteners corrects for astigmatism and field curvature. The lenses are positioned in a two-image input and three-image output relay system. The object side of the relay system has an alternate image prism to provide for the insertion of an EIA registration pattern. A beam splitter is positioned in the image side of the relay system. Beam splitting is accomplished by a unique assembly of prisms with internally coated surfaces. The coated surfaces provide precise monochromatic filtering. Three images (Red, Blue and Green) are transferred to three vidicons by the output legs of the Petzval image lens.

Outputs from each vidicon are fed into low noise, solid state preamplifiers for transmission to the camera control unit. Other circuits in the camera provide shading and deflection. A special circuit monitors the camera +20V supply and sweep circuits to provide vidicon protection by cutting off the beam in the event of failure, and a signal is sent to the control unit sweep failure indicator. The optics, electronic circuits and intercom facilities are contained in a 7-¾" H x 8" W x 21-¾" L camera housing. The camera weighs only 35 pounds (65 lbs with electronic viewfinder and remotely controlled zoom).

THE COHU 1900 SERIES COLOR CAMERA CONTROL UNIT consists of solid-state plug-in circuits, color camera power supply, intercom facilities, and enclosure. The control unit is capable of operating the color camera through 1000 feet of interconnecting cable. Camera operating controls are easily accessible behind a flip-down panel. Switches for video selection, shutter, beam, reticle and iris are on the control unit front panel. Video selection switches provide video output selection capabilities for the waveform monitor or SCOPE, monochrome video monitor or MONITOR, and camera viewfinder or VF. Red, Green, Blue, or reversed Green video can be switched into the MONITOR. Switching in the reversed Green and the Red or Blue provides differential signal registration adjustments. SCOPE selection is RGB waveforms which are commutated or displayed, or, MON which is the waveform being sent to the MONITOR. GREEN or MON can be selected for the viewfinder. In the MON position, the viewfinder can be used as a monochrome monitor. In the GREEN position the viewfinder displays the Green video and will not be disturbed while the monitor is being switched. Intercom facilities consist of two jacks, one for program circuit monitoring (PGM) and one for engineering intercom circuit (ENG) (intercom amplifier optional). The engineering intercom circuit is a two-line system in which both the power for the amplifier and the audio signal are superimposed on the same pair of lines. Input and output connectors for signals from and to various auxiliary equipment are provided at the rear of the control unit. The control unit is 5-¼" in height, fits a standard 19" rack and weighs 26 pounds.

The COHU 1000 Series Color Television System has the specifications, features and flexibility that meet the requirements of broadcast studios, educational facilities, or industrial installations.

BOX 623, SAN DIEGO, CALIFORNIA 92112 • PHONE 714-277-6700 • TWX 910-335-1244

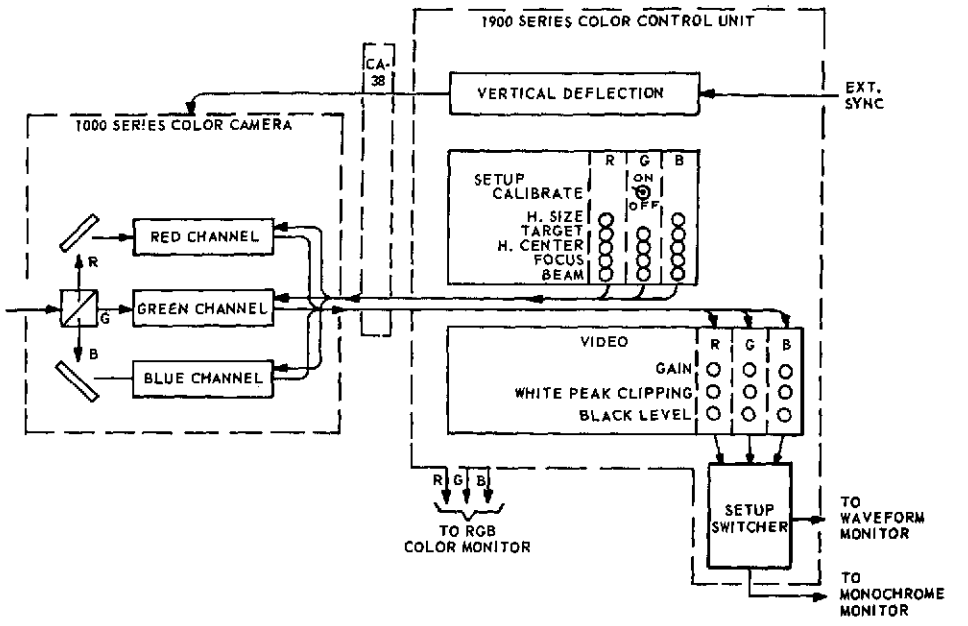


Figure 1. COHU 1000 Series Color Television System

Pictorial diagram of the basic camera system which consists of a COHU 1000 Series Color Camera and 1900 Series Color Camera Control Unit plus a CA-38 interconnection cable.

SPECIFICATIONS

1000 Series Color Camera and 1900 Series Color Camera Control Unit

SENSITIVITY
Meets resolution specifications and produces ten shades of gray from EIA resolution pattern with 150 footlamberts of brightness

RESOLUTION (Green Channel)
Limiting at 500 lines, 50% at 400 lines, 100% at 300 lines

GEOMETRIC DISTORTION
Less than 2%

SCAN LINEARITY
Within 1%

VIDEO OUTPUTS
(Two for each channel) Impedance: 75-ohm sending-end terminated; Output: 0.7V peak-to-peak with 300 footlamberts brightness

FILM CHAIN FUNCTION
Inversion provisions in Green channel for negative film

SIGNAL INPUTS
H. drive, V. drive, blanking, and sync – 4 volts peak-to-peak ±0.5 volt peak-to-peak

CABLE LENGTH
Up to 1000 feet between camera and control unit

GAMMA
Continuously variable, 0.7 – 1

REGISTRATION
Differential signal registration. (Internal pattern provides a registration reference)

SHADING
Shading adjustments (sensitivity modulation) provided at camera

PICKUP TUBES
Three 8134V1 vidicons

VIEWFINDER
6½" (Philips EL8100)

OPTICS
Accepts any "C" mount vidicon-format lens (f/1.9 internal optical system)

POWER
105 to 125 volts ac, 60 Hz, 100 watts

PHYSICAL SPECIFICATIONS

Unit	Size	Net Weight
1000 Series Color Camera	7¾" H x 8" W x 21¾" L	35 lbs
1900 Series Color Camera Control Unit	5¼" H x 19" W x 18" L (Fits standard 19" rack)	26 lbs

COHU reserves the right to change specifications without notice.

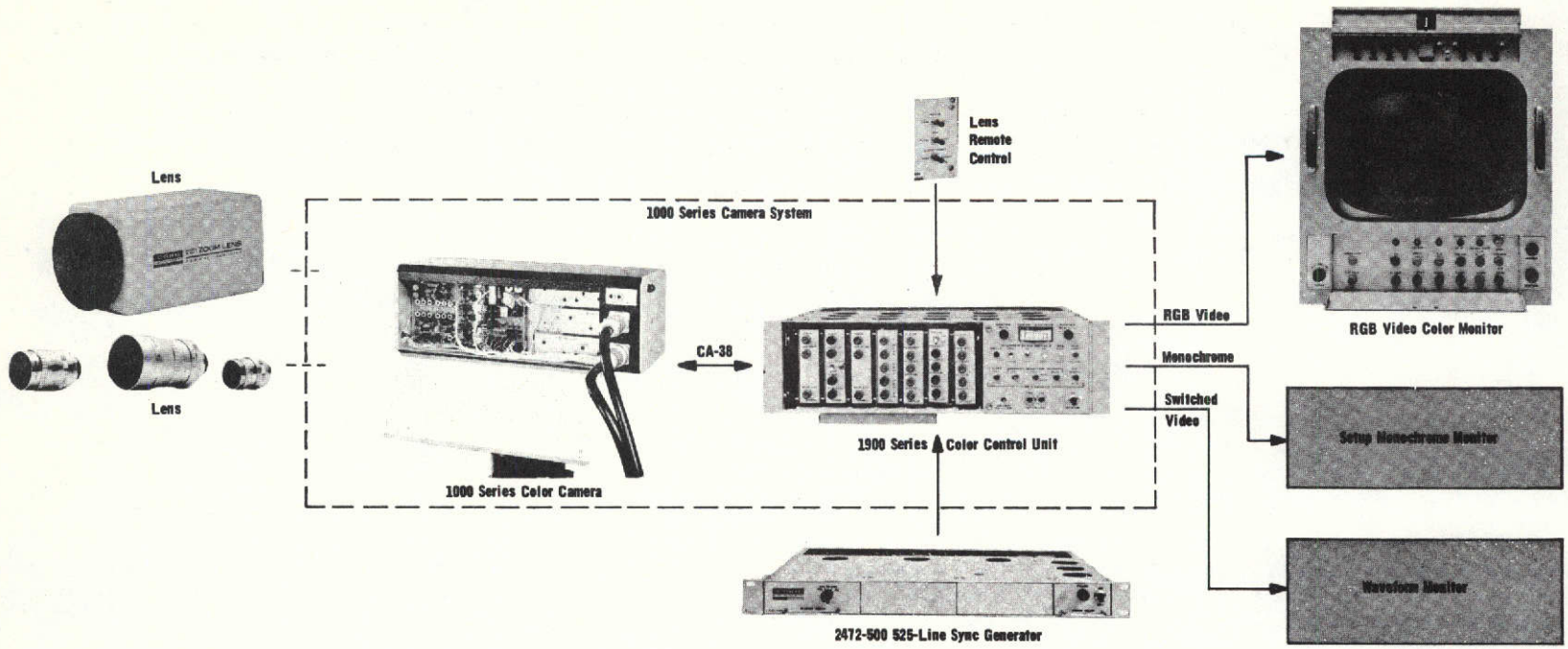


Figure 2. RGB Closed-Circuit Color System

A complete RGB color system consists of a 1000 Series Camera System, sync generator, "C" mount vidicon format objective lens, and monitors. The sync generator is a basic 525-line sync generator, COHU Model 2472-500, which provides horizontal and vertical drive, mixed blanking and sync.

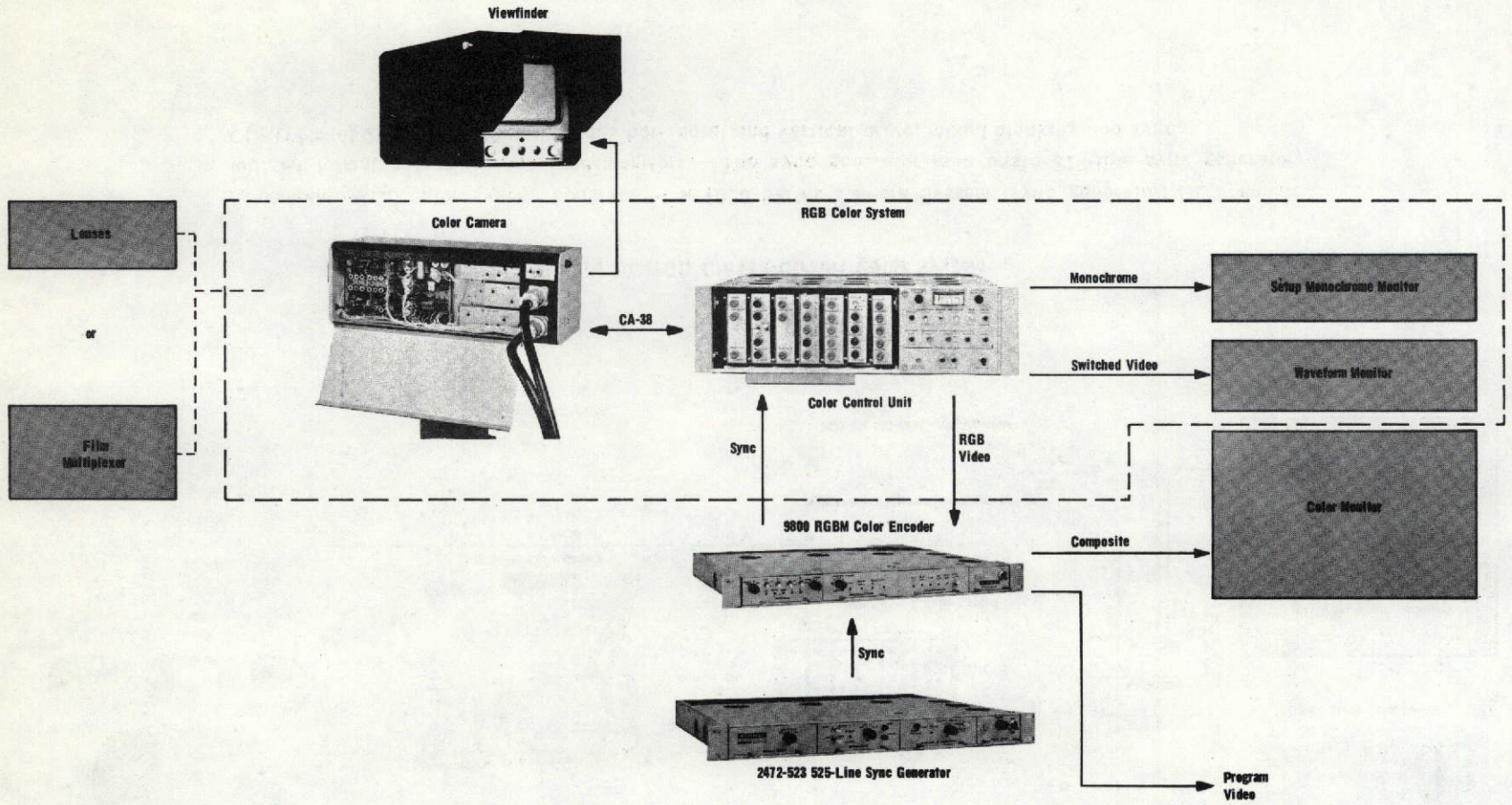


Figure 3. Encoded Color Camera Chain

COHU color systems and accessories are compatible with existing broadcast equipment and are designed to meet or exceed all industry and government regulatory standards. A complete encoded color camera chain is obtained by adding a viewfinder, RGB color encoder and video color monitor to the RGB color system and changing the sync generator to a COHU Model 2472-523. This illustrates the flexibility of the COHU color system by changing a closed-circuit color system to a broadcast color camera chain with the minimum of additions.

#38A CAMERA, X-Y DRIVE

Comments

Mechanical drive system for video cameras (similar to X-Y plotter mechanism) for the purpose of scanning and monitoring various experimental organisms with one camera. Part of cage module, EI 103, E.U. 40.

#41 CENTRIFUGE, REFRIGERATED, HIGH SPEED

Purpose

Separation equipment to support medical and biological research. This unit includes both high speed and standard speeds.

Requirements

Refrigeration

High separation forces (40,000 G)

Gravity independence

Minimum weight, power and volume

Hardware Status

Commercial designs include both vapor compression refrigeration unit and centrifuge. Use of a centralized refrigeration unit should be considered. Also weight and power should be reduced and drive motors replaced.

Technical Description

Catalog descriptions of models from A. R. Thomas Co. 68 P.237 and Braun Chemical Co. No. 63 P. 210-211 are attached. For this unit (International Centrifuge, Model PR-2).

Weight:	750 lbs.
Power	Centrifuge, 70 watts
	Refrigerator, 500 watts
Size:	28 x 38 x 42" (25.9 cu. ft.)
	Centrifuge portion approximately half of the size of this unit.
Speed:	0-20,000 rpm

Preliminary Estimates for Flight Unit

Weight	150 lbs
Power	70 watts
Volume	9 ft^3

Cost

Commercial Model PR-2	$3.1 K

Preliminary Estimates for Flight Unit

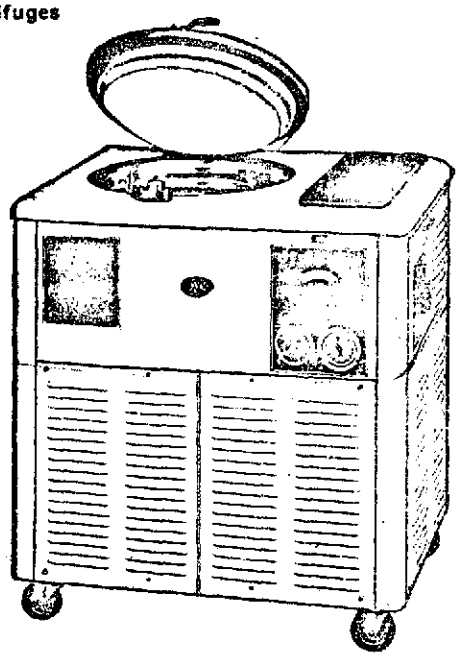
Development	$175K
Unit	$25K

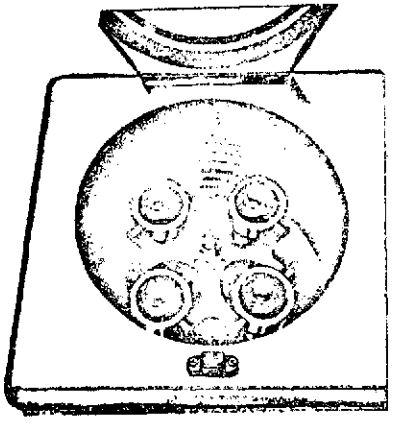
Development Time

2-3 years

BRAUN-KNECHT-HEIMANN-CO. BRAUN CHEMICAL COMPANY SCIENTIFIC SUPPLIES COMPANY
DIVISIONS OF VAN WATERS & ROGERS, INC.

Centrifuges





Interior view of guard bowl of Model PR-2, showing 4-place, 600 ml head No. 20374 and cups, 2400 ml total capacity.

International Refrigerated Centrifuge, Model PR-2

Portable Model PR-2—Essential in many applications where heating during prolonged centrifugation would affect filtered material. Extensively used in the biochemical, physio-chemical and bacteriological laboratories in medical schools and research centers. Particularly useful in the field of plasma fractionation.

The centrifuge and the hermetically sealed compressor unit for low temperature operation are combined in one cabinet mounted on casters. Both units are operated from a single electric cord which can be connected to a 15-ampere lighting circuit. The new sleeve type evaporator is constructed of two thicknesses of stainless steel to provide a non-corrosive, easily cleaned guard bowl interior, and also to insure maximum protection to the operator. Exact temperature of operation may be pre-set by using the selector on the front control panel. The interior of the centrifuge chamber can be cooled to —15°C, and the temperatures are maintained to ±1°C by controlling the operation of the refrigerating unit. The temperature indicator in the control panel registers to within 1°C of the temperature of the material being centrifuged.

The centrifuge motor is of the adjustable speed, ball bearing vertical type with stainless steel shaft, the upper end tapered to receive available heads without use of sleeve adapters. Speed is controlled by a stepless type autotransformer, with the control knob and graduated dial on the right-hand end of the cabinet. The tachometer dial on the front of the cabinet shows at a glance the speed at which the centrifuge is operating, with a range of 0–6000 rpm in 100 rpm graduations. An automatic timer, having a timing interval of 2-hour maximum, 2-minute minimum, is also conveniently located on the front of the cabinet. A switch is provided to disconnect the timer from the circuit if desired.

A variety of interchangeable heads is available for conventional speeds, and two types of high speed angle heads are interchangeable for the multispeed attachment which makes possible a maximum speed of approximately 19,000 rpm (25,000 x gravity), on a spindle driven by a belt from the driving pulley attached directly to the centrifuge shaft. (See the Speed and Force Table herewith.)

The steel cabinet, finished in durable baked white enamel with chrome plated trim, is 28" wide, 38" long and 42" high. Net weight, 750 lbs. Power consumption: centrifuge motor, 70 watts; compressor motor, 500 watts.

20321 (2180) **PORTABLE REFRIGERATED CENTRIFUGE, Model PR-2**—Complete, but without heads and shields. For 115 volts, 60 cycles AC. Each..... 2475.00
(Also available for 50 cycles AC and for 230 volts, 50 or 60 cycles AC, 115 and 230 volts DC, on special order.)

Select heads and accessory equipment from the following table.

HEADS, ACCESSORY EQUIPMENT AND SPEED AND FORCE TABLE FOR INTERNATIONAL CENTRIFUGE, MODEL PR-2

The various heads and accessory equipment for each head for the International Centrifuge, Model PR-2, are shown in this table, with speed and force data. Select appropriate equipment from this table. For a more detailed description of heads and accessories, see numerical listings, pages 215–239.

HEAD				SHIELDS AND CUPS			Approx. Max. Speed	Max. R. C. F. at Tip
Cat. No.		No. Places	No. Tubes	Cat. No.		Description		
20370	(253)	12	12	20743	(320)	50 ml	2400	1450
20371	(269)	8	8	20743	(320)	50 ml	2900	1860
20371	(269)	8	8	20748	(341)	100 ml	2300	1440

* (Continued on opposite page)

BRAUN-KNECHT-HEIMANN-CO. BRAUN CHEMICAL COMPANY SCIENTIFIC SUPPLIES COMPANY

DIVISIONS OF VAN WATERS & ROGERS, INC.

(Continued from opposite page)

HEAD Cat. No.	No. Places	No. Tubes	SHIELDS AND CUPS Cat. No.	Description	Approx. Max. Speed	Max. R. C. F. at Tip
20374 (276a)	4	4	20899 (353a)	600 ml or 1000 ml	2300	1370
20378 (284)	4	4	20899-1 (384)	250 ml	2700	1560
20378 (284)	4	4	20900 (2734)	250 ml sealed cup	2700	1560
20379 (297)	4	4	20899-2 (386)	250 ml conical	2500	1380
20381 (259)	6	6	20899-1 (384)	250 ml	2000	1060
20381 (259)	6	6	20900 (2734)	250 ml sealed cup	2000	1060
20390-1 (811a)	20	20	20739 (302)	15 ml Angle	5000	3900
20391-1 (812a)	8	8	20743 (320)	50 ml Angle	5000	3550
20392-1 (813a)	12	8	20739 (302)	15 ml Angle	5000	3900
		4	20745 (320)	50 ml Angle	5000	3550
20393 (814a)	12	8	20739 (302)	15 ml Angle	4400	3020
		2	20743 (320)	50 ml Angle	4400	2750
		2	20747 (340)	100 ml Angle	4400	3510
20394 (821a)	28	28	20739 (302)	15 ml Angle	39000	2700
20395-1 (831a)	36	36	20739 (302)	15 ml Angle	3300	2120
20396-1 (833a)	20	8	20739 (302)	15 ml Angle	3200	2000
		8	20743 (320)	50 ml Angle	3200	1830
		4	20747 (340)	100 ml Angle	3200	2250
20397-1 (834a)	14	6	20743 (320)	50 ml Angle	3000	1610
		8	20747 (340)	100 ml Angle	3000	1980
20398-1 (838a)	60	60	20737 (356)	10 ml Angle	4200	3630
20399-1 (840a)	6	6	....	100 ml Angle	5100	4240
20400-1 (850a)	6	6	20898 (2733)	250 ml Angle	3900	3180
20401 (832a)	14	14	20747 (340)	100 ml Angle	3000	1980
20402 (862)	4	4	20888 (613)	High capacity attachment	14500	20000
20403 (856)	8	8	20888 (613)	High capacity attachment	11000	14400
20412-1 (822a)	12	12	20743 (320)	50 ml Angle	5000	4080
20413-1 (823a)	16	8	20739 (302)	15 ml Angle	4100	2980
		8	20743 (320)	50 ml Angle	4100	2750
20414-1 (824a)	16	8	20739 (302)	15 ml Angle	3600	2300
		4	20743 (320)	50 ml Angle	3600	2120
		4	20747 (340)	100 ml Angle	3600	2620
20420-1 (845a)	8	8	....	100 ml Angle	4600	3900
20428 (296)	4	4	20869 (298)	Multispeed attachment	18000	24500

(International Equipment Company catalog numbers are shown in parentheses)

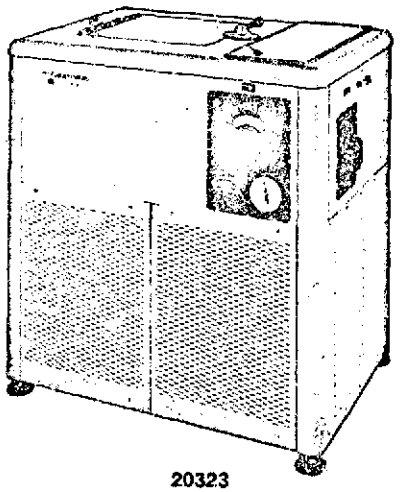
International High-Speed Refrigerated Centrifuge, Model HR-1

The International High-Speed Refrigerated Centrifuge, Model HR-1, will spin 1500 ml at 26,000 x G and maintain material temperature at 0°C. Temperatures between —20°C and +40°C are kept constant within ±1°C by a 1-hp refrigeration unit, a fin-coiled evaporator and a combination of plastic foam and fibre glass insulation.

The 8-place, 50 ml head delivers 40,000 x G and the 6-place 250 ml head, 26,000 x G. High speeds are obtained by a direct drive, special motor. Speeds are set by a stepless autotransformer control. The automatic timer shuts off the centrifuge after any time interval from 2 to 120 minutes. A switch cuts out the timer for longer runs. The combination ammeter and tachometer gives accurate readings of rpms and amperes. Other features include a spring balanced cover, access panels on all four sides, molded rubber work mat, draining system in guard bowl, leveling adjustments with vibration dampeners.

Dimensions: 39" high, 28 wide, 38" long. For use on 208/230 volts, 60 cycles, single phase AC through the use of a combination transformer with high-low control.

20323 (3436) HIGH - SPEED REFRIGERATED CENTRIFUGE, Model HR-1—Complete, but without heads.....Each 2450.00



20323

Select heads and accessory equipment from table on the following page.

BRAUN-KNECHT-HEIMANN-CO. BRAUN CHEMICAL COMPANY SCIENTIFIC SUPPLIES COMPANY

DIVISIONS OF VAN WATERS & ROGERS, INC.

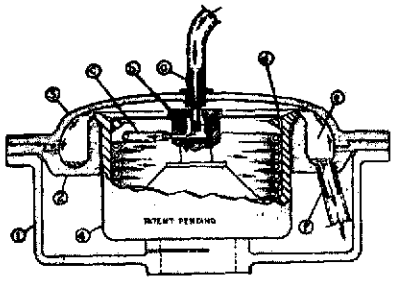
Centrifuges

HEADS, ACCESSORY EQUIPMENT AND SPEED AND FORCE TABLE FOR INTERNATIONAL CENTRIFUGE, MODEL HR-1

The various heads and accessory equipment for each head for the Model HR-1 Centrifuge are shown in this table, with speed and force data. Select appropriate equipment from this table. For a more detailed description of heads and accessories, see numerical listings, pages 215–239.

HEAD		TUBES AND BOTTLES		CAPS		
Cat. No.	No. Places	No. Tubes	Cat. No.	Description	Cat. No.	Approx. Max. Speed	Max. RCF at Tip
20403 (856)	8	8	20888 (613)	50 ml	20804 (1515)	18500	40560
20403 (856)	8	8	21010-1 (638)	50 ml with 20888 tube	20804 (1515)	18500†	40170
20403 (856)	8	8	21010 (659)	50 ml	20804 (1515)	18500†	40940
20403 (856)	8	8	20994-4 (1608)	50 ml	20877 (1518)	18500	40560
20403 (856)	8	8	20994-3 (1621)	18 ml with 20759-5 adapter	20871 (644)	18500	39030
20403 (856)	8	8	20926-1 (514)	12 ml with 20760-2 adapter	20862 (580)	18000*	36590
20403 (856)	8	8	21011-1 (641)	15 ml with 20760-1 adapter	20871 (644)	18000*‡	36950
20403 (856)	8	8	21011-1 (647)	10 ml with 20760 adapter	20870 (643)	18000*‡	36220
20403 (856)	8	24	21010 (654)	3 ml with 20765 adapter	20878-2 (1524)	18000*	34050
20403 (856)	8	24	20994 (1620)	3 ml with 20765 adapter	20878-3 (1523)	18500	35200
20403 (856)	8	8	20893-2 (1622)	50 ml	20893-3 (1526)	18500	40180
20404 (858)	6	6	21019-5 (1616)	250 ml		9000*	10770
20404 (858)	6	6	21024-3 (1617)	250 ml	21024-5 (1519)	14000	26080
20404 (858)	6	42	20994-2 (1624)	12 ml with 20759-17 adapter	20878-4 (1514)	14000	24980
20404 (858)	6	6	21024 (1625)	250 ml	21024-2 (1516)	14000	26300
20405 (859)	12	12	20916 (518)	7 ml		16000*	24040
20405 (859)	12	12	21011 (658)	10 ml	20876 (671)	20000‡	38550
20405 (859)	12	12	20994-1 (1628)	7 ml	20878-1 (1525)	20000	37560
20406 (860)	24	24	20994-2 (1624)	12 ml	20878-4 (1514)	18500	41320

*These speeds must not be exceeded. †When used with expandable sealing caps. ‡When used with plastic caps.
(International Equipment Company catalog numbers are shown in parentheses)



20324

(1) Mounting Bracket, (2) Draining Ring, (3) Cover, (4) Head Assembly, (a) Fitting, (b) Feed Cup, (c) Tygon Tubing, (d) Vent Holes, (e) Supernate Groove, (f) Drain Outlet.

20324 (2300) **CONTINUOUS FLOW SYSTEM, Helical, For Model HR-1, International**—Makes possible two types of separation: general harvesting of micro deposits and gradient separations. Collected solids are easy to remove and foaming of the supernate is minimized.

Consists of a chrome-plated, manganese bronze mounting bracket; stainless steel draining ring, stainless steel cover; stainless steel head assembly, and Tygon tubing.

In operation, the material is fed through a fitting into the feed cup which introduces the suspension into the Tygon tubing, where the solids are removed and deposited on the wall of the tubing. The supernate flows out of the open end of the tubing at the bottom of the head cavity, flows up the wall as a thin film and escapes through vent holes. The supernate then flows up the inclined surface and is thrown off the head onto the curved inner surface of the draining ring cover, where it is collected in the groove of the draining ring and, passing through the drain outlet, is carried outside the machine for collection. The deposited phases are removed from the tubing in the form of paste by squeezing the tubing between rollers.

The recommended maximum speed of 18,500 rpm gives approximately 25,000 x G. Speed, flow rates and tubing sizes will be determined by the nature of the material being centrifuged.

Supplied with Deposit Extractor, but without tubing. **(Complete details on tubing sizes available will be supplied upon request.)** Specify serial number of HR-1 for details on adaptation necessary. Each..... 1750.00

INTERNATIONAL CENTRIFUGES FOR THE OIL INDUSTRY AND FOR SOIL TESTING

In addition to the complete range of sizes and models in Centrifuges for medical, chemical and scientific research laboratories, and an extensive line of interchangeable accessories, listed in this section, International Equipment Company designs and manufactures Centrifuges for a variety of other applications.

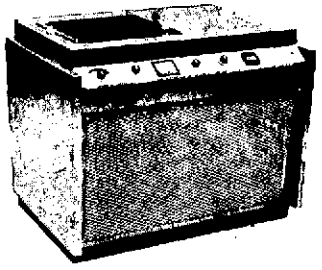
Among them are models for use in the Oil Industry, particularly in hazardous locations requiring explosion-proof equipment, and also for oil testing procedures governed by ASTM requirements and formulae for centrifugation. SEE UNDER OIL TESTING.

Models also are available for testing soils, in road building and agriculture. SEE UNDER SOIL TESTING.

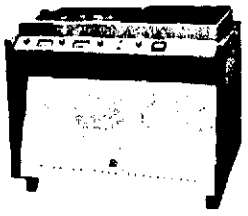
HIGH SPEED REFRIGERATED CENTRIFUGES AND ULTRACENTRIFUGES

The centrifuges described on this page are all stocked by us. All feature: built-in refrigeration unit, controllable over −30° to +30° C, within ±1° C (lowest temperature attainable depends on running speed); solid state speed control; continuously indicating electric tachometer; electric brake; programmed sequential cooling, vacuum (in ultracentrifuges), and acceleration and deceleration within spin time selected. The drives of B-35 and B-60 ultracentrifuges are water cooled. All operate on 208-230 volts, 60 cycles; 50-cycle models are also available.

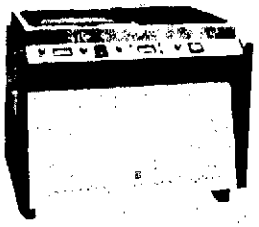
Performance specifications are shown for each model. Further details will be furnished on request.



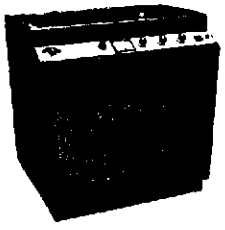
Model B-20



Model B-35



Model B-60



Model PR-6

Model B-20 High-Speed Refrigerated Centrifuge

Maximum Speeds and Forces

Load	Head Angle	Speed	Force (rcf)
24 × 13 ml	33°	19,500 rpm	46,320 G
12 × 14 ml	40°	20,000 rpm	40,000 G
8 × 50 ml	33°	19,500 rpm	45,100 G
6 × 250 ml	20°	14,500 rpm	28,850 G

Model B-35 Ultracentrifuge

Includes vacuum pump producing operational vacuum below 50 microns.

Maximum Speeds and Forces

Load	Rotor	Speed	Force (rcf)
6 × 14 ml	90°	35,000 rpm	206,200 G
6 × 40 ml	90°	25,000 rpm	110,000 G
8 × 55 ml	33°	35,000 rpm	147,100 G
16 × 55 ml	31°	25,000 rpm	90,100 G
6 × 90 ml	20°	35,000 rpm	130,400 G
6 × 280 ml	33°	19,000 rpm	57,000 G
4 × 500 ml	20°	14,000 rpm	28,500 G

Model B-60 Ultracentrifuge

Includes forepump and oil diffusion pump, to produce 0.3 micron vacuum.

Maximum Speeds and Forces

Load	Rotor	Speed	Force (rcf)
6 × 4.2 ml	90°	60,000 rpm	405,900 G
6 × 14 ml	90°	41,000 rpm	283,200 G
8 × 14 ml	35°	60,000 rpm	321,400 G
6 × 40 ml	90°	25,000 rpm	110,000 G
8 × 40 ml	30°	45,000 rpm	211,200 G
8 × 55 ml	33°	35,000 rpm	147,100 G
6 × 90 ml	20°	40,000 rpm	170,300 G
4 × 500 ml	20°	14,000 rpm	28,500 G

Model PR-6 Refrigerated Centrifuge

Takes same heads and accessories as the Model PR-2 (see 2966-C10, ff.) but provides significantly higher speeds and forces. A 4-place windshielded head for 600 ml blood bags is available.

Maximum Speeds and Forces

Load	Head	Speed	Force (rcf)
4 × 600 ml	angle	6000 rpm	7900 G
6 × 250 ml	angle	5800 rpm	7000 G
4 × 600 ml	horizontal	5500 rpm	7000 G
4 × 1000 ml	horizontal	3000 rpm	2250 G
36 × 15 ml	angle	5000 rpm	4880 G
20 × 15 ml	angle	6000 rpm	5620 G
12 × 50 ml	angle	6000 rpm	5880 G
14 × 100 ml	angle	4300 rpm	4100 G

#42 CENTRIFUGE, MICRO

Requirements

Four-place head

Shields and cushions for tube variety

Adapter for fixed tube inclination

Reducing collar for 0.5 mil tubes

Hardware Status

Commercial items may be applicable. Possible modifications include head redesign to accommodate 0-g liquid contamins, weight reduction and dual designs to minimize external torques.

Technical Description

Catalog description from Braun Chemical Catalog No. 63, P. 191-192 attached.

Dimensions 11 in dia. x $8\frac{1}{2}$ in. ($0.47\ ft^3$)

Weight 18 lbs.

Power 25 w

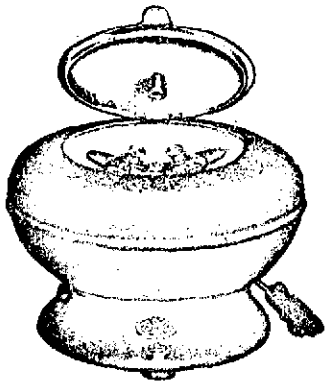
Cost

$0.2K (commercial unit)

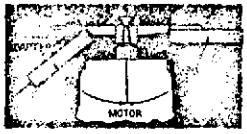
DEVELOPMENT 75K
UNIT 5K

Development Time

2 years



20211



20211
Cross section of Micro Centrifuge Head and Tubes

INTERNATIONAL ELECTRIC CENTRIFUGES

The Micro Centrifuge

20211 (454) **CENTRIFUGE, Electric, Micro, International** — For micro and semi-micro analysis. Suitable for both angle and horizontal sedimentation, it is easy to operate, compact in size and dependable in performance. With quick starting motor, mechanical brake and protective steel guard bowl.

Outstanding characteristics of this centrifuge are the design of the head and unique method of suspending the tubes. The head combines the regular horizontal method of swinging the tubes with the angle method as shown, which is effected by means of removable molded angle adapters. It is possible to swing two of the tubes in the horizontal position and two in the angle position at the same time, as long as they are kept in pairs in opposite slots. It is possible also to swing all of the tubes in either position, the change from one position to the other being easily made. The molded angle adapters are made to slide into slots in the head back of the tubes and to hold them at the correct angle.

The shields are of spun aluminum, Cornell style, with permanently attached trunnions, and are made in two sizes: one for the 5 ml glass tubes or ½" x 4" test tubes and one for the 3, 2, and 1 ml glass tubes, or 10 mm x 75 mm test tubes, and, by means of a metal adapter, the 0.5 ml glass tubes.

The fast-starting motor operates at a constant speed of 1780 rpm. The head attains maximum speed in 10 seconds. A toggle switch and 6-foot portable cord and plug are included.

Complete with two large aluminum shields and rubber cushions, two small aluminum shields and rubber cushions and four angle adapters, but without glassware. Height, 8½". Diameter of guard bowl, 11". Net weight, 18 lbs. Shipping weight, 28 lbs. With motor for 115 volts, 60 cycles AC only.
Each **82.50**

20215 (321) **Shield, Aluminum, Small**—½" diameter x 2⅝" long. With rubber cushion No. 20810 (666) for 0.5, 1, 2 and 3 ml glass tubes. The No. 20761 (311) metal adapter is required to take the 0.5 ml glass tube ..... **Each 1.35**

20216 (322) **Shield, Aluminum, Large**—⅝" diameter x 3⅜" long. With rubber cushion No. 20812 (667) for 5 ml glass tube ..... **Each 1.35**

20217 (665) **Molded Angle Adapter** — For holding shields at an angle ..... **Each .50**

No. 20761 (311), METAL ADAPTER—For 0.5 ml glass tube in No. 20215 (321) shield... **Each 1.25**
No. 20810 (666), RUBBER CUSHION—For aluminum shield, No. 20215 (321)..... **Per dozen .72**
No. 20812 (667), RUBBER CUSHION—For aluminum shield, No. 20216 (322)..... **Per dozen .72**
(International Equipment Co. catalog numbers are shown in parentheses.)

#44 CHEMICALS

Comments

Miscellaneous and premeasured quantities. Laboratory specific. Estimated quantities for a 7-day mission are indicated.

Comments

Premeasured quantities. Estimated weight and volume are for a 7-day mission.

Development cost included in E.I. 44.

#45 CHEMICAL STORAGE CABINET

Purpose

This cabinet is used for room temperature chemical storage through all mission phases.

Requirements

1. Size, number, and compartment configuration: tbd
2. Must hold down and cushion containers.
3. Hermetic sealing desirable in case of spills, outgassing of chemical containers, etc.
4. Connection to ECS contaminant control loop desirable.
5. It would be desirable for this cabinet to mate with the laminar flow bench.

Hardware Status

This is a new item.

Technical Description

Estimated flight item properties are:

Weight:	20 lbs
Volume:	2 ft^3
Power:	0

Cost

Estimated at 10K each and $20K development

DEVELOPMENT TIME

1 year

#048 VACUUM CLEANER, GENERAL LABORATORY

Purpose

To collect general laboratory waste materials, dirt, dust, and debris.

Requirement

1. A vacuum fan which sucks air from the lab to a waste collection bag and back to the lab.

2. A vacuum source manifold leading to a waste collection bag, with manifold routed throughout the laboratory with connectors (receptacles) spaced for use of portable hand-held vacuum tube and vacuum fitting to give access to all corners of the laboratory.

3. Length of manifold to be determined by layout.

4. Vacuum bag and vacuum bag holder for collection and storage of waste, exhausting filtered air back to lab.

Hardware Status

Does not exist. Must be developed.

Technical Description Preliminary estimates for flight unit are:

Weight: 30 lbs

Power: 100 watts

Volume:
a. Hand vacuum line & fitting .5 ft^3.
b. Vacuum manifold tbd by layout.
c. Vacuum bag, bag container and vacuum valve .36 ft^3.

Cost - $200K development; $50K unit.

Development Time - 3 years.

#49A CLEANER, HAND

PURPOSE:

This unit will provide the special purpose cleansing prior to and following any specimen handling, surgical procedures, etc. not performed with a glove box. It should provide sterilization equivalent to that obtained in earth based procedures.

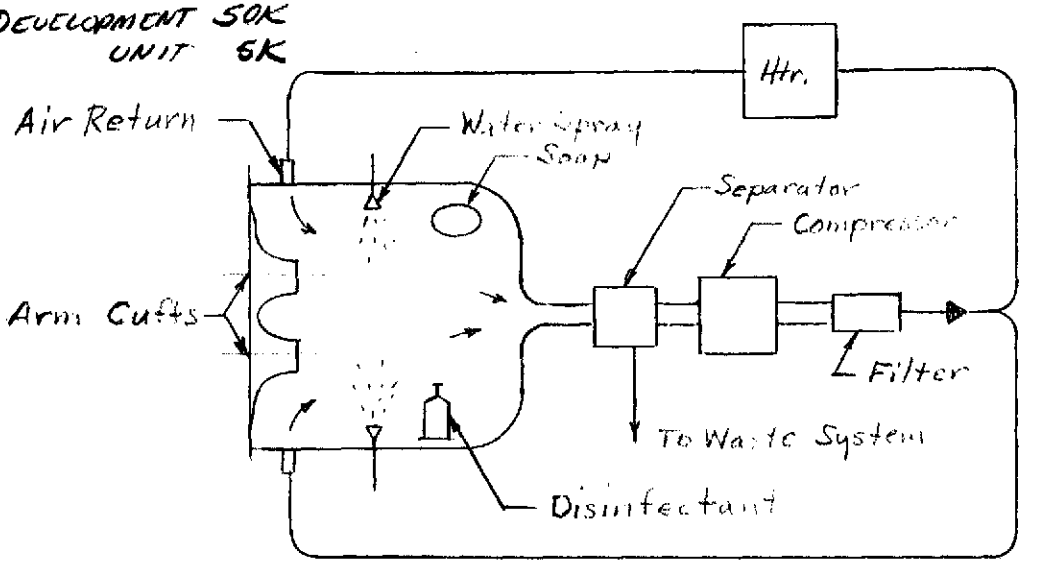
REQUIREMENTS:

1. Crew hand and forearm cleansing and sterilization.
2. Time required should be as short as possible.
3. Maximum use freq.: Approx. 2 times/hr.

HARDWARE STATUS:

Conceptual design item.

COST DEVELOPMENT 50K
UNIT 5K



#50 CLINOSTAT

Purpose

This device contains mounting structure which is motor driven to provide continuous rotation. It is used in 1-g labs for subjecting plants to a rotating gravitational field.

Requirements

1. Platform size available for mounting plants: approx. 0.6 m (2 ft).
2. Rotation rates: tbd.
3. Platform lighting requirements: tbd.

Hardware Status

Many units are currently in use throughout various laboratories. Designs are not uniform. No spaceflight design problems are anticipated.

Technical Description

The following are estimates:

Diameter:	0.6 m (2 ft)
Length:	0.3 m (1 ft)
Volume:	0.085 m^3 (3.14 ft^3)
Weight:	10 kg (22 lbs)
Power:	10 watts continuous

Cost Estimated costs are $50K development and $7K unit.

Development Time - One year.

#50A COMMUTATOR, GAS MANIFOLD

Comments

Automatic gas manifold valving system for control of cage and cage module atmospheric gas sampling.

#50B COMPACTOR, WASTE SOLIDS

Purpose

This unit will compact waste solids for easy handling.

Requirements

Capability to compact wastes such as: wrappers, plastic disposable syringes, vials, metal containers, glass, etc.

Hardware Status

Commercial designs exist which should be adaptable to flight units.

Technical Description

The Sears household compactor has the following approximate properties:

Weight:	86 kg (190 lbs)
Size:	87 x 38 x 61 cm (34.5"H x 15"W x 24"D)
Volume:	0.2m^3 (7.2 ft^3)
Motor:	1/3 HP (approx. 250 watts)
Compaction:	Final vol. = 1/4 initial vol.

Cost

$.2K for Sears commercial model.

Estimated flight item costs are $14K development, $2K unit.

Development Time

1-2 years for space-qualified unit.

#50C CONSOLE, BEHAVIORAL MEASUREMENTS

Purpose:

A device that measures mental processes, attitudes, etc. such as cognitive processes, individual behavioral traits, group behavioral traits, etc.

Requirements:

1. Provide a general purpose display and general purpose response keyboard.

2. Provide the capability to measure the following processes:

   Complex perceptual

   Conceptual and thinking abilities

   Memory

   Reaction time - simple, complex

   Individual behavioral traits

   Group behavioral traits

Hardware Status:

EI #63B has the functional capability required by this item.

Technical Description:

See EI #63B, E.U. 2

Cost:

See EI #63B, E.U.2

Development Time:

See EI #63B, E.U.2

Purpose

To provide automatic data acquisition of the various bio-medical experiments, physiological monitoring of experimental animals, control of lighting, animal feeding, and general laboratory environment monitoring. In addition the computer will be used with various analytical tools such as mass spectrometers, gas analyzers and dialysis equipment. The computer will also be used for driving one or more CRT interactive display consoles for operator/experiment interaction.

Requirements

The computer must be capable of monitoring up to 100 temperatures at a rate of one measure ment/second, 10 temperatures at a rate of 10 measurements/sec, 200 various biological measurements (heart rates, blood pressures, etc.) at a rate of 400 measurements/sec. All of these measurements must be made in any selected combination including all of them simultaneously. In addition the computer must be capable of actuating 50 external relays at a maximum rate of 5 per sec, and 10 digital to analog converters at a maximum voltage change rate of 30 volts/sec. In addition, while accomplishing the preceding tasks, the computer, by the means of the CRT display, must be capable of presenting any of the acquired data in a variety of display formats including historical data, graphical data and alpha-numeric listings. The interactive display will be used to select or modify the parameters being monitored and actions being taken to the external environment. The computer must also be capable of interrupt control,

allowing it to stop taking the high speed biological measurements long enough to sample the output of a gas analyzer for instance. It must be capable of accepting up to 16 of these devices serviced at a maximum rate of 1 device/sec. This data will also be available for display along with standard displays and the computer must also be able to identify an unknown compound by comparing the data from a mass spectrometer with stored data on known compounds.

Finally, the computer must be completely self starting, have rapid access disc storage and an interface to the space station data management system of the maximum payload.

Hardware Status

Most of the current group of "mini" computers with a maximum of hardware options could handle this task. For the data processing speed, accuracy and data thruput a 16 bit 16,000 word main memory machine of microsecond cycle time would be sufficient. In addition, such hardware as programable gain 12 bit analog to digital converters with lo-level multiplexers, direct memory access capability, a flexible interrupt structure, single bit set and sense line capability of up to 64 lines each, a disc storage system capable of 5 million words of storage, a magnetic tape data storage system and an interface to various input/output devices such as interactive displays, plotters, listers and to the space station data management system.

Technical Description

1.	Size	17"W, 72" H, 24" D
2.	Weight	200 lbs.
3.	Power	5000 Watts (approx.)

Cost

Estimated at:	$300,000 - $500,000
Development Time:	3-5 Years

Comments.

The cost, power consumption and size would be reduced by programming to eliminate recording of the data if it has not deviated from some prescribed tolerance. (Save last 10 minutes of data; compare; eliminate if "within limits). The "off the shelf" ruggedized computer and peripherals would have to have a 28 VDC power supply modification. If the IMBLMS computer system under current development is available, then this system or a derivitive of it, would be used to accomplish this task.

#51D EXPERIMENTER'S CONTROL CONSOLE

Purpose:

To provide an operator's control console for biomedical/MSI experiments.

Requirements:

1. Provide the operator with the necessary experiment control functions, for example, provide the capability to set and change experimental conditions (stimulus type, sequence, presentation time, etc. response type, etc.) prior to or during the experiment as necessary.

2. Provide the capability to monitor the safety of the test subject.

3. Provide the capability to monitor recorded data, etc.

Hardware Status:

IMBIMS equipment may be adaptable to fulfill the requirements.

Technical Description:

Estimated values:

Weight: 100 pounds

Volume: 6 cubic feet

Power: 100 watts

Cost:

Development Cost: $150K

Unit Cost: $50K

Development Time:

Approximately 2 years

#52 CELL COUNTER

Purpose

The purpose of this unit is to measure the blood cell properties of blood samples placed in the unit. It is essentially a Coulter Counter.

Requirements

No specific requirements are available. The unit would be similar to, or a modified (0-g) version of a Coulter Counter. This unit will measure 7 basic parameters of blood. These are: hemoglobin, hematocrit, red blood cell count, white blood cell count, mean cell volume, mean cell hemoglobin, and mean cell hemoglobin concentration. The reproducibility is within 1%.

Hardware Status

Commercial units are available. These units employ various reagents and electrochemical processes for the blood analysis. Due to the liquid/gas handling problems, it is anticipated that modifications would be required for 0-g operation. Both an automatic Coulter Counter (Model S) and simpler manual versions are available. The large automatic unit is designed for rapid analysis of many samples. This would not be required of a flight research version, and appropriate design modifications would be made, or the simpler manual units would be used.

Technical Description

Preliminary estimates of manual flight unit:

Weight = 20 lbs

Volume = 2 ft^3

Power = 40 watts

Cost

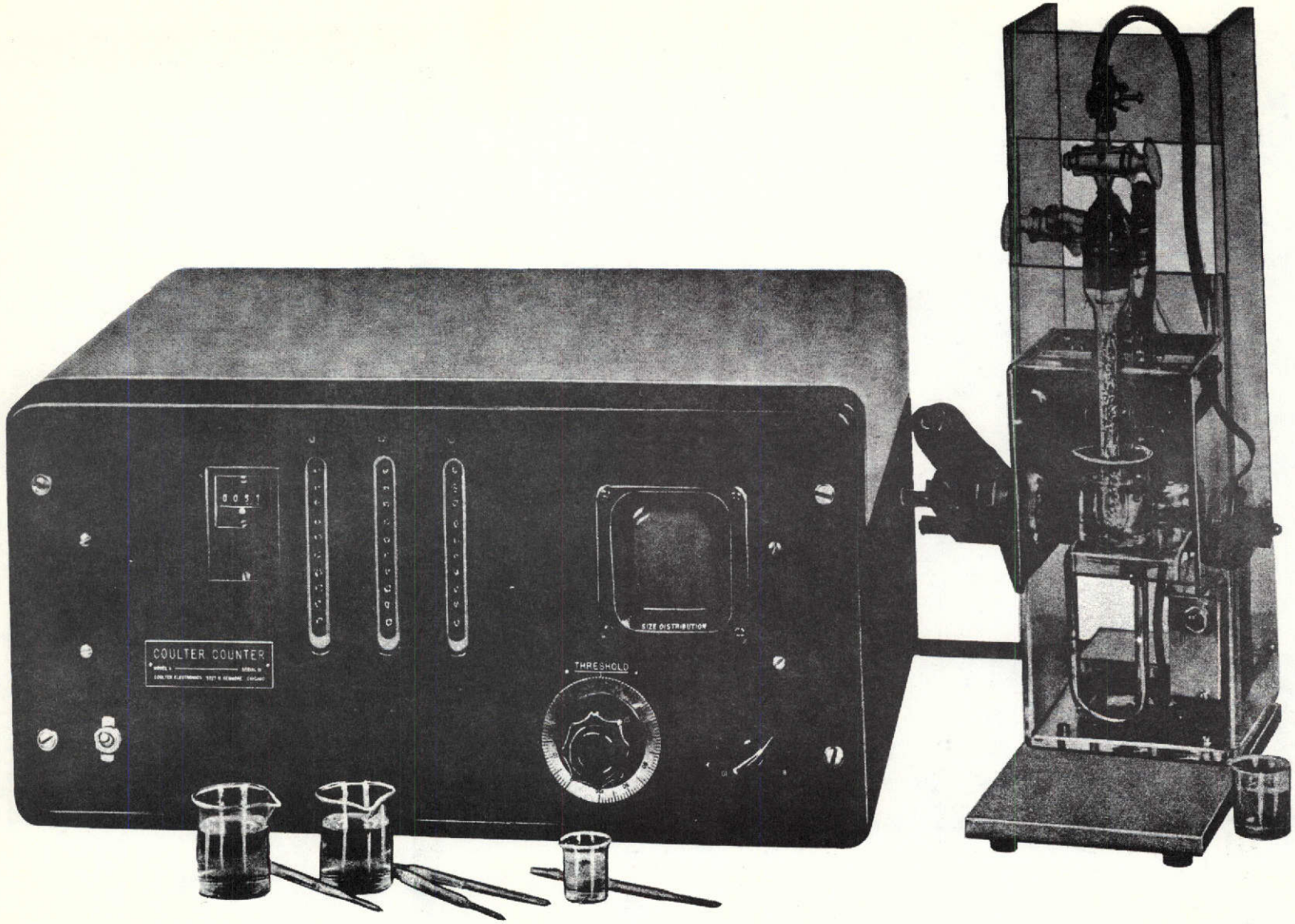
Preliminary estimates are:

$200 K - development

$ 30 K - unit

Development Time

One to two years



Simplified Manual Coulter Counter

COULTER COUNTER® MODEL S

A Major Advance
in Automated Blood Analysis.

In the field of hematology, automation is not new. But, in the field of automation devoted to hematology, there *is* something new.

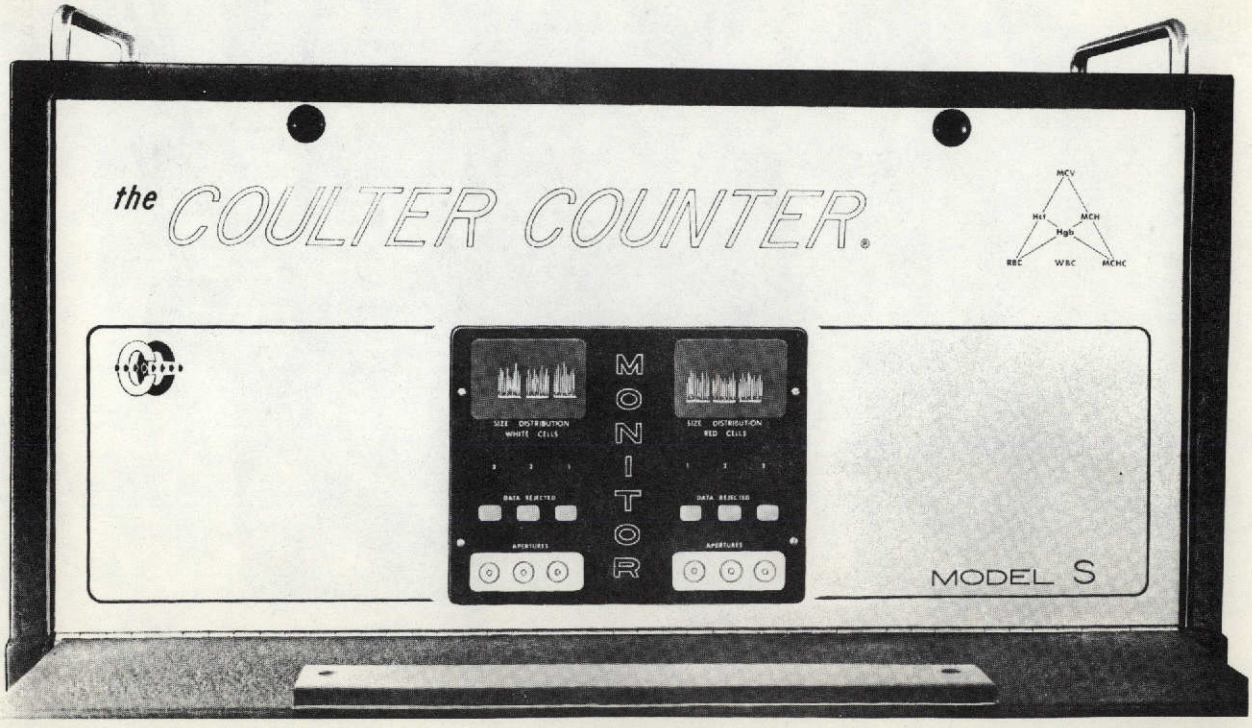
It is the *Coulter Counter/Model S,* a significant contribution to the ever-growing need for automated hematology procedures *that are absolutely reliable and admit of no human error in judgment or interpretation.*

Utilizing the world-renowned Coulter non-optic principle of one-by-one counting and sizing with an automatic discrete volume diluting system, the *Coulter Counter* now makes it possible for hematology laboratories of even the largest hospitals to cope with the necessity for swift, sure, complete and comprehensive analysis of 7 basic blood parameters: Hemoglobin, Hematocrit, Red Blood Cell Count, White Blood Cell Count, Mean Cell Volume, Mean Cell Hemoglobin, and Mean Cell Hemoglobin Concentration.

With a single unit, it is possible to make over 1,000 hematology determinations per hour, 24 hours per day, with better than 1% reproducibility.

Accuracy Paramount

Important though speed may be, it is perhaps unnecessary to point out that accuracy of results must take precedence. The *Coulter Counter* assures accuracy. Absolute accuracy. Accuracy not only in methodology, but in total elimination of operator error in misreading or mis-interpreting results.



From the standpoint of methodology, the *Coulter Counter*® is unique. In addition to the non-optic Coulter principal, the hemaglobinometer blanks before each determination using the same solution and glassware as the sample. There can be no question of accuracy. This methodology with a self-blanking photometer minimizes debris, and eliminates frequent calibrations and inaccuracies due to variations in reagent density and to dirty glassware.

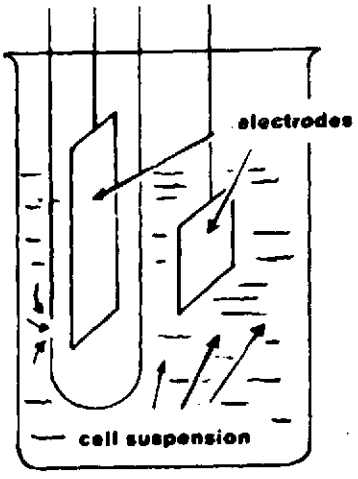
From the standpoint of operator-error, the *Coulter Counter* provides a clear, constant, centrally and strategically located system of monitors. These instruments are designed to detect instantly the presence of debris, less-than-optimum mechanical and electrical performance, or to signal a malfunction and identify its cause.

Human Error Minimized

Beyond the point of operational monitoring, however, the *Coulter Counter* minimizes human error in "reading" results. Findings are reported in a precise digital form that allows no margin for interpretative error. The results are printed in numerical language, *not graphical*. There is no need for the operator to interpret a chart or graph. Normal values are immediately adjacent to the printed results for instant, accurate comparison. Findings are reported in simple card form or may be fed into a remote computer.

In essence, then, the *Coulter Counter* gives you the speed of automated hematology analysis at the rate of four samples per minute. It also gives you the *accuracy* of a unit into which has been built a system of checks and balances that assures virtually infallible results.

COULTER THEORY AND PRINCIPLE



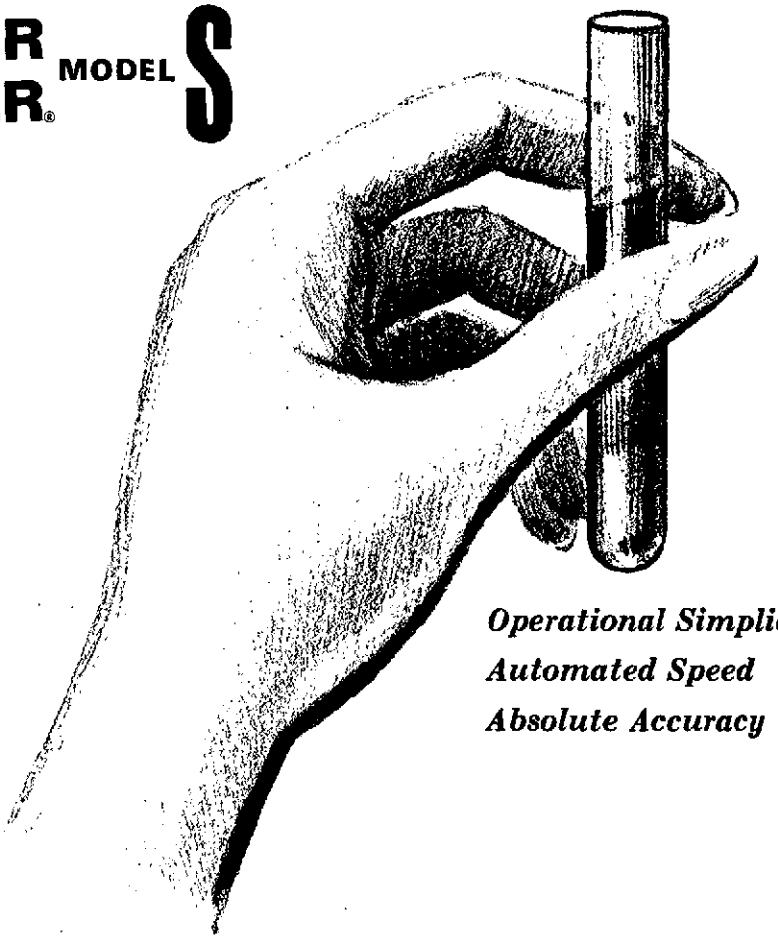
Operation is based on electrical differences between all blood cells and common diluents. Blood cells are poor conductors, diluents good electrical conductors.

A An electrode in the sample beaker and one in the orifice tube cause an electric current to flow through the orifice.

B An individual cell as it is carried through the orifice displaces some of the fluid to raise the electrical impedance of the orifice contents. Impedance increase produces an electrical pulse of short duration which has an amplitude proportional to cell size.

C Pulses are amplified and displayed on the oscilloscope screen as distinct vertical "spikes." Relative cell size is indicated by relative height of the spikes. Pulses are also fed to a threshold circuit allowing selection of a level which if reached by a pulse causes the pulse to be counted. Threshold level is indicated by a brightening of pulse segments above the threshold level.

COULTER COUNTER® MODEL S



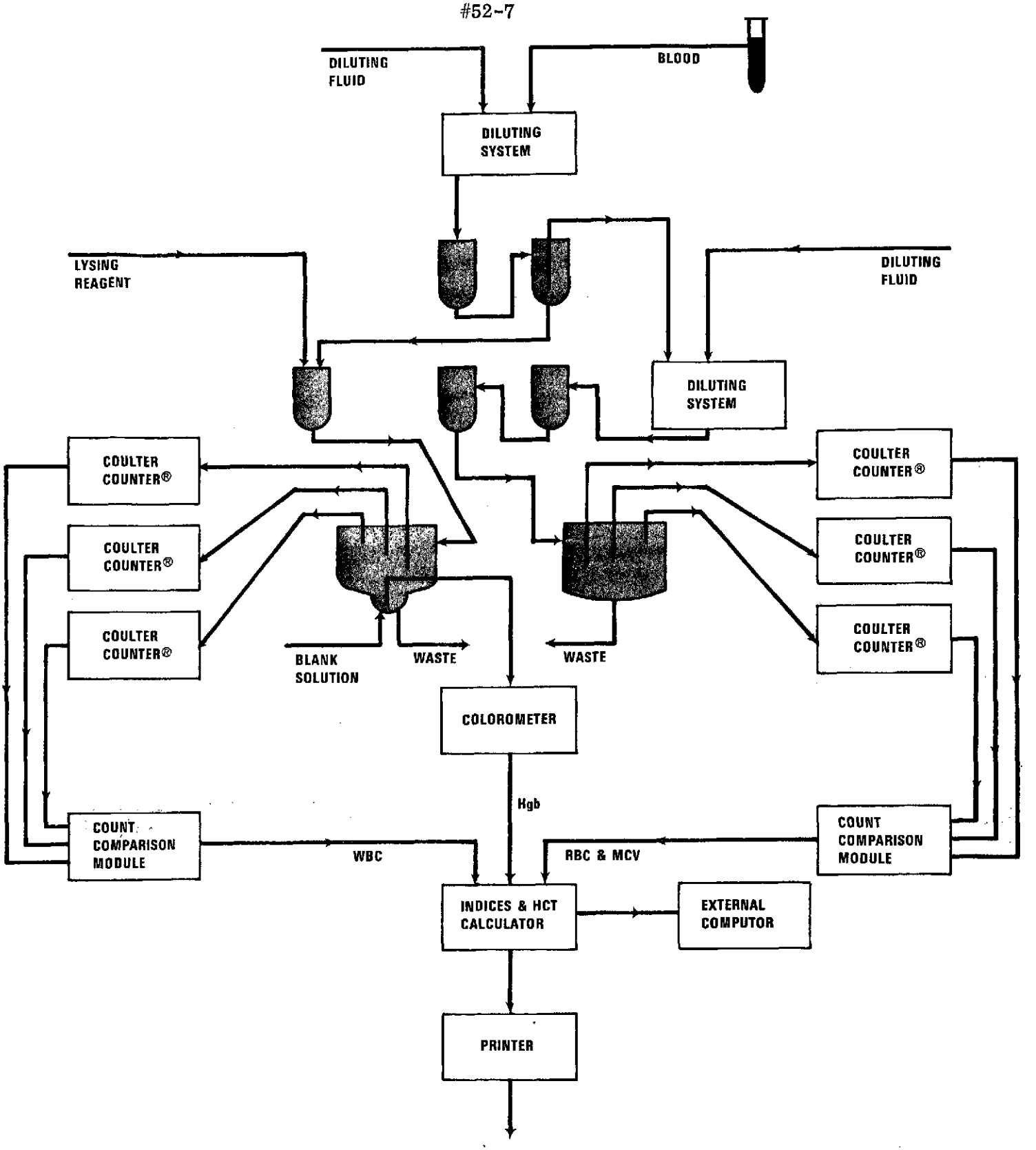
Operational Simplicity
Automated Speed
Absolute Accuracy

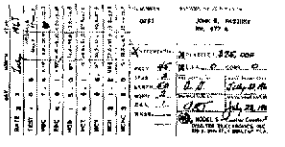
SIMPLIFIED OPERATION

In operational simplicity, the Coulter Counter is unequalled.

Comfortably seated in front of the *Coulter Counter* control console, the operator merely places a sample of blood under the aspirator tip. With the same hand, she gently depresses the touch control. Approximately 1 cc. of anti-coagulated blood is drawn into the system. From that point on, all dilutions and analyses are performed automatically.

Results of all seven blood parameters are available in printed numerical form in a matter of seconds.



Flow diagram of the Coulter Counter® Model S,  depicting the transition of whole blood to patient print out.

AUTOMATED SPEED

The complete 7-parameter analysis is accomplished in 15 seconds from a 40 lambda sample of blood. Samples can be introduced into the system at the rate of four per minute and swiftly analyzed as to hemoglobin, hematocrit, red blood cell count, white blood cell count, mean cell volume, mean cell hemoglobin, and mean cell hemoglobin concentration.

Thus, it is entirely possible to make more than 1,000 determinations per hour with clearly understandable, printed numerical results.

CAPILLARY BLOOD

An important feature of the *Coulter Counter* is the system's ability to handle capillary blood. As little as 40 lambda capillary blood may be pre-diluted and introduced into the first mixing chamber for complete analysis. Blood obtained from a finger-stick can be diluted, introduced and analyzed with equal speed and efficiency. In this way venipuncture is not always required.

ABSOLUTE ACCURACY

The *Coulter Counter* is designed to provide consistently accurate readings in a clear and concise printed form.

The possibility of error – in judgment or interpretation – has been virtually eliminated. And a system of internal/external checks and balances assures both operational efficiency and demonstrably accurate readings.

RBC and WBC counts are performed in triplicate and the average of the three counts recorded. Should one count fail to be in agreement with the other two counts, it is rejected and the two remaining counts are averaged. Should all three counts be in disagreement, a stop system alarm is actuated to alert the operator to a possible malfunction.

The monitoring system at the control console of the *Coulter Counter* also provides the operator with visual checks on electrical and mechanical performance. These include:

1) Projected aperture images providing a constant visual check for debris.
2) Oscilloscope display for monitoring both mechanical and electrical performance.
3) Signals to alert the operator to a malfunction and to pinpoint the aperture or component.

ADDITIONAL SAFEGUARDS

Additional safeguards are built into the *Coulter Counter* to assure operational efficiency and accuracy of results.

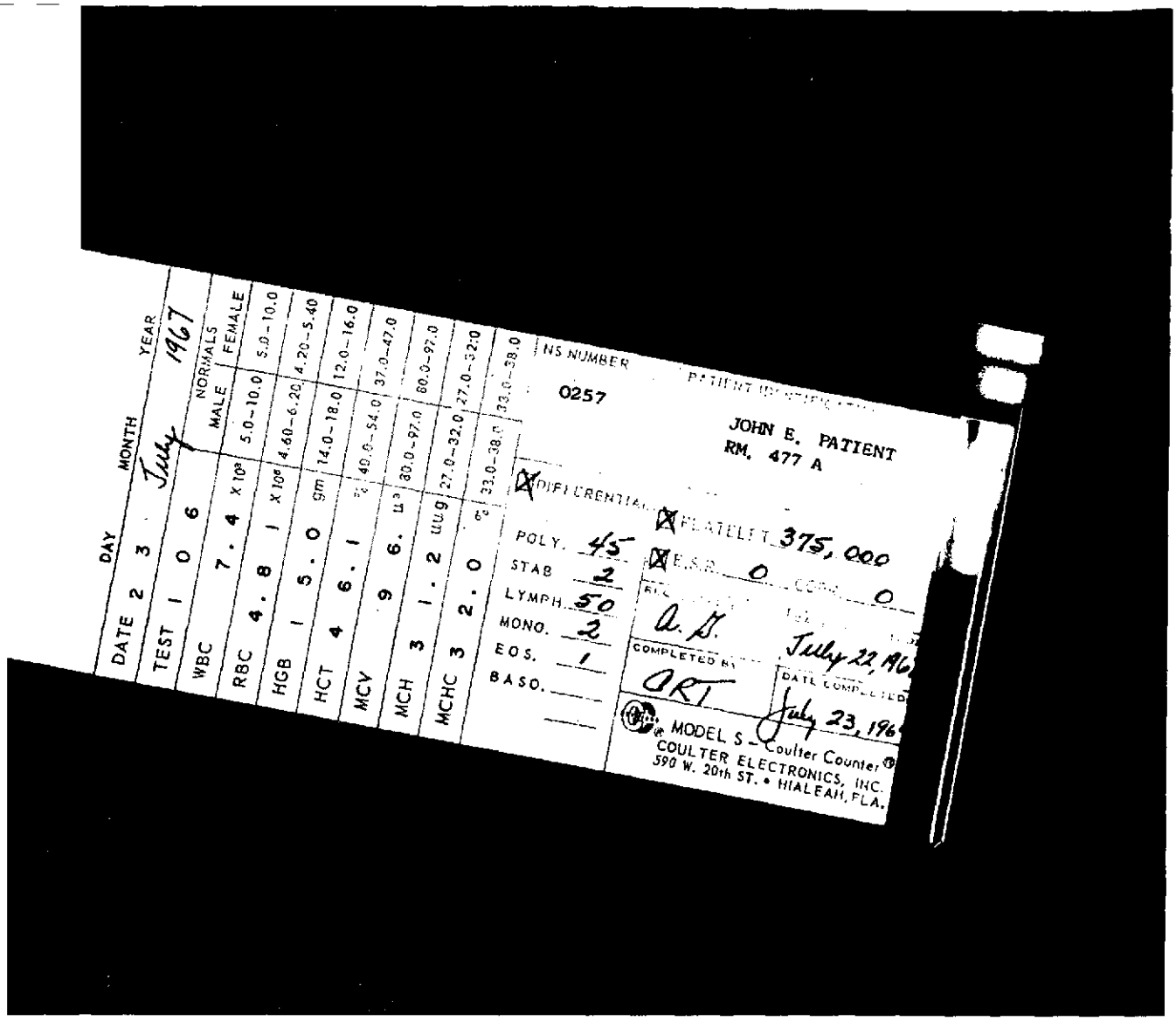
The entire dilution system, for example, is visible to the operator as a constant performance checkpoint.

In case of debris, the system is equipped with a back pressure arrangement designed to "unblock" apertures.

A .005% pulse generator is included which can be utilized to check the entire system for stability and overall accuracy.

Dual printers are provided. Should one printer become defective, the remaining printer will continue to operate.

Electrical and mechanical components are placed on convenient plug-in boards for quick and easy replacement. Indicator lights consistently monitor control functions and test points are available to facilitate trouble shooting if needed. Maintenance is simple and minimum.



The unique *Coulter Counter* digital readout method significantly minimizes confusion, improper judgment or mistaken interpretation of results. Findings are reported in printed *numerical* form with normal values listed for appraisal. There is no need for the operator to interpret the wavering lines of a graph. Results are clear, concise and complete.

COULTER COUNTER® MODEL S

Superior Performance in Automated Hematology Procedures

The advantages of the Coulter Counter over conventional hematology procedures are manifold. We suggest that you utilize this page as a check list of the unit's performance edge.

Unit employs the exclusive Coulter non-optic principle of one-by-one counting and sizing and an automatic discrete volume diluting system.

Blood is automatically aspirated directly from blood collection tubes. No intermediate containers or operations needed.

Complete 7-parameter analysis is accomplished in seconds. Introduction of stat samples is accomplished easily. Actually, *every sample is a STAT.*

Glassware is automatically flushed with clean solution between samples. Virtually no carryover.

Pre-diluted capillary blood can be analyzed with equal efficiency.

Operational speed and automatic numbering eliminates confusion between samples. Integrity of individual samples is protected at all times.

Accurate and reproducible dilutions. Recalibration rarely needed.

Triplicate counting automatically rejects invalid counts. Warning signals alert operator to malfunction and identify cause.

Compact and fully transistorized. Occupies approximately 36″ of bench space, with storage space below.

All components are easily removable, simple to test. Indicator light system monitors control functions and test points. Plug-in control boards simplify exchange of components.

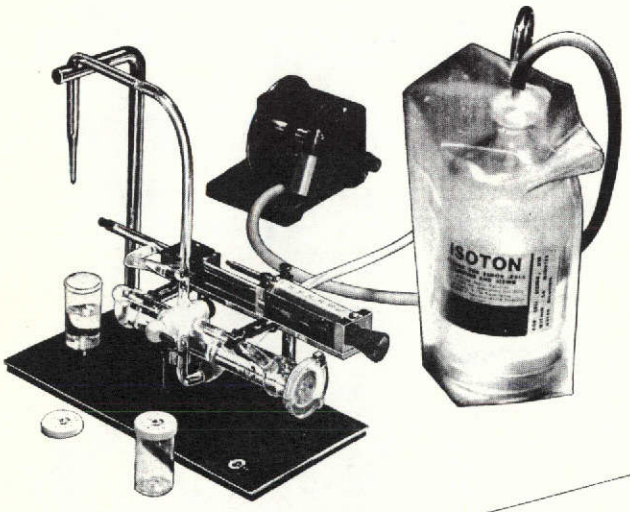
Dual printers operate independently. Should one fail, the other will continue to function.

Virtually unaffected by electrical or RF-type interference. Maximum filtering and shielding.

Coulter Electronics developments expand your diagnostic capabilities while simplifying handling

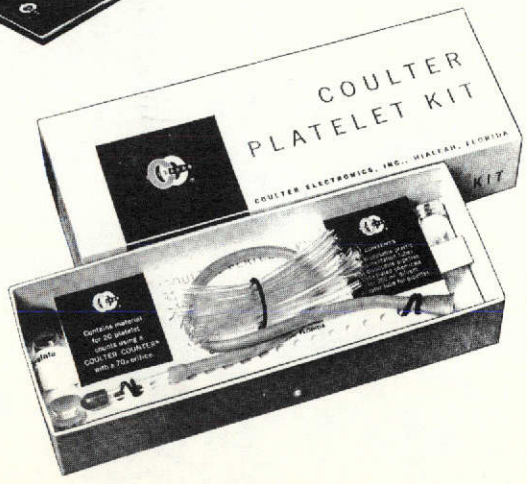
ZAPonin Red Cell Lysing Reagent
For white blood cell counts. Simple (3 drops from the plastic dropper-bottle) and stable.

Isoton
Particle free diluent for blood cell counting and sizing.



the Dual Diluter
Offers 2 selected dilution ratios with a simple "flick-of-the-wrist" operation. In calibrations from 0 to 100λ for 5 ml. diluent; 0 to 100λ for 10 ml. diluent; 0 to 250λ for 20 ml. diluent.

U. S. Patent No. 3,138,290 3,138,294



the Coulter Platelet Kit
Used with the Coulter Counter to provide 20 highly accurate platelet tests per kit. Disposable, ready-to-use, no eye strain, easy to do.

COULTER ELECTRONICS, INC.

590 West 20th Street / Hialeah, Florida 33010

#53 AUTOMATIC COLONY COUNTER

Purpose

To determine the number of viable colonies growing on an auger substrate.

Requirements

Must be able to count the number of colonies growing on an auger substrate without confusion between overlapping colonies.

Hardware Status

Current models are not capable of distinguishing between overlapping colonies. Manual methods are preferred until this deficiency can be corrected.

Technical Description

Flight Unit - preliminary estimate

Weight	10 lbs
Power	20 watts
Volume	1 cubic foot

Cost

Development	$50K
Unit	$10K

Development Time

2 years

#054 BACTERIAL COLONY COUNTER

Purpose

For use in the manual counting of bacterial colonies.

Requirements

Standard colony magnifier/counter.

Hardware Status

Commercial units are available which should be applicable to space use with minor midifications to accept spacecraft power supply in lieu of 115 volt 60 Hz in the commercial unit.

Reference (a) Quebec Colony Counter, Darkfield Illumination APHA, Americal Optical No. 3330.

Technical Description

The unit consists of a 10"x11"x10" box with 50 watt bulb inside, which illuminates a plate which is viewed through a magnifying glass.

Weight	$\approx$ 3 lbs
Power	50 watts
Volume	.6 ft^3 (10"x11"x10")

Cost

$115 per catalog (Scientific Products).

10K DEVELOPMENT

2K UNIT

Development Time

Six months.

#55A CREW MOBILITY AIDS

Purpose

To allow the crew to move with or without cargo from one point to another while maintaining control of their rate, direction, and distance of travel and their body orientation.

Requirements

Mobility aids should enhance crew mobility so that minimum crew time and energy are diverted from the experimental operations for mobility operations.

Hardware Status

The mobility aids discussed below have been recommended[1] for use during short range (intracompartment) and medium range (intercompartment) transfers:

a. Handrails. Rails with a rectangular or oval cross-section set off from the surface at least two inches. Parallel rails provide better control than the single handrail, although both are adequate. Development status - fully developed and flight qualified on Gemini and Apollo.

b. Handholds. One-half to 1-1/2 inches in diameter and 4-1/2 inches inside width with a 2-inch clearance from surrounding surfaces. Can be either recessed or protruding. Recessed type is a better mobility aid, as it presents minimum potential for interference of movement. Development status - fully developed and flight qualified on Gemini and Apollo.

c. Magnetic "Shuffler" Shoe. The shoe consists of a fabric foot cover in a loafer design, with permanent magnets embedded in the ball and heel areas of the sole. A strap with D-ring arrangement is attached to the shoe and routed over the instep to permit lifting the heel magnet from the floor. A low coefficient of friction material (Teflon) covers the ball of the foot and a high coefficient of friction material (Viton) covers the heel and toe. The shoe requires a 0.030 inch ferrous floor. Development status -

ground tested in neutral buoyancy tank and on air-bearing zero-g simulators. Flight evaluated in KC-135 zero-g. Requires further development before flight qualification.

d. Suction Shoes. The shoe incorporates suction diaphragms are activated by placing the shoe on a surface (of undetermined smoothness) and twisting the foot. This action operates a large-pitch screw mechanism to draw a vacuum between the diaphragm and the floor. As the shoe twists, the suction cup remains in a fixed position on the floor. By returning the foot to the normal position, the vacuum can be eliminated. Development status - untested. Concept development estimated at six months to one year.

e. Linear Induction Mobile Handhold. This handhold is attached to a linear induction motor and is propelled along a railing which provides electrical power, directional guidance, and acts as the armature of the induction motor. A three-position switch (forward, off, reverse) controls the motor, is integral with the handhold, and is operated with the thumb. Development status - untested. Estimated development time is one year.

f. Rigid, Spring-Loaded Waist Tether. A rigid tether is connected to a handrail mounted slide and a belt worn by the user. The slide assembly/rigid tether connection is spring loaded to exert a downward force on the tether providing a gravity substitute force enabling near normal walking by the user. In instances where hands-free mobility is not required, grasping the rigid tetner with one or both hands will provide the user with the capability of compression walking without having to physically complete the belt/tether connection. Development status - untested. Development time estimated to be 6 months to 1 year.

Technical Description

	Handrails	Handholds	Magnetic Shoes	Suction Shoes	Mobile Handhold	Rigid Waist Tether
Weight, lbs	.85/ft	.85	4.5/pr	2.0 pr	8.0 + 0.8/ft	7.5
Volume, ft^3	.005/ft	.005	0.03/pr	0.5 pr	0.6 + 0.25/ft	0.8
Power, watts	---	---	---	---	500	---

Cost - DEVELOPMENT 50K
UNIT 1K

Comments

See merits, deficiencies, and concept sketches on attached sheets. Reference: 1 Mobility and Restraint Handbook, Contract NAS9-10456, August 1970. Directional Free Floating (Soaring), while not requiring mobility aids except at the terminal point, should not be overlooked as an effective mobility mode.

HANDRAILS

DESCRIPTION: Handrails with a rectangular or oval cross-section were evaluated as excellent mobility aids for Gemini and Apollo. It was determined that these rails should be set off from the surface at least two inches to permit ease of use. They may run the entire length of travel desired or may be in sections. They also offer good purchase for temporary restraint. The parallel handrails as shown provide much better control than the single handrail, although the single rail is adequate.

SOURCE: Lockheed Missiles and Space Corporation
Crew Systems Status Report #CS-1, 4/18/69

TESTING: Qualified - Used on Gemini and Apollo

HANDHOLDS

DESCRIPTION: Handholds can be either recessed or protruding depending on use intended. For mobility, the recessed type would be better since they don't present "elbow knockers". For restraint, the protruding type would probably afford a better purchase and are excellent temporary restraints. The protruding type is usually $\frac{1}{2}$ to $1\frac{1}{2}$ inches in diameter and $4\frac{1}{2}$ inches inside width, set off the surface at least 2 inches.

SOURCE: Lockheed Missiles and Space Corporation
Crew Systems Status Report #CS-1, 4/18/69

TESTING: Qualified in flight on Gemini and Apollo

Merits	Deficiencies
o Requires no electrical power	o Requires use of one or both hands
o Light weight	
o Durable	o Difficult to manage large packages
o Reliable	
o Simple	o Structural interface with vehicle - should be incorporated in vehicle design
o Maintenance Free	
o Applicable at all levels of gravity	
o Positive control	

Handrails and handholds have been fully developed and flight qualified during the Gemini and Apollo programs. Handrails have proven to be the most simple and effective method of zero gravity translation across a surface.

Handrails and handholds provide excellent temporary restraint for transition to a hands free restraint system. They also provide ready made attach points for tethers, and can be used for stability aids throughout the vehicle.

MAGNETIC "SHUFFLER" SHOE

DESCRIPTION: This concept uses a shuffling technique (sliding one foot forward on a low coefficient of friction surface) maintaining constant contact with the floor. The propelling force will originate from the high coefficient of friction surface in the heel area of the foot. The low coefficient of friction and high coefficient of friction materials are Teflon and Viton, respectively. The use of these materials in conjunction with the distributed attractive force not only provides the user with stability in shuffling and performing tasks, but allows easy separation from the floor when free float is desired.

The shoe consists of a fabric upper part in a loafer design, with the magnets imbedded in the sole and heel portions. A strap with D-ring arrangement is attached to the shoe and routed over the instep to permit lifting the heel magnet from the floor.

SOURCE: Martin Marietta Corporation (NASA Contract #NAS-9-9336)

TESTING: Ground tested in neutral buoyancy tank and on air bearing zero-g simulator. Flight evaluation in KC-135 zero-g.

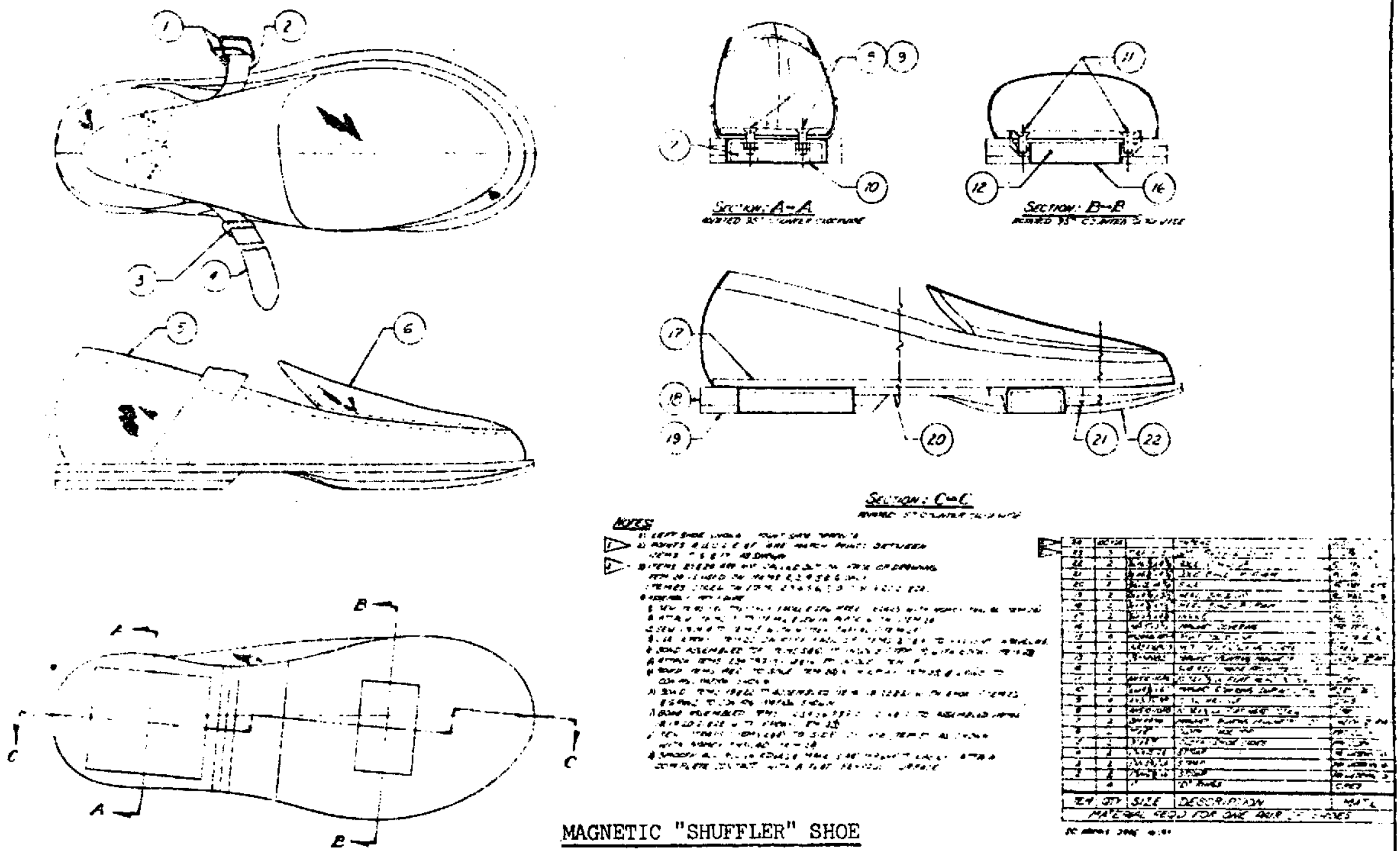
Merits	Deficiencies
o No electrical power requirements	o Soft iron floor is an integral part of restraint system - excessive weight penalty for other than limited application
o Footwear can be worn in artificial gravity environment and serve as primary footgear	o Incorporation of this concept would require shielding of instrumentation and displays, complicating construction pre-launch and onboard checkout of vehicle
	o Requires individual issue to each crewman

The magnetic shoe(shuffler) developed under NAS 9-9336 would require periodic spray application of Teflon to the sliding surface of the footwear. Initial test evaluation on KC-135 zero gravity flight number 3/3/70A-015Z determined:

1. In the opinion of the test subject, the "shuffling" method of walking was quite unnatural and required constant attention on his part.
2. Practical application would be limited to work stations which require limited amount of translation by the operator.

The use of this concept would also be limited by the high weight penalty imposed by the requirement for iron flooring.

This concept, if it is to be considered at any time, requires more development to overcome some inherent problems such as fit to crewmen, and the attractive force of the magnets.



MAGNETIC "SHUFFLER" SHOE

Ref: Final Report - Analysis/Design and Prototype Construction of a selected Mobility and Restraint Device
Nov. 1969 Contract NAS 9-9336 Martin Marietta Corp. (MCR-69-507)

SUCTION SHOES

DESCRIPTION: This concept incorporates suction diaphragms on the soles of shoes. The suction diaphragms are activated by placing the shoe on a smooth surface and twisting the foot, which operates a large-pitch screw mechanism to draw the vacuum between the diaphragm and the floor. As the shoe twists, the suction cup remains in a fixed position on the floor. By returning the foot to the normal position, the vacuum can be eliminated.

This concept is primarily intended as a short duration restraint system with possible use as a short range mobility aid.

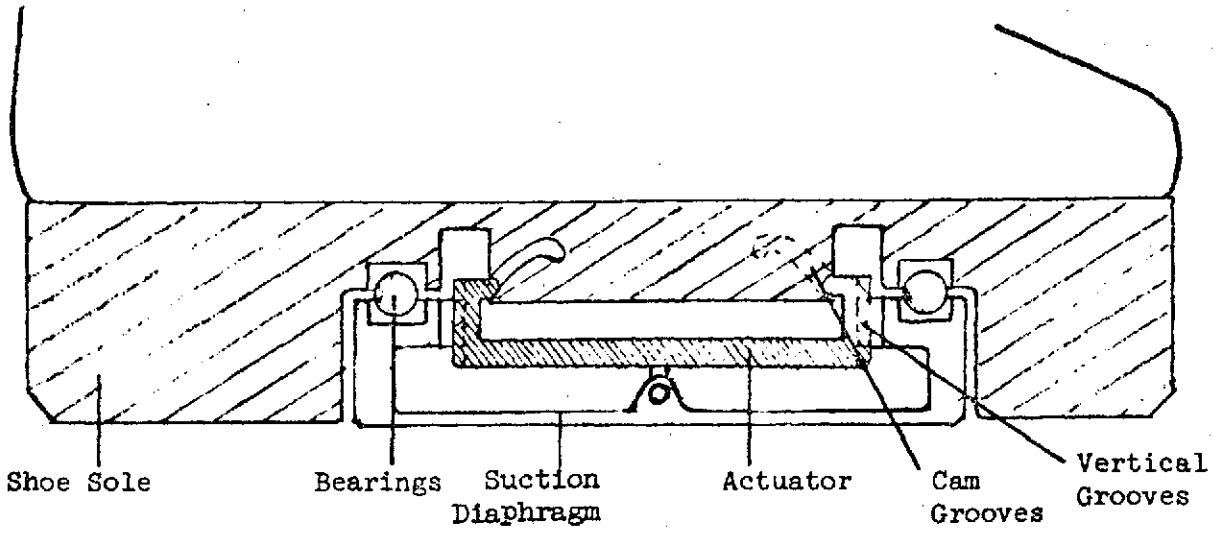
SOURCE: Grumman Aerospace Corporation

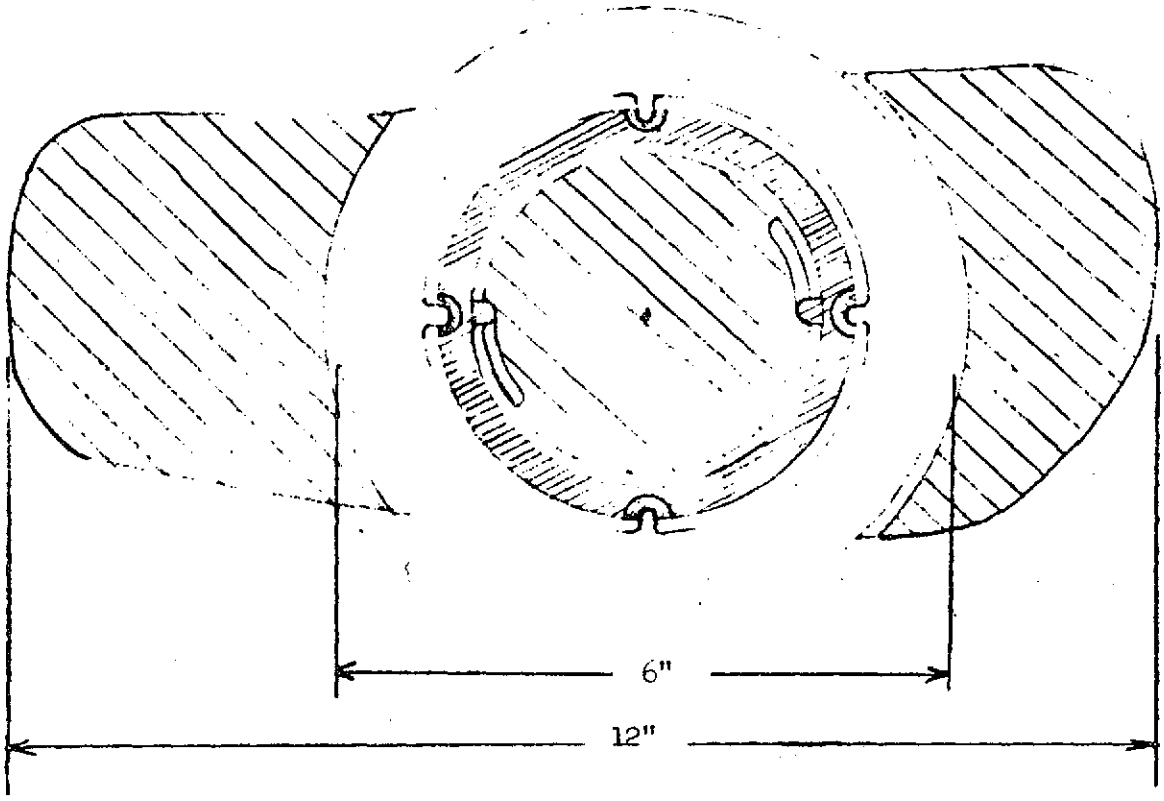
TESTING: None (New Concept)

Merits	Deficiencies
o Uses no electrical power	o Requires smooth, clean surface for proper function
o Simple to use	o Restraint duration dependent on leakage rate
o Restraining force derived from existing ambient pressure	o Restraint loss occurs without warning
o Broad applicability	o Maintenance required
o Primarily intended for short range mobility or restraint in zero gravity--may be worn in artificial g environment	o Footwear equipment requires individual assignment for fit and hygiene
o May be added at any time	o Requires temporary restraint for initial engagement
o Restraint of each foot provides redundancy	o Training required for proper foot movement

Reliability of the suction shoe would be inherently good based on mechanism simplicity. Maintenance would be limited to periodic suction diaphragm replacement. Concept development is estimated at six months to one year.

Requirements for floor smoothness compatible with use of suction shoes must be established by test. Smoothness requirements would determine the cost penalty incurred by implementation of this concept. A weight penalty is not anticipated.





SUCTION SHOES

LINEAR-INDUCTION MOBILE HANDHOLD

DESCRIPTION: This concept employs a linear induction motor with a handhold attached, to be propelled along a railing which provides electrical power, directional guidance, and also acts as the armature of the induction motor. A three position switch (forward, off, reverse) controls the motor, is integral with the handhold, and is operated with the thumb.

By grasping the handhold and activiating the switch, the person can propel himself in either direction along the rail.

SOURCE: Grumman Aerospace Corporation

TESTING: NONE (New Concept)

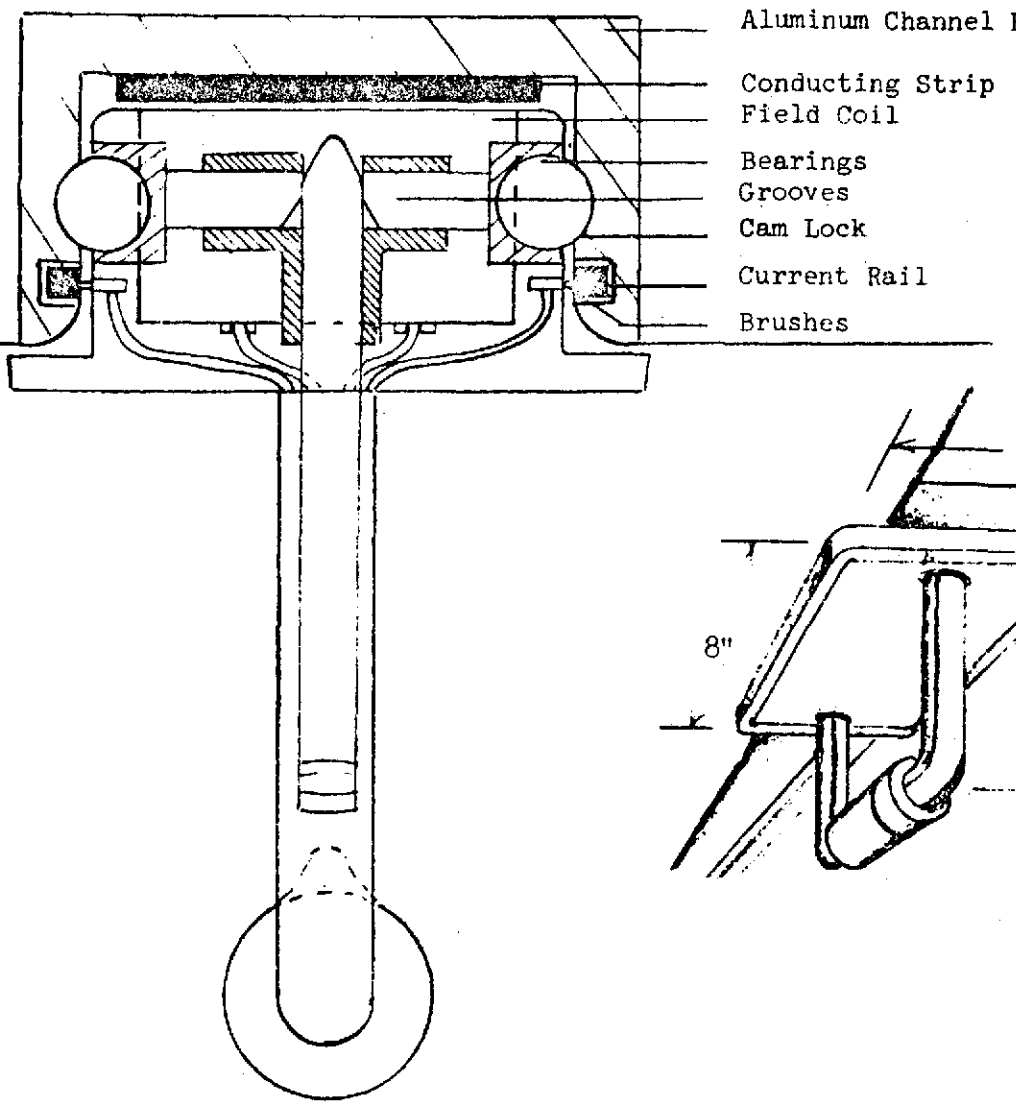
Merits	Deficiencies
o Positive control of direction and velocity	o Electrical power required
o Manual effort limited to holding on.	o Requires one hand to operate
o May be applied to equipment transport	o Electromagnetic field generated requires RFI shielding of instrumentation and communication systems
o Simplicity of operation	o Flexibility limited by rail system
	o Simultaneous two way traffic requires parallel system
	o Application should be incorporated in basic vehice design

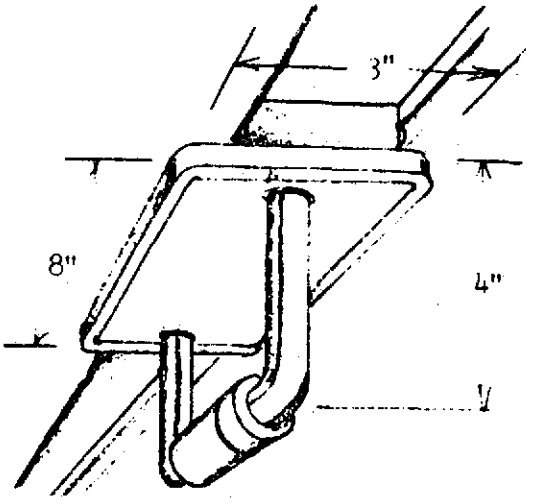
The linear induction mobile handhold is intended to provide inter-level, long range mobility in a zero gravity environment. Since the propulsion force of the handhold does not involve rotating parts, the system reliability would primarily be a function of the power source. It is expected maintenance would be limited to brush and slide bearing replacement or refurbishment.

Estimated development would require approximately one year.

The major shortcoming is that common to all rail or trolley systems. Simultaneous two way traffic requires either parallel systems or a switching arrangement, and would require relatively large turn radius, or separate unit for each new direction of travel.

As envisioned, handholds would be stowed at each boarding station in quantities designed to meet demands.





LINEAR INDUCTION MOBILE HANDHOLD

RIGID WAIST TETHER

DESCRIPTION: This concept consists of a telescoping, rigid tube affixed to the waist tether belt with a slide similar to that shown for the D-ring. The rigid tube has a ball-joint on the slide, permitting the tether to swivel at the user's waist. Once extended to the length desired, the collet clamp can be tightened by use of the nut, or the tension spring can be used to apply the required forces. This tether can be used in pairs with swiveling pip-pins which can be locked into receptacles anywhere in the spacecraft, or a rigid pin can be used to attach one tether to the slide assembly as a mobility aid.

SLIDE ASS'Y - RIGID TETHER

DESCRIPTION: The sketch shows the slide assembly intended for use with the Telescoping Rigid Tether and the Waist Tether Belt. The slide is attached to a standard handrail via spring loaded rollers and employs a tether attach point which is also spring loaded. The tether attach arm (pressure arm) applies a downward force to the user through the rigid tether, affording him the necessary traction to propel himself by walking. This slide, with minor modifications, could be arranged to accept a pallet for transporting equipment.

BELT - WAIST TETHER

DESCRIPTION: Shown here is the belt and attachment for waist tethers. The attachment pictured is a D-ring and slide, intended for use with the flexible tethers. The slide is just wide enough to prevent twisting on the belt. The user can position the D-ring slide at any point on the belt, thereby giving himself extra body twisting ability. This belt can be used for either the flexible or rigid waist tethers.

SOURCE: Grumman Aerospace Corporation

TESTING: None

Merits	Deficiencies
o No electrical power required	o Mobility range limited to handrail system
o Restraint system provides gravity substitute force enabling hands free mobility	o Simultaneous two way traffic requires parallel systems
o Can be used for transporting equipment	o Maintenance required
o Removable from handrail for stowage	o Tolerance critical to prevent binding

The Rigid Waist Tether employs a rigid tether connected to a handrail mounted slide and a belt worn by the user. The slide assembly/rigid tether connection is spring loaded to exert a downward force on the tether providing a gravity

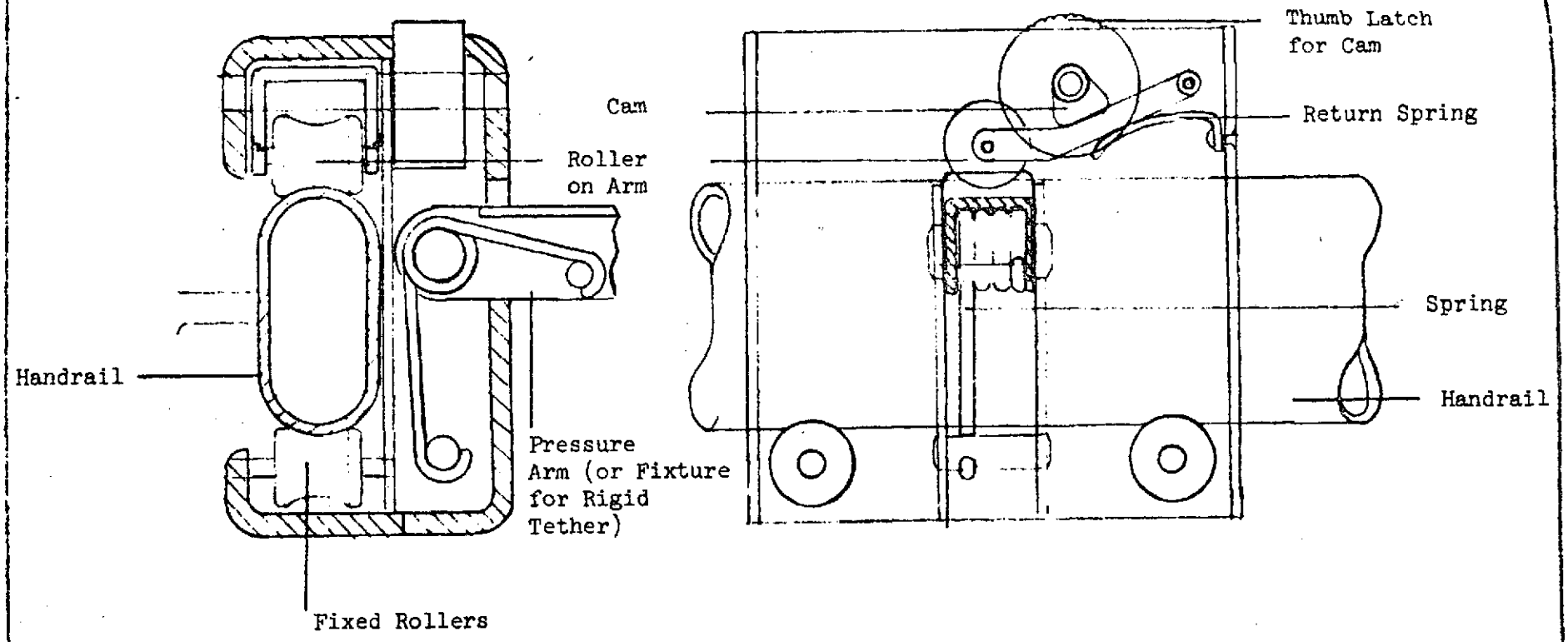
RIGID WAIST TETHER (CONT'D)

substitute force enabling near normal walking by the user.

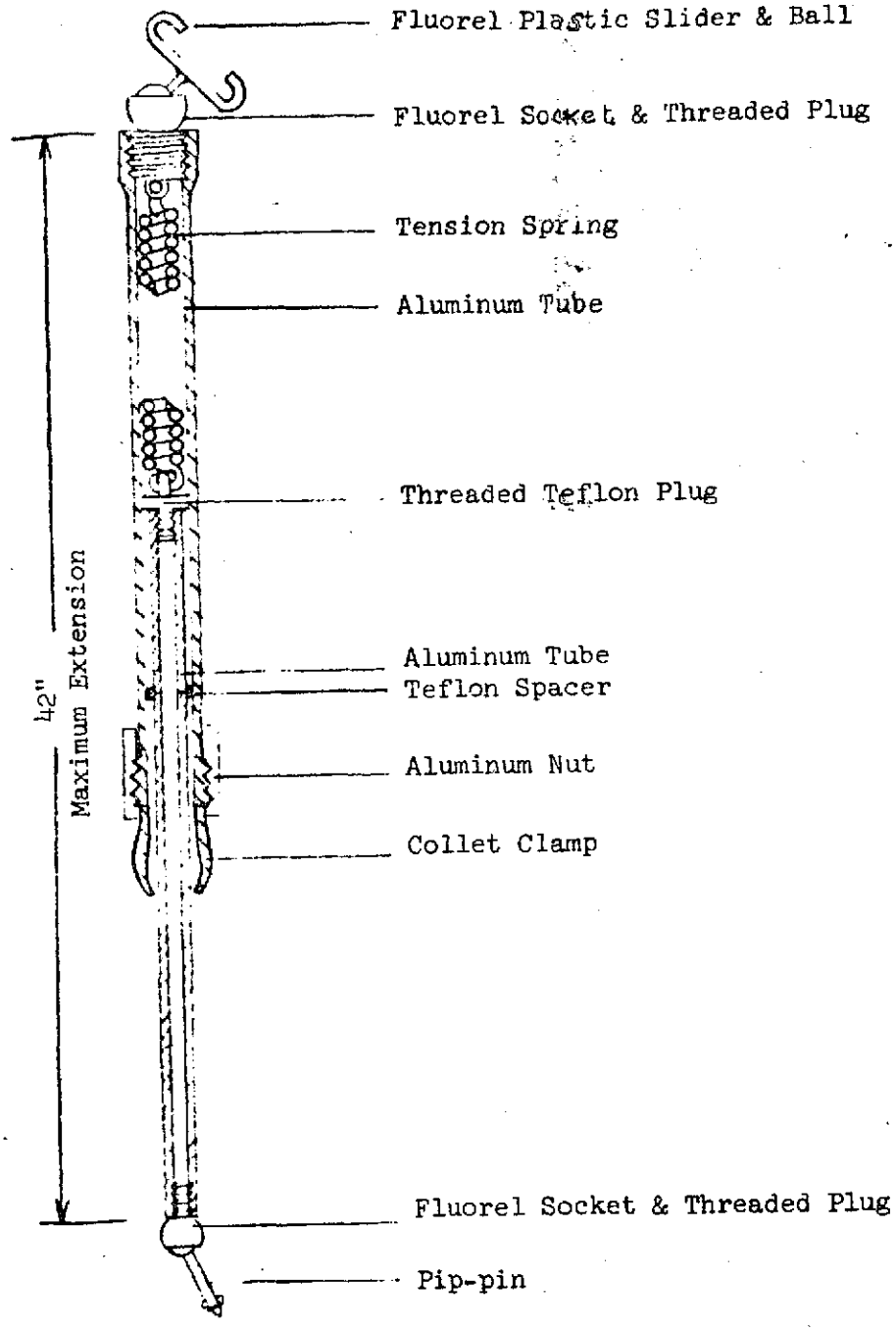
The simplicity of the design combined with periodic maintenance and inspection should insure a reliable system. Concept development would require an estimated six months to one year.

Application of the Rigid Tether is intended for zero gravity work stations where limited mobility is required, or for hands-free mobility in long passageways. In instances where hands-free mobility is not required, grasping the rigid tether with one or both hands will provide the user with the capability of compression walking without having to physically complete the belt/tether connection.

Rigid tethers can be used in zero gravity situations where it is necessary to maintain a location and position not allowing use of the flexible tether.



SLIDE ASSEMBLY - RIGID TETHER



RIGID WAIST TETHER

#55B CREW RESTRAINTS

Purpose

To provide the crew with the required degrees of restraint (task dependent) to allow effective and efficient task accomplishment or to work in conjunction with other restraint devices toward the same end.

Requirements

Crew restraints should allow effective experimental operations with a minimum of crew time and energy diverted to the restraint task. Mobility aids should enhance crew mobility so that minimum crew time and energy are diverted from the experimental operations for mobility operations.

Hardware Status

The restraints discussed below have been recommended[1] for use in laboratories and workshops:

a. Dutch Shoes. The shoes are two rigid shoe restraints, open at the top and sides, which can be fixed to any surface. Development status - fully developed and flight-qualified on Gemini.

b. Leg Rail. See Comments for description. Development status - untested. Development time - less than six months.

c. Flexible Waist Tethers. See Comments for description. Development status - untested, but related concept flight- qualified on Gemini.

d. Inflatable Mid-Torso. See Comments for description. Development status - untested. Development time estimated to be six months to one year.

The restraints discussed below have potential for application in the biolab:

e. Handholds. See Mobility Aid Spec.

f. Handrails. " " " "

g. Rigid Waist Tether. " " " "

h. Suction Shoes. See Mobility Aid Spec.

i. Magnetic Shoes. " " " "

j. Astro-Grid Shoes. See Comments for description. Development status - prototype-tested in neutral buoyancy tank and KC-135 zero-g flight. Will be flight evaluated aboard SKYLAB.

	Dutch Shoes	Leg Rail	Flexible Waist Tether	Inflatable Mid-Torso	Hand-Holds	Handrails	Rigid Waist Tethers	Suction Shoes	Magnetic Shoes	Astro Grip Shoes
Weight, lbs	12.1	1.0/ft	2.0	3.2	.85	.85/ft	7.5	2.0/pr	4.5/pr	2.4/pr
Volume, ft^3	0.7	0.2/ft	0.2	0.4	.005	.005/ft	0.8	0.5/pr	0.03/pr	0.03/pr
Power, watts	--	--	--	--	--	--	--	--	--	--

Cost -

DEVELOPMENT 50K
UNIT 1K

Comments

See description, merits, deficiencies, and concept sketches on attached sheets for a, b, c, d, and j. See Mobility Aid Spec (#55A) for same on e-i. Reference: 1 Mobility and Restraint Handbook, Contract NAS9-10456, August 1970.

FIXED FOOT RESTRAINT (DUTCH SHOES)

DESCRIPTION: The diagram shows a top view of two rigid shoe restraints which can be fixed to any surface. The user restrains himself by inserting his feet into the restraint and rotating the toes outward until both toes and heels are held under the rim of the restraint. He can then resist work forces through reaction points at his heels and toes.

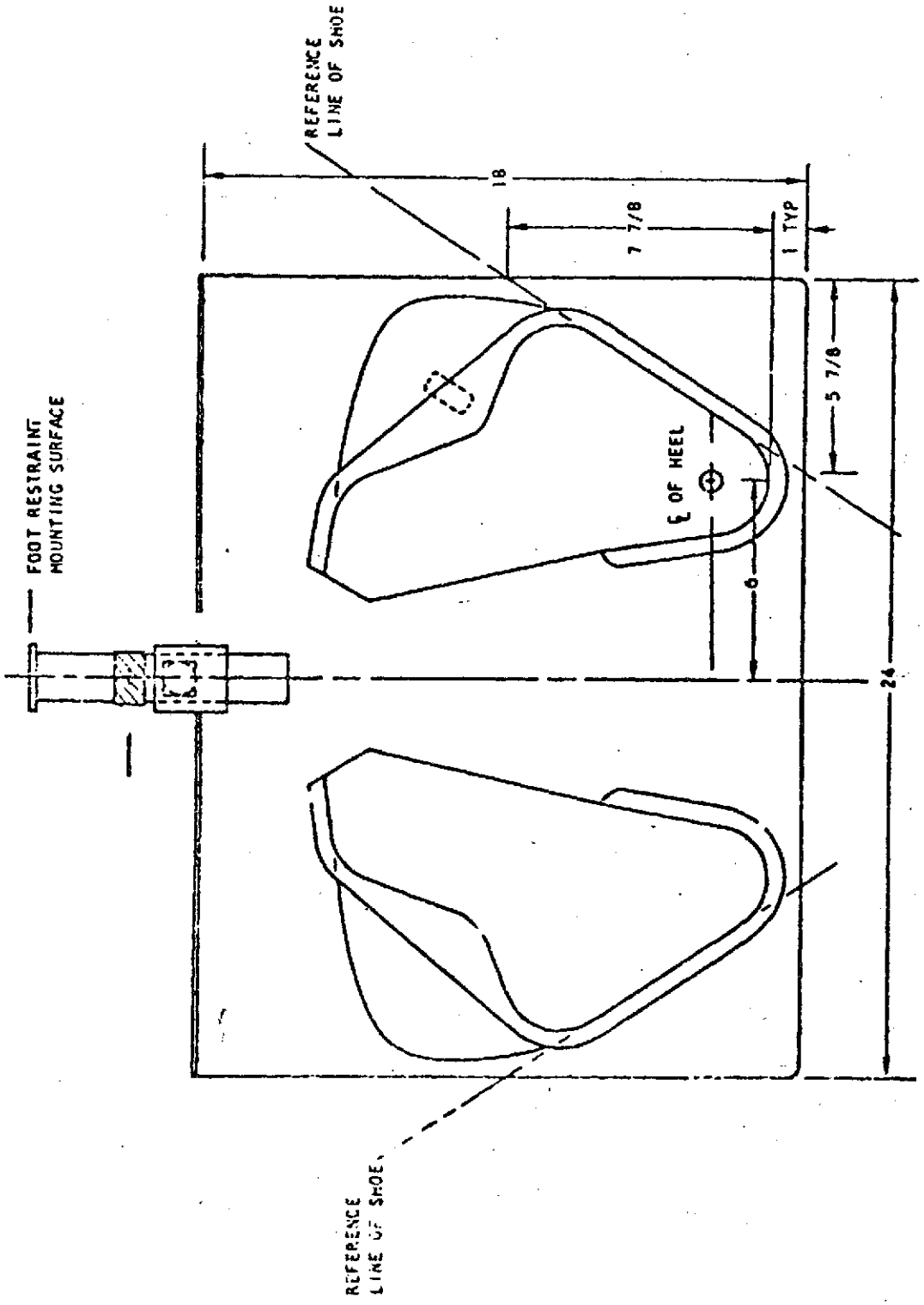
SOURCE: NASA Report #CR-1334, May 1969 "A Study of Astronaut's Work Capabilities in Weightless Conditions".

TESTING: Flown on Gemini 12 - fully developed and qualified.

Merits	Deficiencies
o Rapid entry and exit from restraint	o Mobility completely restricted
o Simplicity	o Structural interface with vehicle
o Qualified on Gemini and Apollo	o Requires conscious effort to retain restraint
o Excellent for work stations requiring high torque expenditure	o Handhold provision desirable for restraint entry

The Dutch Shoe restraint was fully developed and qualified for use on Gemini and Apollo flights. It was rated by the pilots as the best overall restraint for localized work in zero "g". This restraint can be used very effectively in conjunction with handholds or waist tethers. It may be permanently fixed in required locations or made portable, to be fastened in place only when required.

The simplicity of use and design make this restraint very reliable and maintenance free.



FIXED FOOT RESTRAINT (DUTCH SHOES)

LEG RAIL RESTRAINT

DESCRIPTION: The restraint apparatus consists of two rigid rails used in conjunction with outermost edge of control panels. With toes hooked under the bottom rail and knees over the top rail, the crew member can obtain three point restraint by employing slight body pressure on the edge of the console or work station.

SOURCE: Grumman Aerospace Corporation

TESTING: None (New Concept)

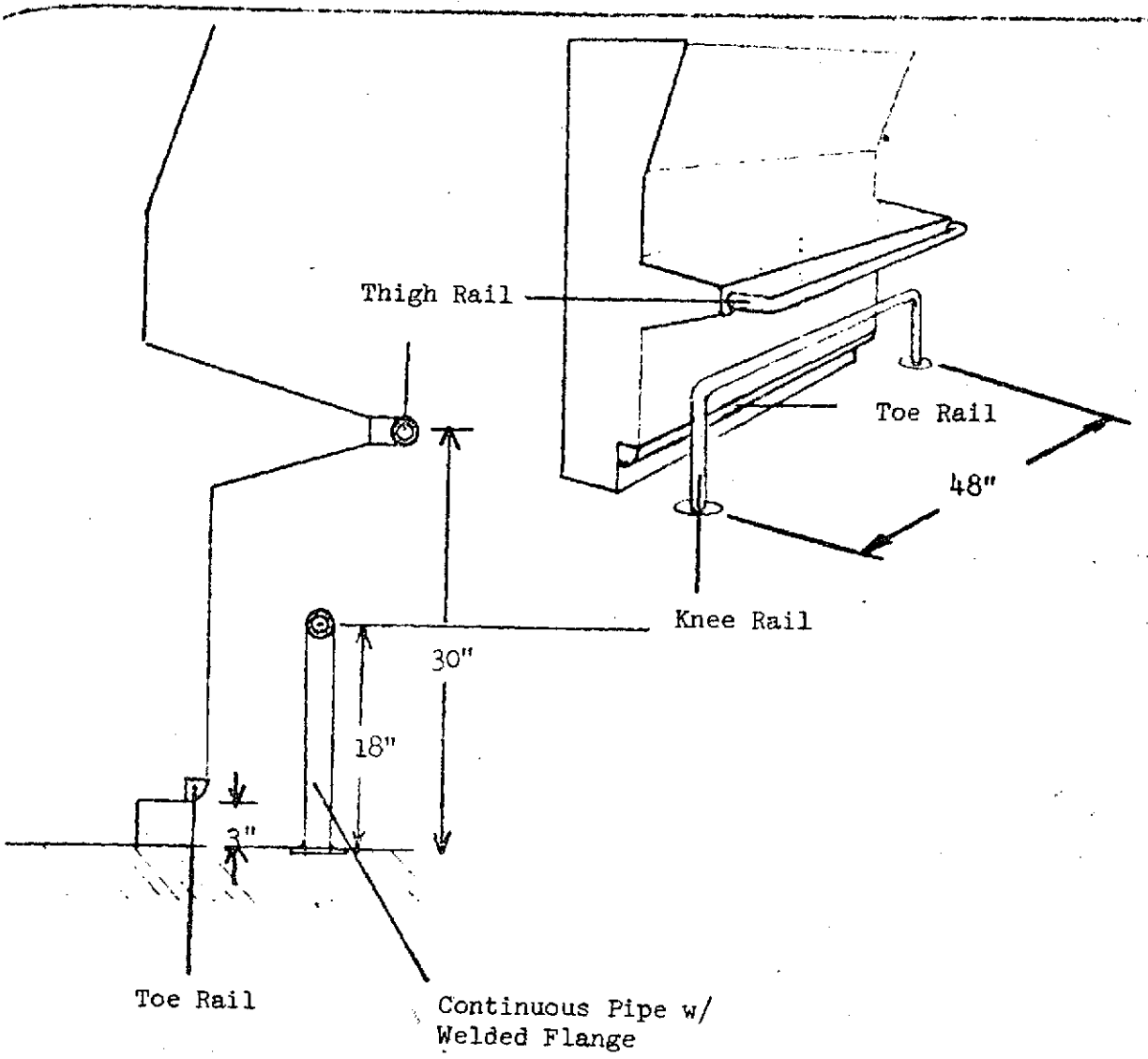
Merits	Deficiencies
o Requires no electrical power	o Not usable in artificial g environment
o Does not restrict movement of trunk, arms or head	o May cause pressure points after prolonged use
o Light weight	
o Simple Design	
o Applicable for zero g "sitting"	

The simplicity of this restraint system should result in a reliable maintenance free design applicable in zero gravity "sitting" situations. Concept development should require less than six months.

Modifications of concept by deleting approximately an 8 inch section in the middle of the knee rail would enhance applicability for dressing or body cleaning in zero gravity environments.

The toe restraint may be incorporated into the console or work bench and produce another variation of this system.

Early development testing could easily be accomplished as a parasite test on a zero g KC-135 flight.



LEG RAIL RESTRAINT

FLEXIBLE WAIST TETHERS

DESCRIPTION: This restraint system consists of the waist tether belt, with two D-ring slides worn by the user, and two tethers which attach to the D-rings via. spring clips. The other end of the tethers can be attached to fixed rings on the interfacing work areas, or to suction cups (much the same as those used by glaziers to transport panes of glass) which can be affixed to any smooth surface in the vehicle. By adjusting the tethers to provide a force component downward, the user can restrain himself for successful performance of many tasks.

SOURCE: Grumman Aerospace Corporation

TESTING: None

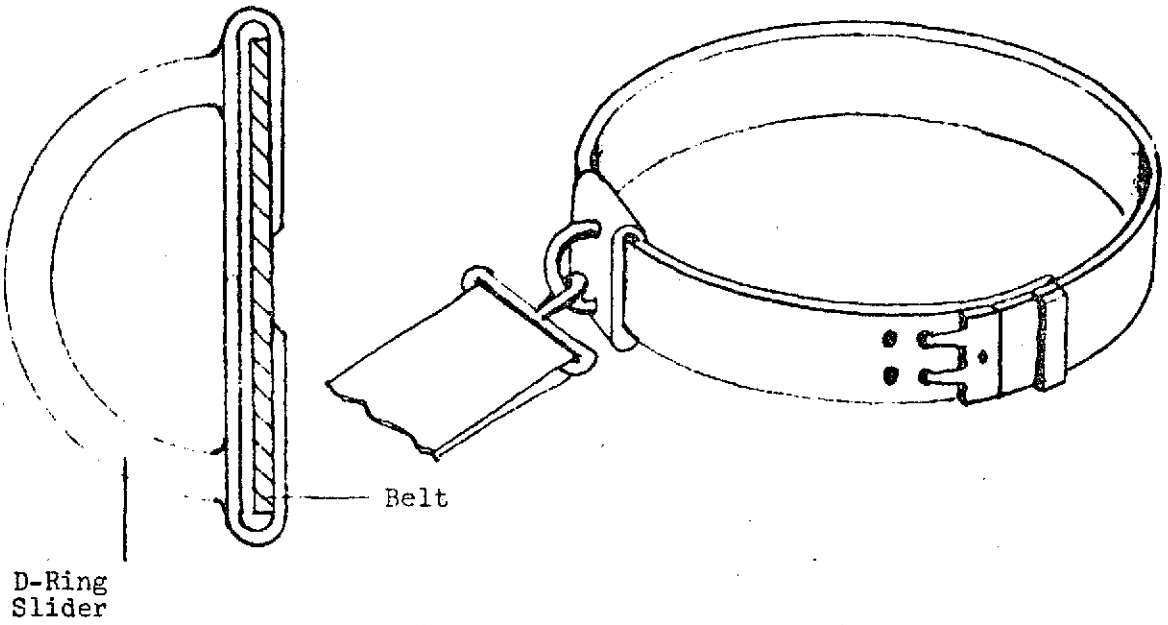
Merits

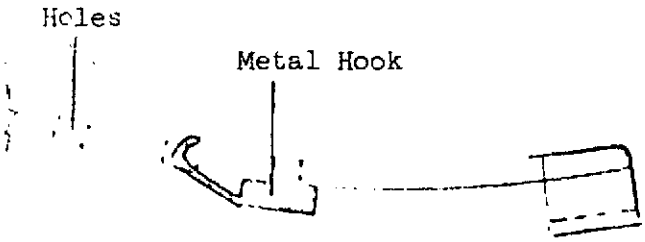
- o Requires no electrical power
- o Applicable for tasks requiring exertion of high torques
- o Minimizes effort required for body control
- o Limited mobility superior to that of foot restraint
- o Broad variety of configurations adaptable to many applications

Deficiencies

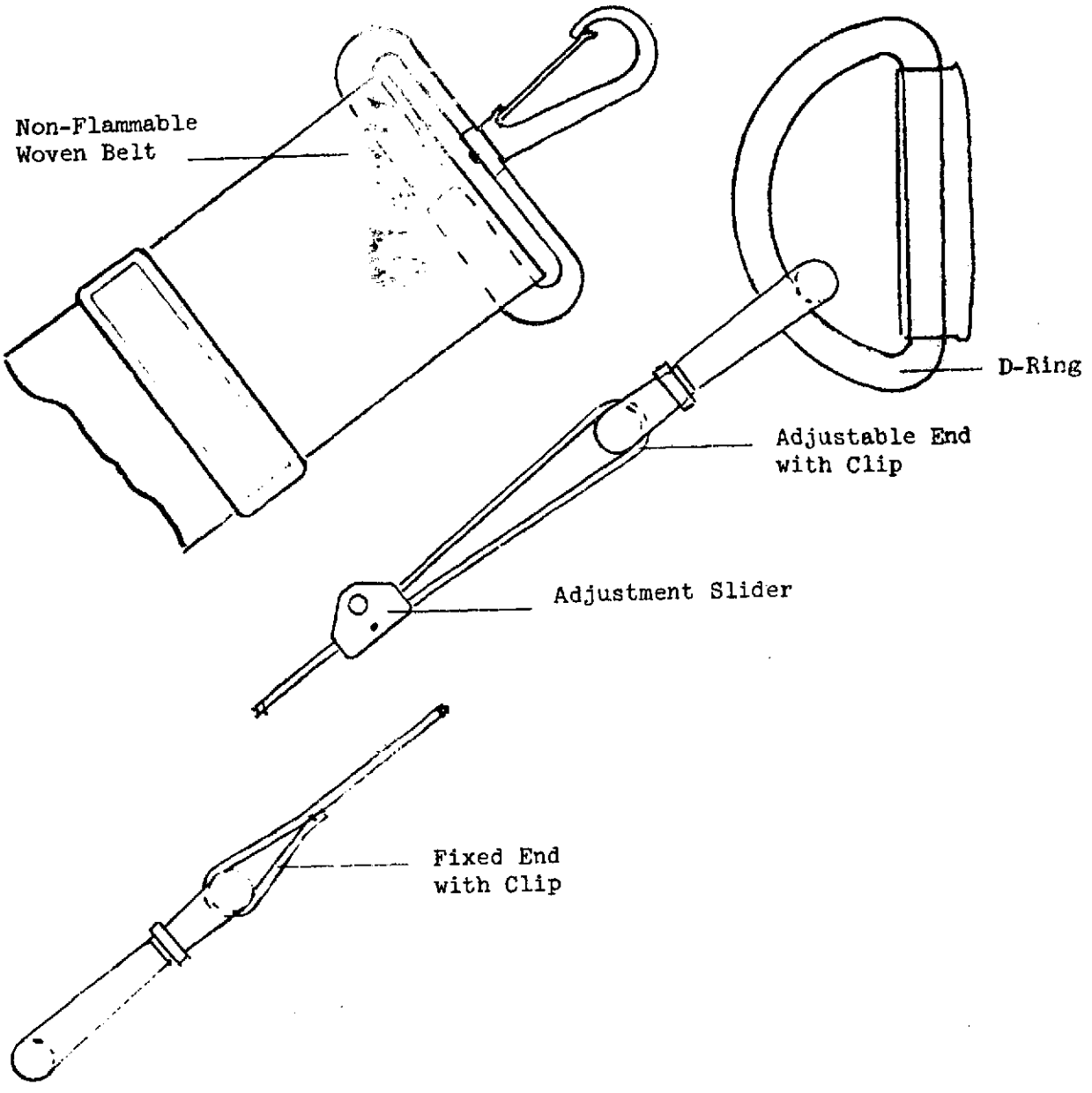
- o Requires structural attach fittings and personnel harness or belt attachment
- o Mobility limited by tether length
- o Usually requires both hands for connect/disconnect

Waist tethers developed and qualified on Gemini EVA were of the flexible tether type, limiting movement within an envelope determined by tether length, or providing a gravity substitute force by interaction of the users legs placing the tethers in tension.





WAIST TETHER BELT



FLEXIBLE WAIST TETHER

INFLATABLE MID TORSO RESTRAINT

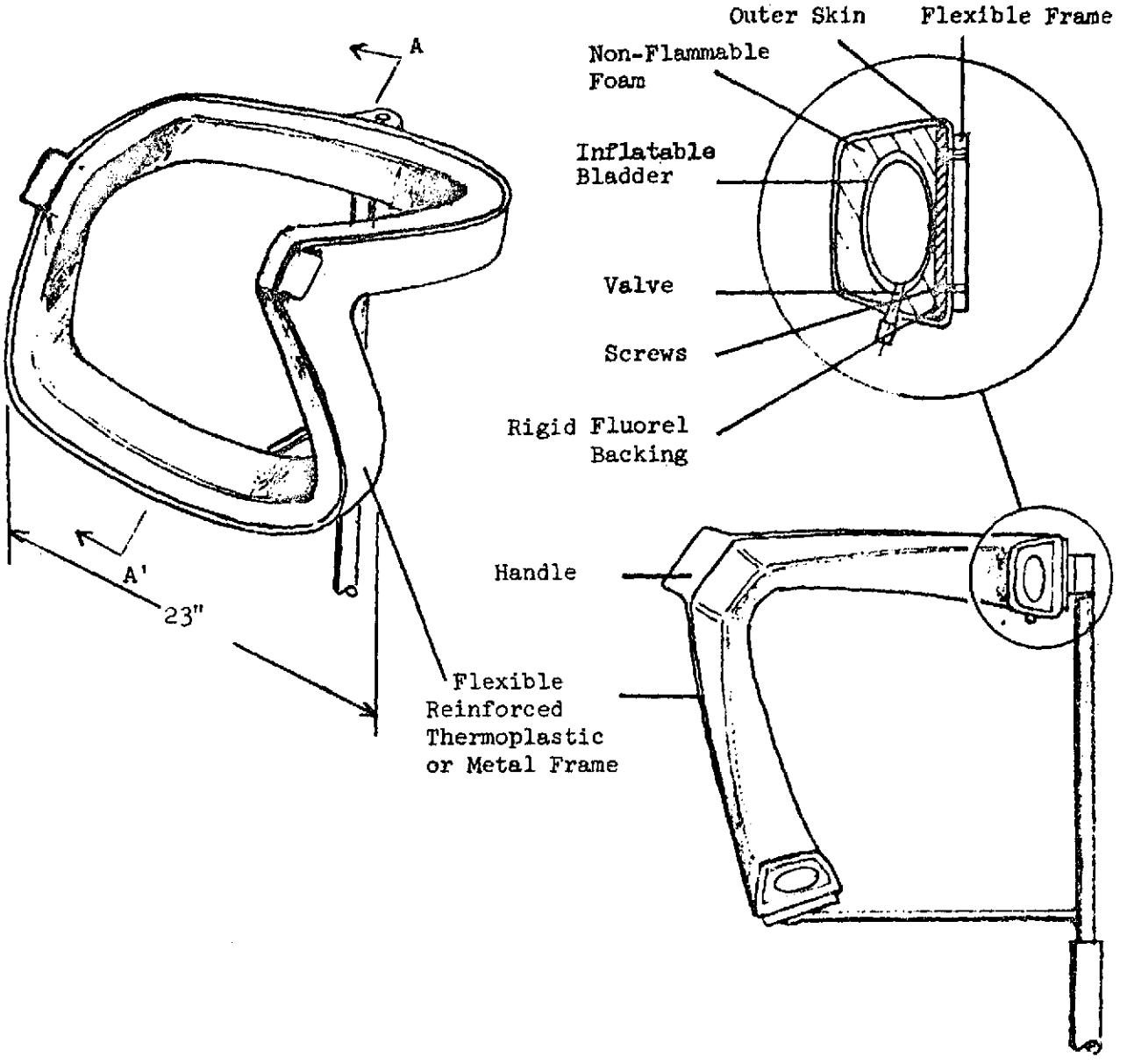
DESCRIPTION: The restraint shown consists of a spring steel frame on which is mounted an inflatable form. By spreading the restraint frame, the person positions his mid section within the restraint. The inflatable bladder has the ability to provide pressure for force resistance while still maintaining ability to adapt to different body shapes and proportions. By anchoring the person's hips and buttocks, the restraint allows freedom of legs, feet, arms, head, and torso.

SOURCE: Grumman Aerospace Corporation

TESTING: None (New Concept)

Merits	Deficiencies
o Uses no electrical power	o Fixed location
o Broad applicability	o Requires means of inflation
o Usable in all gravity levels	
o Simple	
o Light weight	
o Provides familiar pressure of chair	

The simplicity and maintenance free design of the Inflatable Mid Body Restraint should result in a reliable restraint applicable in a variety of "sitting" situations, i.e., console operation, laboratory, etc. Concept development is estimated at six months to one year.



INFLATABLE
MID-TORSO
RESTRAINT

ASTROGRID SHOE RESTRAINT

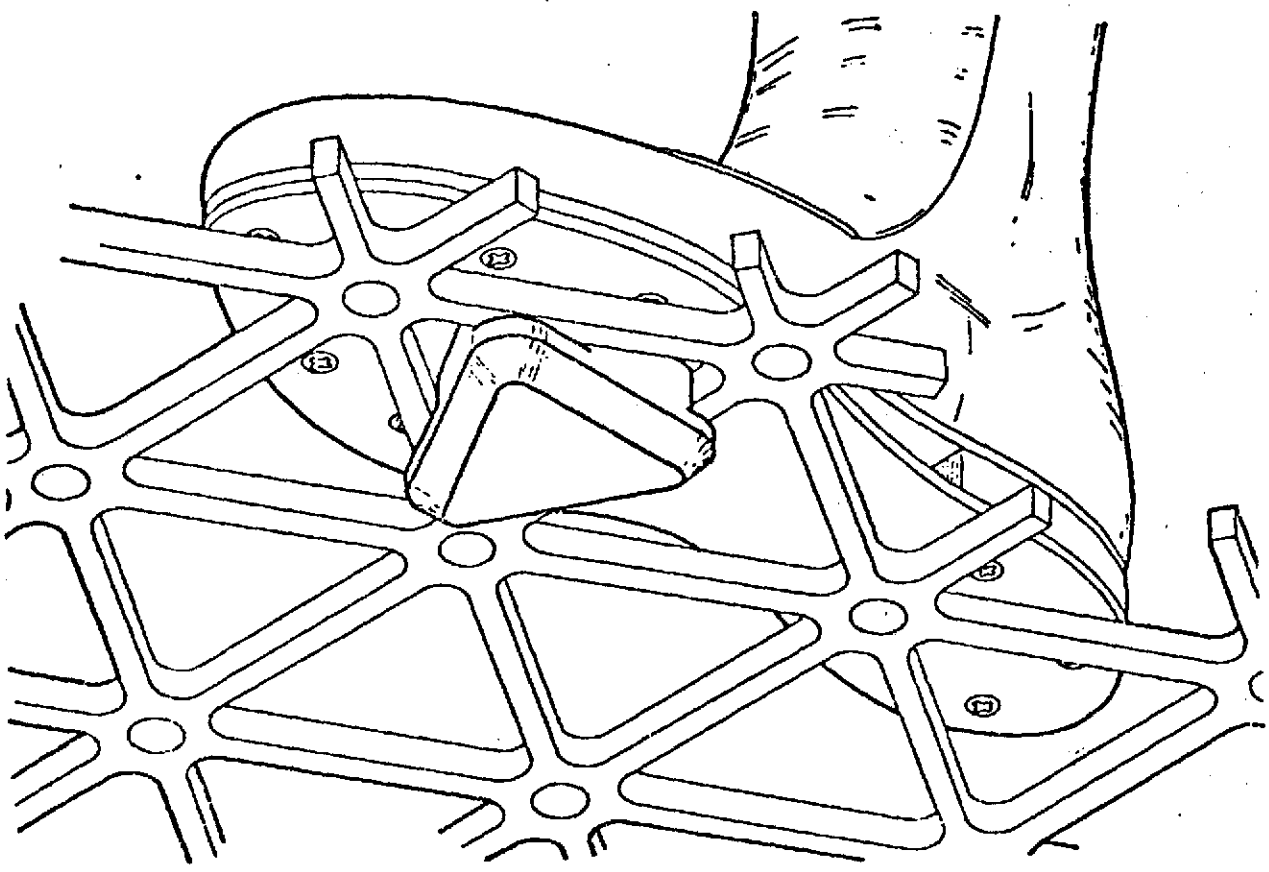
DESCRIPTION: The restraint system consists of a floor grid surface of triangular holes in a hexagonal array. Shoes are provided with interfacing, positive triangular shapes or cams, which are mounted off the mid-sole of the shoe. The system acts as both a restraint and a mobility device. The person inserts the cam of the shoe into a triangular hole in the floor grating. By then twisting the shoe a given amount, the shoe becomes securely fastened to the grating. The hexagonal array of triangular floor openings allows for the widest possible directions of movement.

SOURCE: McDonnell-Douglas (for AAP workshop)

TESTING: Neutral Buoyancy KC-135 Zero "G" Flights

Merits	Deficiencies
o Positive restraint - excellent for activities requiring high torque	o Footwear can be worn only in zero gravity
o Provides short range mobility at/between work stations	o Triangular grid surfaces are integral part of restraint
o Retention of restraint without conscious effort	o Individual footwear required for proper fit and hygiene
o Foot restraint does not impede mobility or dexterity of rest of body	o Handholds should be provided for temporary restraint while engaging restraint system

This concept has been developed for, and will be evaluated aboard Skylab. Pending the results of those tests, comments on its worth will not be made here. The concept has shown to be feasible in prototype and the only real test of its value will be its performance under prolonged zero "g" conditions aboard Skylab.



ASTROGRID SHOE RESTRAINT

#56A DATA MANAGEMENT SYSTEM, BUSES

Comments

Data Buses and Lines. Considered to be part of the Data Management Subsystem.

#58 DATA MANAGEMENT SYSTEM,
DIGITAL PLOTTER, PRINTER

Purpose

To provide hard copy output from the computer of both graphical data and alpha-numeric tabular data.

Requirements

System must be compatible with the computer of item 51. System should do both plotting and printing functions on same device and using same paper.

Hardware Status

Hard copy unit, Tektronix Model 4601, is available for this use. This unit produces high resolution $8\frac{1}{2}$ x 11 inch copies of data displayed on a CRT display. This unit uses 3 M Type 777 Dry-Silver Paper. Power supply modification for 28 VDC would be necessary.

Technical Description

Dimensions	11" H, 17" W, 24" D (2.60 ft^3)
Weight	70 lbs
Power	100 W standby, 360 W avg during operation, operation cycles 18 sec/copy

Cost $3800 (commercial unit)

Flight Estimates:

Development, $100K
Unit, $38K

Development Time

One year

#58A DATA MANAGEMENT SYSTEM, REMOTE CONTROL STATION

Comments

Control & Display Station Module, for crew/data management subsystem interaction. Considered to be part of DMS.

#58B DATA MANAGEMENT SYSTEM, REMOTE INSTRUMENTATION MODULE

Comments

Provides interface between DMS and bioinstrumentation. Includes bus terminals, multiplexers, switching units, etc.

63B DISPLAY-KEYBOARD, PORTABLE

Purpose:

A general purpose CRT display and response keyboard linked to the control data management computer that provides information, operating instructions, etc. for the crew on demand. Replaces instruction manuals, checklists, etc.

Requirements:

1. Provide a general purpose CRT that can display alphanumeric data in instruction and question formats, detailed schematics, flow charts, etc.

2. Provide a general purpose response keyboard that contains the standard alphanumeric input keys as well as multi-function special purpose keys.

3. Provide a computer control system for stimulus presentation and response interpretation and recording.

Hardware Status:

The IMBIM's Complex Behavioral Processes Assembly may be adaptable for use. It provides the necessary general purpose display, keyboard, and central computer linkup.

Technical Description:

Estimated values:

Weight: 30 pounds

Volume: 1.5 cubic feet

Power: 60 watts

Cost:

Development cost: $50K

Unit cost: $30K

Development Time: Approximately 2 years

#63G DEIONIZER, WATER

Purpose

Provides a means of removal of cations and anions from water supplies required for specialized laboratory analytical procedures.

Requirements

The deionizer must be capable of removing all dissolved solids and ions to levels of 1 part per million or less.

Hardware Status

Many types of commercially available units may be adapted to flight packaging provided liquid handling systems and ionic monitoring systems are modified, for 0-g compatibility. The commercial units shown in the accompanying sheet are larger than that required for a Sortie flight laboratory with a 7 or 30-day mission duration.

Technical Description

Estimated flight unit properties are estimated below:

Weight: 15 lbs.
Power: 0 watts (battery for conductivity meter)
Volume: 0.5 cu. ft.
Ion reduction: to less than 1 ppm.

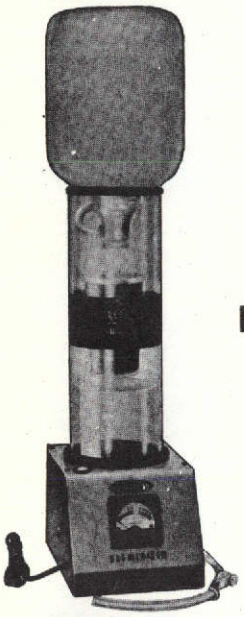
Cost

Commercial	K$	0.1
Development	K$	100
Flight Unit	K$	15

Development Time

1 year

DEMINERALIZERS



24804–002
Gallon Jug not supplied

Crystalab Deeminizer

24804–002 DEMINERALIZER, Deeminizer, Crystalab — Produces from ordinary tap water, mineral-free water with an ionic content of less than 1 part per million, initially. Removes all ionized minerals and dissolved solids, such as anions (sulfates, chlorides, bicarbonates, fluorides, silicates, carbonates, etc.) and cations (iron, nickel, calcium, manganese, sodium, etc.).

Raw water placed in the upper reservoir flows by gravity through the Deeminite resin and filters into the lower reservoir for instant use. Water is drawn off as needed by merely releasing spring clamp on outlet tubing. Productive capacity up to 5 gallons per hour continuously.

The shatter-proof transparent inert plastic tower holds 4 quarts but the reservoir capacity can be doubled by inverting a gallon jug on the cushioned top. The dial is graduated 0 to 50 ppm as NaCl. The super-charged Deeminite resins insure maximum absorptive capacity. Minimum grain removal 1080 grains as NaCl, or 1800 grains as $CaCo_3$. Portable, no plumbing connections required.

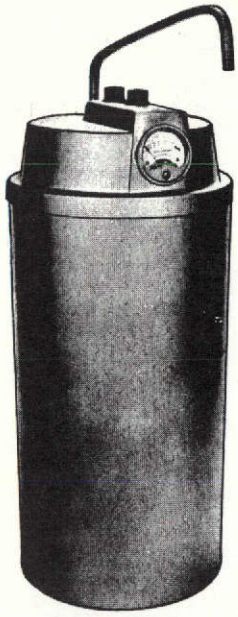
For 115 VAC 60 Hz. Without Deeminite filter.

Each 49.50

24805–005 FILTERS, Resin, Ion Exchange, Deeminite — For No. 24804–002. Complete silica and CO_2 removal, flow rate up to 6 gpm. Carton of 6 units.

Carton 15.00

Quikpure Lab-Flow



24809–006

24809–006 DEMINERALIZER, Quikpure, Lab-Flow — Removes minerals by means of ionic exchange resins, anion and cation, replacing all the ionized solids in the water with pure water.

A portable unit weighing only 20 lbs., this Lab Flow Quikpure Demineralizer attaches to any water faucet or to gravity flow reservoir in field. Typical resistance of water produced by a single passage through demineralizer is 14,000,000 ohms/cc. Water produced by this demineralizer meets all specifications for ionically purified water by the deionizing process as defined in the U. S. Pharmacoepia XV, page 783.

The purifying cell has a useable exchange capacity of 1500 grains total ionic solids, calculated as NaCl. Sodium, calcium, iron, silica, magnesium, heavy metals, chlorides, carbonates, iodides, etc. are exchanged at faucet flow speeds up to 60 gallons per hour. Resin cell is completely disposable.

Demineralizer features a built-in, transistorized, mercury-battery operated purity meter. The meter gives accurate water purity reading from 100,000, to 10,000,000 ohms. Off-On switch is spring loaded to avoid drain on battery, prolong battery life. Unit measures 23" high, 9" diameter. Container is of acid and alkaline resistant plastic.

Each 97.50

24809–050 RECHARGEABLE CELL — For 24809–006 Demineralizer. Replacement cartridge attaches to permanent fittings on Purity Meter base plate. It is fitted into demineralizer without tools. Cartridge has 1500-grain capacity, weighs 10 lbs.

Each 29.00

#64 ECG COUPLER

Comments

Coupler (signal conditioner), for use on man and other vertebrates, see E.I. 156 for definition sheet.

#65 EEG COUPLER

Comments

Signal conditioner, see E.I. 156 for definition sheet.

#65B ELECTROPHYSIOLOGY BACKPACK

Purpose:

A backpack containing the necessary electronics for sensing and transmitting man's physiological data such as ECG, EEG, EMG, EOG, etc.

Requirements:

Provide the necessary sensors, signal conditioners, multiplexers, A/D converters, and transmitters to sense and transmit ECG, EEG, EMG and EOG data.

Provide a portable man-mounted unit that minimizes weight and volume so as to minimize interference with and degradation of the test subject's performance.

Hardware Status:

The IMBIMS Bio-Belt Assembly may fulfill the functional requirements for this piece of hardware.

Technical Description:

Estimated values:

Weight: 5 pounds

Volume: 0.2 cubic feet

Power: 0 watts

Cost:

Development cost: $100K

Unit cost: $25K

Development Time:

Approximately 2 years

#65C ELECTROPHYSIOLOGY RECEIVER

Purpose

To provide special reception of cardiovascular and neural electrophysiological events via biotelemetry systems. This receiver is predominantly for biomedical experiments involving man.

Requirements

EEG (electroencephalogram) monitoring and the following cardiologic studies:

Electrocardiogram (ECG)
Vectorcardiography (VCG)
Balistocardiography (BCG)
Impedance Cardiography (ZCG)
Phonocardiography (PCG)

Hardware Status

Many types of clinically oriented and some flight rated units are available. Minimum modification will be required for commercial units.

Technical Description

Estimated properties of a flight unit are as follows:

Weight: 10 lbs.
Power: 5 watts
Volume: 0.5 cu. ft.
Frequency response: 0.1 - 1000 Hz.
Sensitivity: 0.5 microV.

Commercial Unit properties are: Hewlett-Packard Model 78101A

Weight: 6 lbs.
Volume: 3.5 x 7.9 x 11 in. (0.176 ft^3)
Input Impedance: 50 ohms nominal
Antenna: 7 in. monopole

Cost

Commercial	$0.8K
Development	$100K
Flight Unit	$ 25K

DEVELOPMENT TIME

1 year

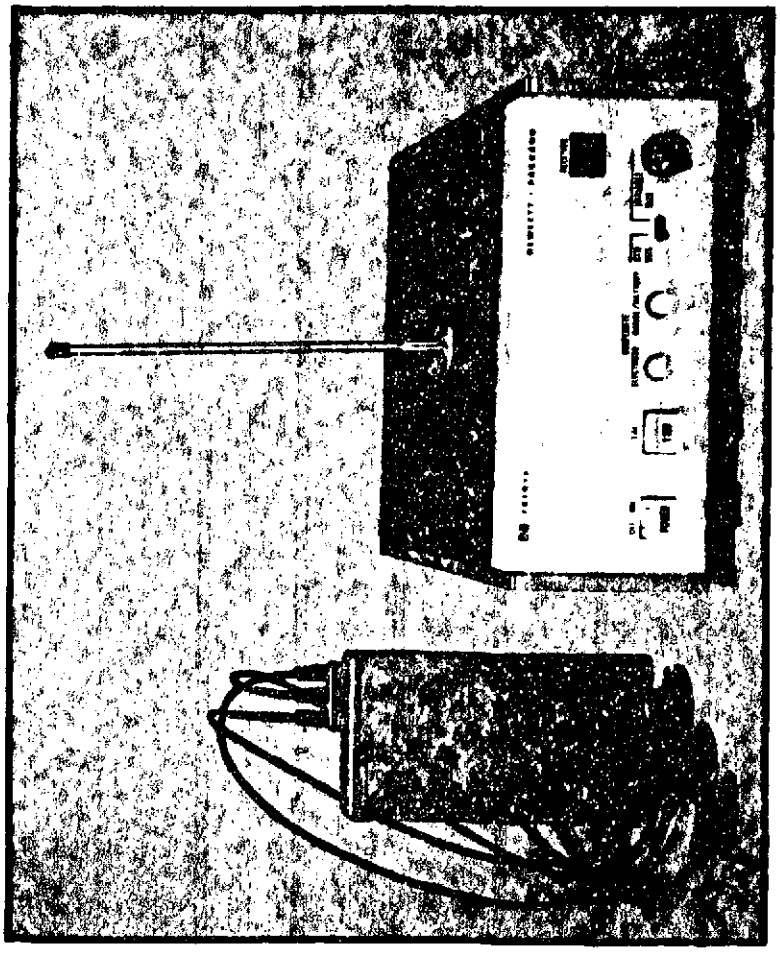


Fig. 1. *Model 78100A ECG Telemetry Transmitter (left) and Model 78101A Receiver substitute an RF link for direct wiring between cardiac patient and monitoring instruments.*

#65D ELECTROPHYSIOLOGY DISPLAY

Purpose:

A dedicated display for the physiological data transmitted by EI 65B, Electrophysiology backpack, or by hardwire.

Requirements:

TBD

Hardware Status:

IMBIMS Vital Signs Display and Four Channel Storage Oscilloscope may fulfill the functional requirements of this piece of hardware.

Technical Description:

Weight: 40 pounds

Volume: 1 cubic foot

Power: 20 watts

Cost:

Development cost: $100K

Unit cost: $25K

Development Time:

Approximately 2 years

#66 EMG COUPLER

Comments

Signal Conditioner, see E.I. 156 for definition sheet.

#69A ELECTROMETER

PURPOSE:

The electrometer will be used to measure small voltages and currents as are found in nerve and muscle potential studies. Its output will be used to produce permanent recordings of the signals to allow experiment correlation.

SPECIFICATIONS:

Measure DC voltages from $\pm$10 μV to $\pm$1 V (F.S.(full scale)

Measure DC currents from $\pm$1 pA to $\pm$3 mA (F.S.)

Provide $\pm$10 volt output for external recording.

Drift $\pm$5 V per day after 10 m. warm up.

HARDWARE STATUS:

DC microvolt-ammeter, model 425A by Hewlett-Packard will meet most of the specifications.

Existing design with suggested modifications will be adequate.

Existing ranges and sensitivities are adequate.

TECHNICAL DESCRIPTION:

Battery operated portable instrument similar in appearance to HP 425A but smaller and uses semiconductors exclusively. Power supply recharging on 28 VDC available.

COST:

Development cost	$70K
Unit Cost	$15K

#70 ELECTROPHORESIS APPARATUS

Purpose

The electrophoresis apparatus is for the separation of protein and amino acid constituents in serum, plasma, urine or spinal fluid for quantitative analysis.

Requirements

Same as for standard clinical laboratory models.

Voltage: 0-500 volts regulated DC
Substrate: Starch block, paper or gel.
Sample volume: 0.001 to 5 ml

The electrophoresis system is required only for missions of 30 days or over since samples for electrophoresis analysis may be stored at 0°C for 7 days.

Hardware Status

Many types of commercial units available. Various casette types would be most easily adaptable to space biology research with minimum modification and would also provide maximum crew handling ease.

Technical Description

Estimated properties for a flight item are:

Weight: 20 lbs.
Power: 85 watts
Volume: 0.9 cu. ft.

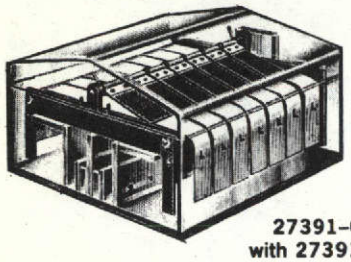
The commercially available units are generally of plastic construction with 2 compartments for buffer solutions and electrode connections to a DC power supply. The substrate (starch, paper or gel strips) containing the applied sample, is placed between the 2 compartments with the ends of the strip immersed in the buffer and in contact with the electrodes. Separation of the proteins is accomplished by the influence of the voltage applied across the strip on the electric charge on the protein molecules.

Cost

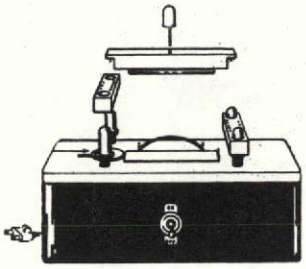
Commercial	K$	0.9
Development	K$	50
Flight Unit	K$	5

Development Time - 1 year

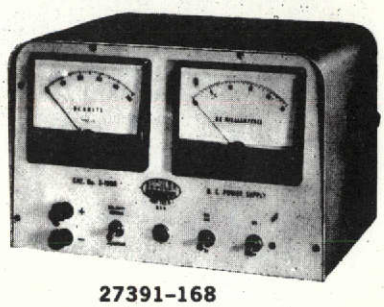
BUCHLER APPARATUS



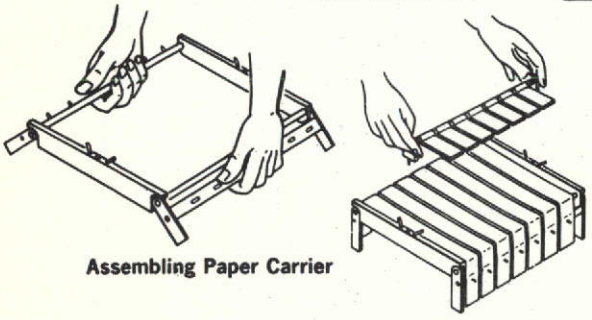
27391-022
with 27391-044



27391-146



27391-168



Assembling Paper Carrier

27385-008 ELECTROPHORESIS APPARATUS, Paper Punched Strips — Consists of a Migration Chamber, No. 27391-022; Paper Carrier No. 27391-044; Strip Tension Device; Power Supply No. 27391-168; and complete operating kit including 7 micropipets, 2 micropipet tubings with mouthpiece, 5 dyeing and washing pans with cover, 1 dyeing frame, box of 12 vials of veronal buffer, box of 10 vials of bromphenol blue dye, box of 200 punched paper strips, package of 25 strip record folders, and instruction manual. For 115 VAC, 60 Hz.
Each 505.00

27387-003 IMMUNOELECTROPHORESIS APPARATUS — Similar to No. 27385-008, except that it includes an Agar Cutter, No. 27391-146, and operating kit with 6 micropipets, 2 micropipet tubings with mouthpiece, 4 staining dishes, box of 12 vials veronal buffer, dual pack of 2.5 g. Ponceau S dye and 25 ml. dye concentrate, and instruction manual.
Each 435.00

Buchler Components

27391-022 MIGRATION CHAMBER — Includes cover, electrode assemblies, and safety terminal arrangement. Other items supplied are buffer height scale and electrical leads. Capacity of each buffer chamber is one liter.
Each 145.00

27391-044 CARRIER, Paper — Includes frame, punched paper strip holders, and paper mounting bars, for 7 strips.
Each 43.50

27391-088 CARRIER, Microscope Slide — Capacity of six 1" x 3" microscope slides or three 2" x 3" slides.
Each 18.25

27391-102 TRAY, Starch — For starch and other solid media. Contains five removable partitions and makes a maximum of six starch bricks 1⅛" x 8" x 1".
Each 25.00

27391-124 CARRIER, Cellulose Acetate — Accommodates six 1" x 6" cellulose acetate strips. Equipped with rubber strip tension device. **Each 28.00**

Agar Cutter

27391-146 CUTTER, Agar, Universal — With illumination from underneath, mounted on a base 6¼" x 3¾" x 2". The cutter enables one to cut precise slits and wells in agar-coated slides. Complete with electric bulb, line cord, ON-OFF switch.
Each 95.00

Power Supplies

27391-168 POWER SUPPLY — With variable output voltage; equipped with individual voltmeter and milliameter, current control, and polarity reversing switch. Range 0—500 volts, DC 0—20 and 0—200 ma. For use with 115 VAC, 60 Hz.
Each 180.00

27391-180 POWER SUPPLY — Same as No. 27391-168, but for 0—1000 volts and 0—200 ma.
Each 210.00

27391-226 POWER SUPPLY, Regulated, Solid-State Constant Current/Constant Voltage — Voltage output 0—1000 VDC with ±1% regulation; current output 0—200 ma. with ±1/5% regulation; Ripple current/voltage 1% peak to peak maximum. Equipped with individual voltmeter and ammeter with high and low as well as polarity reversing switches; circuit breaker for overload protection. Operation 115 VAC, 60 Hz.
Each 595.00

27392-182 PAPER STRIPS, Punched — 1" x 13". (Whatman #3MM). **Box of 200 8.00**

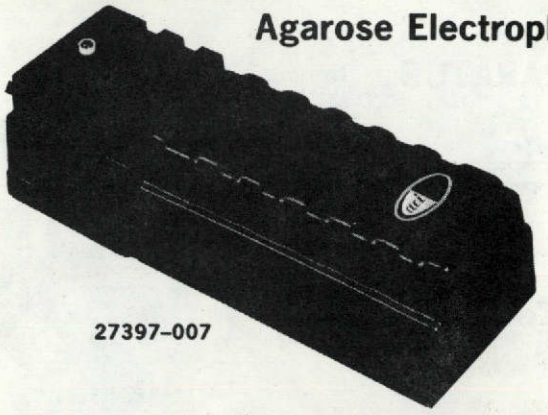
27392-229 DISH, Staining, Molded Plastic — 8 3/32" x 4⅛" x 1¼". Accommodates one microscope slide carrier No. 27391-088 during staining and humidifying. May be used as a culture chamber. **Each 4.50**

Note: CELLULOSE ACETATE STRIPS for Electrophoresis, see No. 27403-008 Series, page 477.

AGAROSE — A neutral polysaccharide useful in zone and immunoelectrophoresis and in bacteriology and immunology. Extracted from agar and refined for commercial use, Agarose is a strongly gelling, non-ionic substance. It has the properties of minimal adsorption and electroendosmosis with an extraordinary degree of optical clarity.

27392-400	25-Gram Bottle	**12.00**
27392-422	100-Gram Bottle	**40.00**
27392-444	250-Gram Bottle	**80.00**

Agarose Electrophoresis Film Apparatus



27397-007

27397-007 CASSETTE ELECTROPHORESIS SYSTEM, Agarose Film, ACI — This convenient system makes it possible to isolate proteins, lipoproteins, isoenzymes or hemoglobins by electrophoresis in high resolution agarose film.

Three major components of system are:

(1) High resolution electrophoresis film, imprinted with troughs and sample wells, mounted for simple cassette loading.

(2) Cassette electrophoresis cell and power supply.

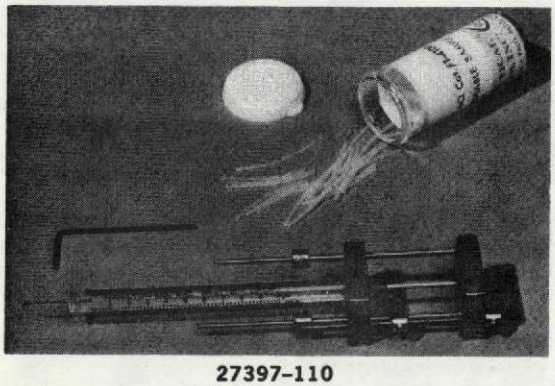
(3) Quantitative microliter dispenser with disposable tips.

The cell is precisely made to allow easy cassette loading of Agarose Film, No. 27394-100. Modular Power Supply provides the appropriate electrical conditions for reproducible isolations. The Agarose Film slips into the cassette cover of the electrophoresis cell. When the cassette cover is placed on the cell, a safety switch is activated as indicated by a red pilot light on the power unit. The electrophoresis run takes only 35 minutes.

With agarose film for 96 determinations, LDH reagent film set, humidity chambers, stain sets, buffer, and film cutter. For 117 VAC. **Each 310.00**

27397-051 CELL, only **Each 50.00**

27397-084 POWER SUPPLY, only — Required for operation of No. 27397-051 Electrophoresis Cell. During a run, with electrophoresis cell containing 200 ml. of 0.05 M. pH 8.6 barbital buffer, power unit develops a voltage gradient of 15 V/cm. in the agarose film with negligible heat build up. No cooling is necessary. Plugs into end of cell unit. With 3-wire cord and plug. For 117 VAC, 50/60 Hz. **Each 50.00**



27397-110

27397-110 SAMPLE DISPENSER, Quantitative, Microliter — A 10μl syringe with a specially modified Chaney adapter. Permits easy one-hand sample loading of the Agarose Film. Calibrated to draw 2 μl of sample into the disposable tip and to deliver 1 μl $\pm$1% into a sample well. **Each 50.00**

27397-142 SAMPLE TIPS — Non-wettable, disposable tips for No. 27397-110 Dispenser. **Vial of 100 4.50**

27397-175

27397-175 HUMIDITY CHAMBER, Stir-Stain Dish — Each chemically resistant dish includes a stirring well for magnetic stir bar No. 27397-200. When placed on a magnetic stirrer, the circulation minimizes handling and speeds fixing, staining and clearing.

Cover is rigid transparent plastic and form-fits onto the dish to provide a humidity chamber for immunoelectrophoresis.

Dish measures 6 inches wide x 7½ inches long x 1½ inches high. Set of 4 chambers with covers. **Set 20.00**

27397-200 MAGNETIC STIR BARS, Teflon-coated — For use with the No. 27397-175. **Set of 4 14.00**

27397-211 FILM CUTTER — As supplied with No. 27397-007. **Each 37.50**

27397-233 AMIDO BLACK, 10B — Densitometry stain for serum protein, immunoelectrophoresis and hemoglobin procedures. Set contains 5 premeasured vials of Amido Black 10B. Each vial makes up to 1 liter of working stain solution when mixed with 10% Acetic Acid. (200 determinations per set.) **Set 6.00**

27397-266 PONCEAU S — Set contains 5 premeasured vials of Ponceau S. Each vial makes up to 1 liter of working stain solution. (200 determinations per set.) **Set 6.00**

27397-299 ANSA (8-Anilino-1-Napthalene-Sulfonic Acid) — Fluorometric stain for serum proteins.

Set contains 1 premeasured vial of ANSA for making stock solution which is used to prepare fresh working stain. (200 determinations per set.) **Set .7.00**

27397-313 TANNIC ACID and ANSA — Fixative and brightener for immunoelectrophoresis photography.

Set contains 1 vial premeasured Tannic Acid and 5 vials ANSA sufficient for fixing and staining 200 IEP samples for photography. **Set 8.00**

27397-335 FAT RED 7B and STABILIZER, Densitometry Stain — For plasma and serum lipoproteins.

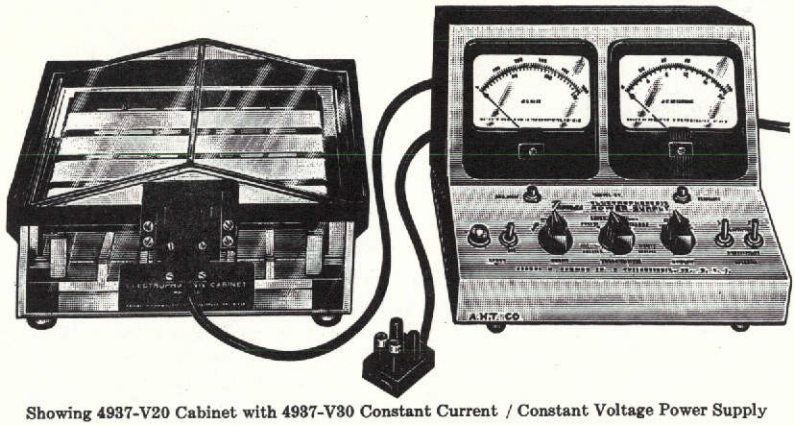
Set consists of 3 vials of premeasured stain and stabilizer, makes sufficient solution for staining 200 samples. **Set 9.00**

27397-357 BUFFER, ELECTROPHORESIS, Barbital, pH 8.6, 0.05M with 0.035% EDTA — Set consists of 5 premeasured packages of Sodium Barbital with EDTA and 1 container of 1 N HCl. Each package makes up to 1 liter of working buffer. **Set 8.00**

Thomas MULTI-MEDIUM ELECTROPHORESIS APPARATUS

Cabinet takes paper and cellulose acetate strips; starch, agar, and other gel trays; immunoelectrophoresis slides; and coated glass plates for thin layer technique.

4937-V10



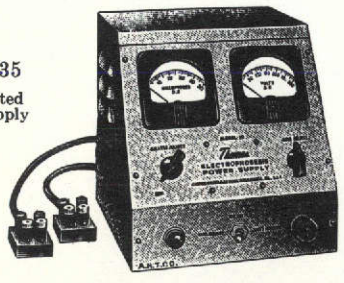
Showing 4937-V20 Cabinet with 4937-V30 Constant Current / Constant Voltage Power Supply

ELECTROPHORESIS APPARATUS, Thomas. An improved form of our widely used horizontal strip apparatus for paper, acetate strip, or gel block electrophoresis. The electrophoresis cabinet is slightly more compact, has a gable cover, new safety interlock system and platinum wire electrodes. A completely new power supply provides either constant potential or constant current output, increased in range to 500 volts and 100 milliamperes, respectively. A second power supply, identical with the earlier model in 300-volt, 50-milliampere output characteristics, but modified to incorporate the new interlock circuit, is also available for non-critical routine analysis. The new cabinet takes the same paper strips and general accessories as the original model.

Cabinet. Takes carrier with four sample strips, 30 mm wide, or single sheet up to 185 mm wide, with usable migration length of at least 135 mm. Length of strips must be approximately 300 mm. Agar or starch gels approximately 200 × 200 mm can be accommodated, using proper accessory tray and plate. Made of clear plastic, with tight-fitting gable cover. Double-pole safety interlock prevents removal of cover while current is flowing to electrodes; current cannot be restored until cover is replaced. Platinum wire electrodes are easily replaceable if damaged. Three transverse baffles in each compartment minimize buffer diffusion. Large surface area of buffer promotes rapid equilibration. Total buffer capacity 880 ml. Cabinet size permits use in refrigerators, incubators or other thermostatically controlled cabinets. Gable cover promotes runoff of condensate droplets, preventing them from falling onto sample strips and distorting the pattern. Overall dimensions, with cover, 10⅝ × 11⅝ × 5⅜ inches high.

4937-V35

Unregulated Power Supply



Double-pole safety interlock
Choice of two power supplies

Power Supply Model 21. For critical analysis and research techniques, particularly in gel procedures, or study of migration velocities. Provides fully regulated output of d.c. current up to 100 milliamperes, or potential up to 500 volts. Dual range milliammeter and voltmeter cover ranges of 0 to 20 or 0 to 100 ma, and 0 to 150 or 0 to 500 volts, respectively. Output range is selected by 4-position switch. Maximum output fluctuation in normal use, ±1 volt or ±0.5 ma for 10-to-1 change in load. Meter scales are 4 inches long. Voltmeter is graduated from 0 to 150 volts in 5-volt divisions, and 0 to 500 volts in 10-volt divisions. Ammeter is scaled from 0 to 20 ma in 1-ma divisions, and 0 to 100 ma in 2-ma divisions. To prevent meter damage, movements are provided with overload protection, and high range shunts are normally in circuit; low ranges are read by depressing momentary contact switches. All power supply components are protected by fuses in both line and load circuits. Double-pole relay is incorporated into the safety interlock circuit. When two cabinets are used with power supply, current flowing in either may be read individually, or total can be observed, by using selector switch. Electrode polarity in either cabinet may be reversed independently of the other by separate switches. Other front-panel controls include variable output adjustment, range selector, power switch and pilot lamp. Two 4-conductor cables, approximately 3 feet long, with 4-pole polarized plugs, emerge from the power supply for attachment to interlock terminals on cabinets. Overall dimensions of power supply housing, 9¾ × 10¾ × 7½ inches high.

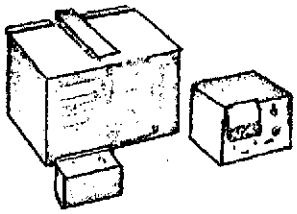
Power Supply Model 19. Simple transformer-rectifier supply with 300-volt, 50-ma output, of type furnished with earlier electrophoresis outfits, and entirely suitable for non-critical, routine separations. Circuit does not compensate for changes in load during migration, and no provision for separate current reversal in cabinets is made. Voltmeter and milliammeter have scales 2½ inches long. Voltmeter is graduated 0 to 300 volts in 5-volt divisions; ammeter, 0 to 50 ma in 1-ma divisions. Safety interlock circuit utilizes same double-pole relay protection as Model 21 Power Supply. Front panel controls include 10-position, 30-volts-per-step coarse voltage adjustment; stepless 30-volt fine voltage adjustment; current reversal switch, power switch and pilot lamp. Connecting cables are same as described for Model 21.

For densitometers for quantitation, see 4940-J, etc.

#70-5

Clinical Chemistry

Microzone Electrophoresis System This electrophoresis system features the use of cellulose acetate for routine separations of serum proteins in only 20 minutes. This is substantially faster than conventional paper electrophoresis methods which may require as long as 16 hours to complete. The Microzone Electrophoresis System, consisting of a specially designed cell, a scanning attachment, and an accessory kit, is easily integrated into the Beckman Model R Paper Electrophoresis System.



Microzone Electrophoresis System

Beckman/Spinco Div.

#76C FILM

Comments

Still photography and motion picture film.

#76E FILTERS, VIDEO

Comments

Filters for color video camera.

#76F FLOWMETER, WATER MANIFOLD

Comments

For in-line measurement of water flow, generally of low rate associated with water consumption by organisms, FPE specific.

#76G FLOWMETER, ULTRASONIC

Comments

Implantable, to measure cardiac output. Experiment specific.

#76H FLOWMETER COUPLER

Comments

Signal conditioner for E.I. 76F. See E.I. 156, E.U. 2, for definition sheet.

#76J FLOWMETER, GAS

Comments

Generally for air flow measurement, FPE specific.

#76K FLOWMETER, DOPPLER

Comments

Blood Flowmeter. Doppler type for measurement of pulse velocity and contour in conjunction with ECG. FPE specific.

#76L BLOOD CLOT FIBROMETER

Purpose

To provide an automatic measurement of plasma coagulation time.

Requirements

Measure coagulation time to ± 0.1 second.

Hardware Status

Commercial hardware would have to be adapted for space use.

Technical Description

Commercial Unit Estimate

Weight	10 lbs
Power	40 watts
Volume	0.7 cubic feet

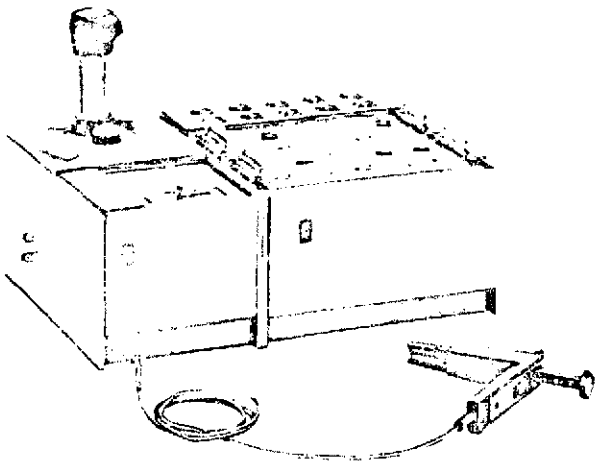
See attached sheet for description of commercial item.

Cost

Development	$100K
Unit	$10K
Commercial Unit	$1K

Development Time

2 years



B4180-1,-2,-3

B-B-L FIBROMETER SYSTEM

For all routine plasma coagulation time determinations; automatically senses and records clot formation end-point. Reproducible results are displayed on readout panel. System is modular in design; consists of the following components: Thermal Prep-block – holds up to 20 Fibrotube disposable reaction cups, and up to ten 12mm test tubes; pre-heats and maintains plasma and reagents at 37°C. Automatic Pipet – delivers measured 0.1 or 0.2ml volumes of plasma or reagent. Fibrometer Timer – utilizes stationary electrode in plasma mixture which cycles through reaction mixture every ½ second; senses clot formation and halts timer. Time is recorded to nearest 0.1 second; timer and electrode shut off automatically.

B4180-1
FIBROMETER COAGULATION TIMER – Has 6 warming wells, on-off switch, bar to activate unit if automatic pipet is not used, reset button to return readout to 0 after determination is completed. Complete with 500 B4181-1 Fibrotube disposable plastic reaction cups, 6 feet of 3-wire cord and plug. For operation on 115V, 60 Hz.
Order **B4180-1 – Fibrometer** . . . . . Each **$570.00**

B4180-2
THERMAL PREP-BLOCK – Heating block maintains 37°C temperature of plasma and reagent. Has 20 cup and 10 test tube wells. For operation on 115V, 60 Hz.
Order **B4180-2 – Prep-Block** . . . . . Each **$275.00**

B4180-3
PIPET, Automatic – For delivery of plasma and reagent. Complete with 250 B4181-2 disposable pipet tips, 33½" special 2-wire electric cord and plug. For operation on 115V, 60 Hz.
Order **B4180-3 – Pipet** . . . . . Each **$82.50**

B4180-4
PROBE, 0.4ml Volume – Required for prothrombin consumption determination. Replaces the standard 0.3ml probe supplied with the fibrometer.
Order **B4180-4 – Probe** . . . . . Each **$45.35**

B4180-5
PROBE, 0.3ml Volume – Replacement for standard 0.3ml probe supplied with the fibrometer.
Order **B4180-5 – Probe** . . . . . Each **$36.30**

B4180-6

B4180-6
ORGANIZER – For use with Fibrometer System; provides dust-free storage for 200 cups and 100 tips.
Order **B4180-6 – Organizer** . . . . . Each **$10.00**

REPLACEMENTS FOR FIBROMETER SYSTEM

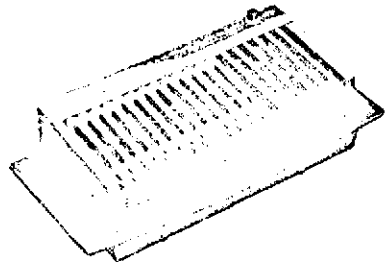
B4181-1
FIBROTUBE REACTION CUPS – Disposable plastic; insure proper heat transfer and liquid level control of plasma and reagents. Extended tab provides identification. 2000 per case.
Order **B4181-1 – Fibrotube** . . . . . Case **$35.00**

B4181-2
TIPS, Pipet – Disposable plastic tips for B4180-3 Automatic Pipet. 1000 per case.
Order **B4181-2 – Tips** . . . . . Case **$32.50**

C6572
PEDICHRON, Clay-Adams – See listing in Timer Section.

C6560
S/P STOPWATCH, ⅕ Second – See listing in Timer Section.

SERA-TEK PROTHROMBIN TIME SYSTEM – System for observational determination of clot formation; consists of thermal block and disposable reaction chambers. Temp-Control Block maintains 37°C test temperature; accepts up to 20 plastic chambers and warms them to test level in about a minute. Chambers have two pipet positions: reservoir end for thromboplastin, and capillary end for plasma; no mixing occurs until chamber is tilted – simplifies timing procedure. Constricted walls of chamber permit observation, and timing, of clotting activity.



B4190

COMPONENTS OF SERA-TEK PROTHROMBIN SYSTEM

B4190
PROTHROMBIN TEMP-CONTROL, Sera-Tek – For operation on 120V, 50/60 Hz. Dimensions: 9⅛"l × 4¼"w × 2¾"h. For use with Sera-Tek Reaction Chambers.
Order **B4190 – Sera-Tek** . . . . . Each **$88.75**

#77B FREEZER, CRYOGENIC

Purpose

To provide a simple means for freezing and storing frozen biological specimens.

Requirements

Storage capability:	Unit should have 115 cubic inches of storage capacity.
Temperature:	Liquid Nitrogen refrigerant at -320°F.
Refrigerant Loss:	Minimum Holding time of 3 weeks between refills of refrigerant.

Hardware Status:

The Linde Company Model LR-10A-6 Liquid Nitrogen Refrigerator might be modified for use. It is described below:

Technical Description

Size	21"H, 10.25" Dia. (1 ft^3)
Weight (full)	37 lbs.
Power	-
Liquid Nitrogen Consumption (maximum)	0.36 liters/day
Liquid Nitrogen Capacity:	10.4 liters

Cost $2500 commercial)

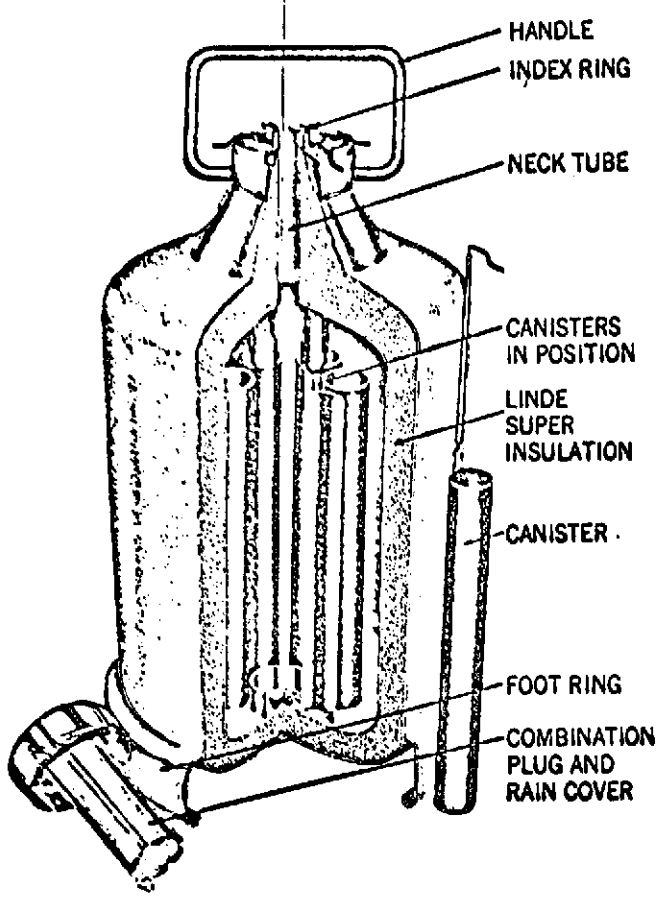
Estimated flight unit costs:

Development:	$500K
Unit:	25K

Development Time

3 years

LR-10A-6 LIQUID NITROGEN REFRIGERATOR



SPECIFICATIONS

Rated liquid nitrogen capacity	10.4 liters
Height	21 in.
Outside diameter	10¼ in.
Entrance tube diameter	2 in.
Weight full	37 lb.
Weight empty	14 lb.
6-canister capacity	115 cu. in.
Ampule capacity (1.2 ml)	
racked and tubed	144
without tubes	252
Canister size	
height	10⅞ in.
outside diameter	1½ in.
Storage temperature	−320°F. (−196°C.) below the liquid nitrogen level
Liquid nitrogen consumption rate (max.)	
(without canisters)	0.34 liters per day
(with canisters)	0.36 liters per day

Description:

A light, rugged, portable refrigerator for economical shipping and storage of biological specimens in small quantities. The unit holds six canisters which store 115 cubic inches of product at a constant temperature of −320°F. An index ring at the top of the neck tube suspends and positions the six plastic-handled depository canisters in the container. A porous neck tube plug plus cover is used to reduce evaporation losses. The LR-10A-6 has a minimum holding time of three weeks between refills of liquid nitrogen.

Features:

The LR-10A-6 is a double-walled aluminum container combining lightweight with high structural strength. It is vibration and shock resistant. A bucket-type handle makes the container easy to carry and a metal foot ring provides a stable base. LINDE Super Insulation assures extremely low evaporation loss. The LR-10A-6 is guaranteed for one full year against excessive evaporation losses. The unit is designed for a service life of five years without the need for repairs.

#80 FREEZER GENERAL

(-20° C)

PURPOSE:

Storage of serum, plasma, specimens and organisms.

REQUIREMENTS:

Temp.: -20°C $^{+}_{-}$2°C

Volume: Approx. 4 ft^3 storage

HARDWARE STATUS

Conceptual design item - modification of commercial refrigeration units may be possible. Zero G effects on evaporator, condensor, and refrigerant storage for vapor compression units must be considered and comparison should be made with thermo-electric units.

TECHNICAL DESCRIPTION:

Conceptual Design Item
Weight 50 lb (est)
Power 70 W (est)
Volume 7 ft^3 (est)

COST: Estimated flight unit costs are:

Development: $50K

Unit: 5K

Commercial unit cost is $0.2K

DEVELOPMENT TIME: 2 years

#81 FREEZER, LOW TEMP.

(-70°C)

PURPOSE:

This unit provides preservation storage for some specimens and organism, some constituents of which are destroyed at the higher -20°C preservation temperature.

REQUIREMENT:

Temp: 203°K (-70°C) (estimate)

Volume: Approx. 1 ft^3 storage

HARDWARE STATUS:

Conceptual Design Item - Modification of Commercial refrigeration units may be possible. See considerations suggested for Item #80.

TECHNICAL DESCRIPTION:

Weight 50 lb (estimate)
Power 250 W (estimate)

Volume 4 ft^3 (estimate)

COST:

Commercial unit: $1.7K

Estimated flight item:

Development: $200K

Unit: 10K

DEVELOPMENT TIME: 2 years

#83 REFRIGERATOR (4°C)

PURPOSE:

Primarily to store serum and plasma. This refrigerator could also serve to store radioisotopes if provided with a shielded section.

REQUIREMENTS:

Temp. 0 - 4°C

Volume: Approx 1 ft^3

HARDWARE STATUS:

This is a conceptual design item. Modification of thermo-electric commercial units for spacecraft application may be possible. See considerations suggested for Item #80.

TECHNICAL DESCRIPTION: Estimated flight unit properties are:

Weight 20 lb (estimate)

Power 15 W (estimate)

Volume 2 ft^3 (estimate)

COST:

Commercial unit: $200

Estimated flight item:

Development: $50K

Unit: $ 5K

DEVELOPMENT TIME: 2 years

#84 REFRIGERATOR, RADIO ISOTOPE STORAGE

PURPOSE:

To store liquid and solid radioactive materials. This box may be served by the same cooling unit as the general purpose refrigerator. It should be near the radiation glove box to facilitate material transfer.

REQUIREMENTS:

Temperature: 278 ± 2°K (5 ± 2°C)

Volume: Approximate 0.028 m^3 (1 ft^3) of storage volume.

Must House: H^3, C^{14}, FE^{59}, Cr^{51}, I^{131}, Co^{45}, etc.

Shielding: tbd

HARDWARE STATUS:

Modification of commercial designs would probably suffice. See considerations suggested for Item #80.

TECHNICAL DESCRIPTION:

Weight 50 lb (estimate)
Power 15 W (estimate)
Volume 2.1 ft^3 (estimate)
} for flight items

COST:

Use part of EI 83.

DEVELOPMENT TIME:

2 years

#85 GAS ANALYZER, AUTOMATIC, BLOOD GAS

Purpose

To determine the partial pressures of oxygen and carbon dioxide dissolved in blood samples and to determine the hydrogen ion concentration.

Requirements

Unspecified. (Capabilities of a commercial unit are given under "Technical Description.")

Hardware Status

Present systems use gravity to preclude air entrainment in the sample so special fluid handling techniques must be applied.

Technical Description (Instrumentation Laboratory Model IL 313)

	Commercial Model		Flight Unit - Preliminary Estimate
Weight	30 lb (est.)		18 lb
Volume	3 ft^3 (est.)		1.6 cubic feet
Power	100 watts (est.)		55 watts
Ranges	pH	6.000 to 8.000	
	P_{CO_2}	0 to 200 mm Hg	
	P_{O_2}	0 to 2000 mm Hg	
Precision	pH	± .003 pH	
	P_{CO_2}	± 0.5 mm Hg	
	P_{O_2}	± 1 mm Hg at 200 P_{O_2}	
		± 10 mm Hg at 2000 P_{O_2}	

Cost

Development	$200K
Unit	$50K
Commercial	$5.3K

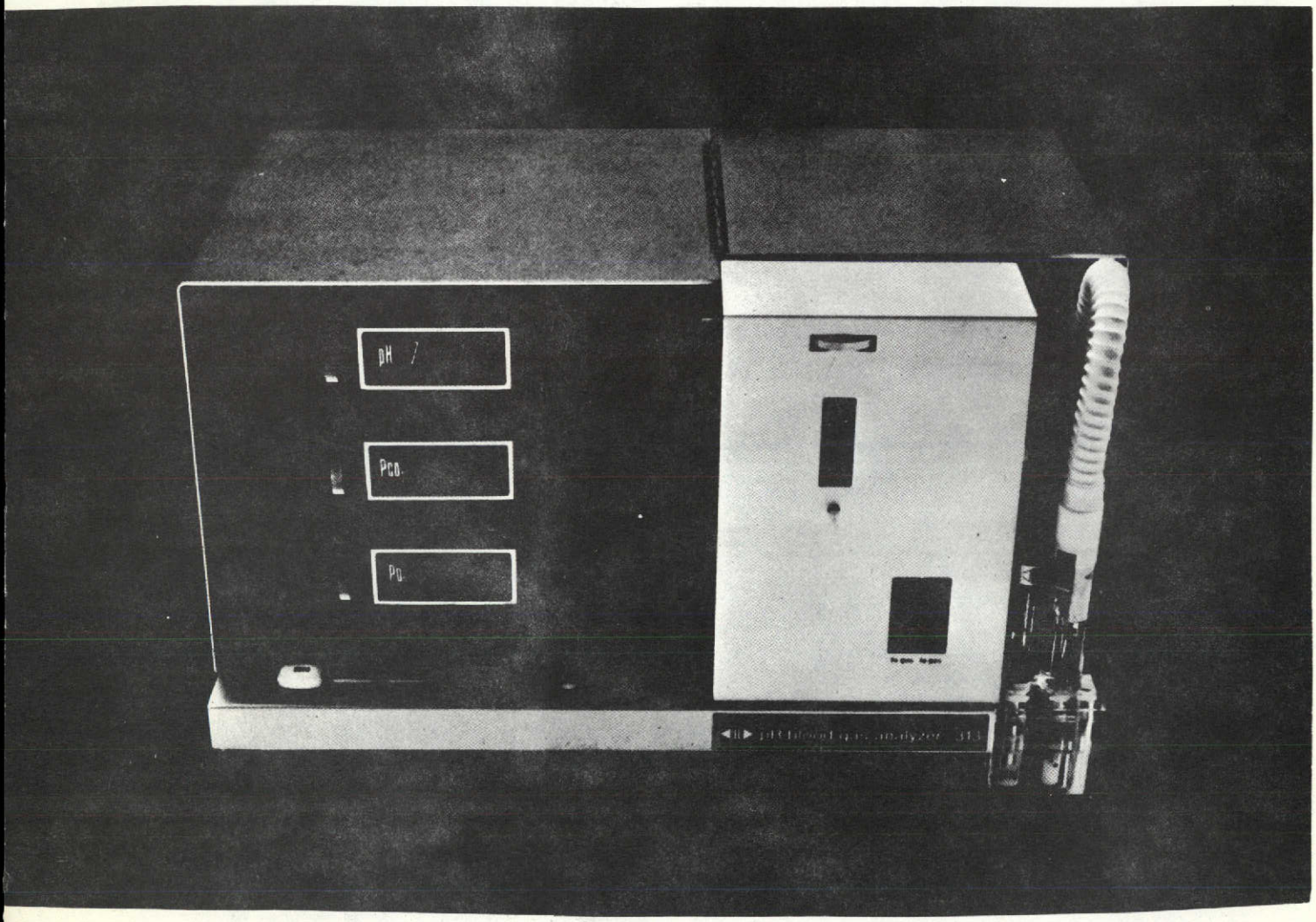
Development Time

One year.

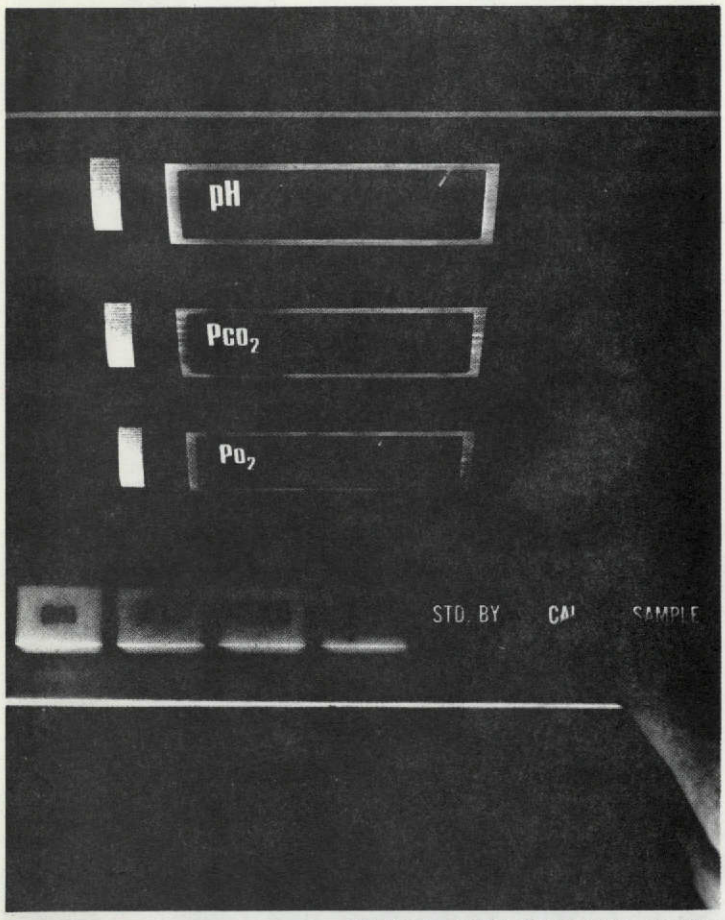
Comments

For basic principles of operation and logistics, see Allen C. Norton, Ph.D., "Survey of Commercial Laboratory Instruments for Space Station Application," Volume II, Beckman Instruments, Inc., FR-1065-101, October 31, 1970.

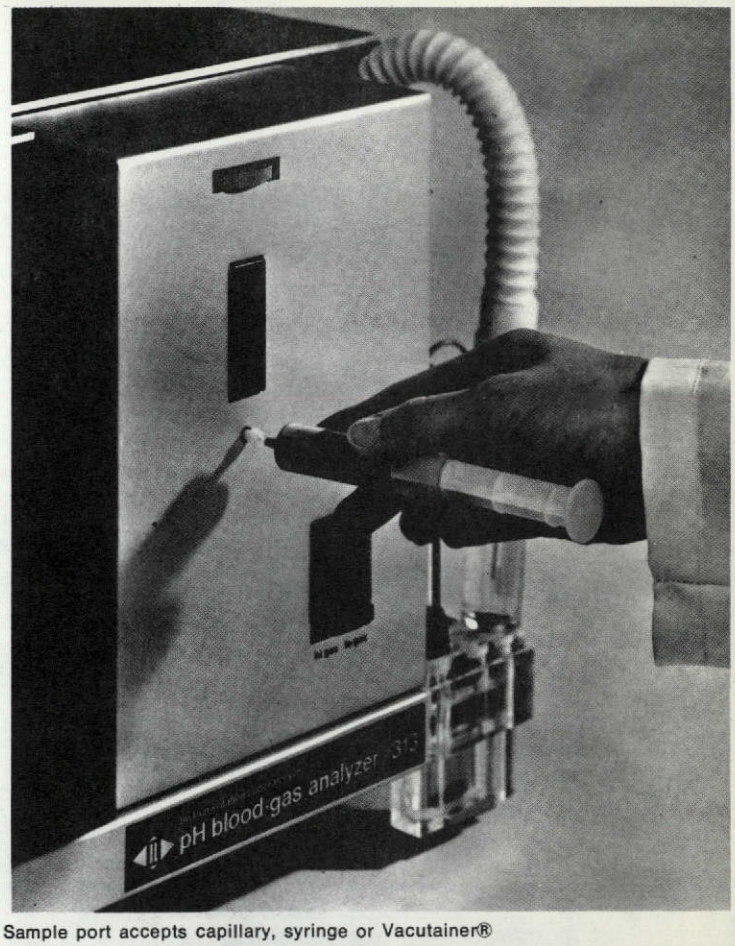
#85-3



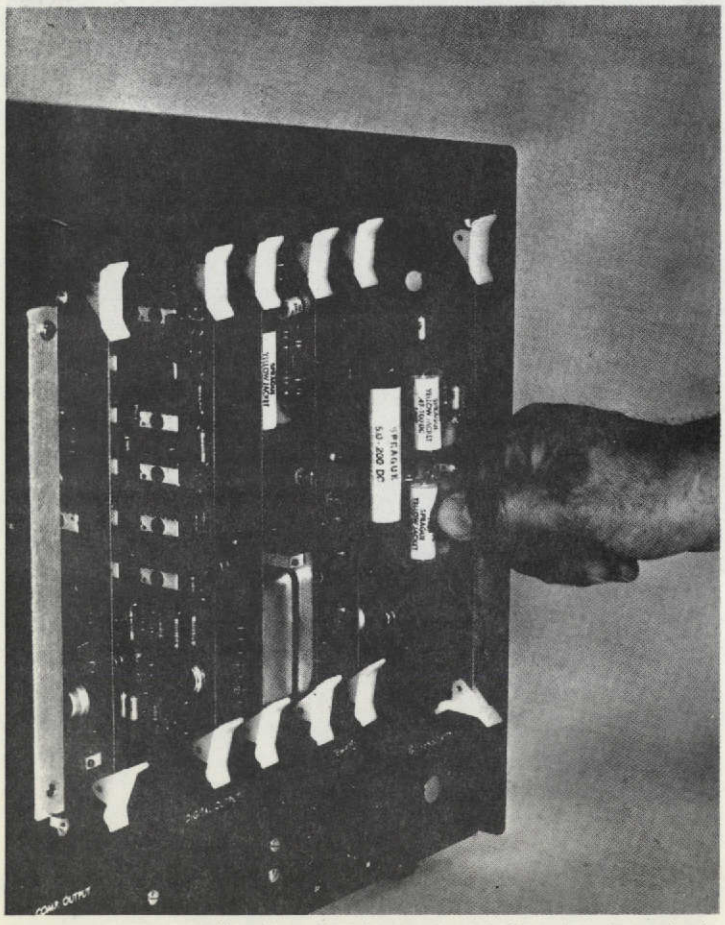
#85-4



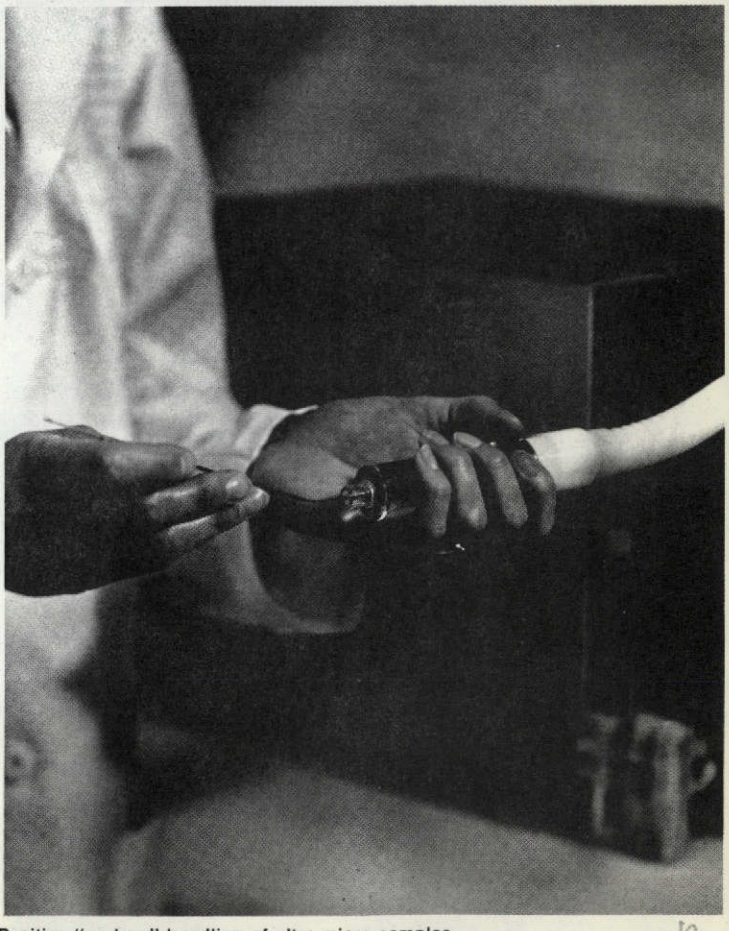
Tip-Touch controls insure easy operation



Sample port accepts capillary, syringe or Vacutainer®



Modular "plug-in" electronics simplify maintenance checks



Positive "no loss" handling of ultra-micro samples

Digital pH/Blood Gas Analyzer

The IL Model 313 is an all new, automated system for faster, more precise blood parameter analysis. Oriented to the needs of the busy laboratory it has been specifically engineered to simplify and speed-up blood analyzing procedures. The instrument's wide range provides for both clinical and research usage. Automatic features allow even inexperienced personnel to get answers of the accuracy and precision that have been routinely obtained only with long experience. For the first time an operator can introduce a sample and within a minute read simultaneously the pH, Pco_2 and Po_2 values. A digital programmer sequentially controls introduction of calibrating gas, data presentation and automatic cuvette cleaning. Alternate sample presentation by capillary tube, Vacutainer® or syringe is made without need for instrument adjustment. Modular design of all major components simplifies maintenance.

Method of Operation

A precision pump draws the sample from the collection vessel into the blood gas measuring cuvette. Use of a specially designed measuring circuit speeds up read out time. Within 45 seconds a DATA light signals presentation of final results. All three values now can be read simultaneously on the Nixie® tube displays. Answers are held for one minute allowing ample time for recording. During this period the unit's digital programmer automatically starts a cleaning and gas calibration cycle. The sample is drawn from the cuvette and prewarmed cleaning solution pumped through the system. Temperature controlled, humidified calibrating gas follows and remains in the chamber for an immediate calibration check. From one sample to the next the entire procedure takes less than two minutes.

Useful Innovations

Among the many useful innovations that insure quick, accurate analyses is the programmed instrument sequence which systemizes gas calibration, sample presentation and cleaning operations. Before entering the measuring chamber all samples, calibrating gases and cleaning solutions are prewarmed to bath temperature. The chamber itself is lighted for quick observation during analysis. Signal lights on the front panel continuously monitor both the temperature of the cuvette and the integrity of the electrode membranes. Once the gas flow rate through the humidifiers has been set, it rarely requires adjustment. Positive protection against cross mixing of calibrating gases is provided, and a "GAS SAVER" stand-by position automatically insures gas flow only when it is required. Other innovations include lighted controls for a continuous indication of the function being performed by the 313 System, and a highly stable electronic circuit instead of a battery supplying polarizing voltage to the Po_2 electrode. Sample and the flushing solutions are pumped into any convenient drain.

New Features

Each measuring circuit is independent, and analog to digital converters are interchangeable. Pco_2 readings are made linearly, eliminating the need to ratio calibrating gases. A "STAND-BY" position maintains the Model 313 in constant readiness for immediate analysis of "stat" samples. The geometry of the new Pco_2 electrode has been engineered to insure minimum response time, improved washout and maximum precision. For greater stability both the pH and the Pco_2 electrodes are now supplied with coaxial connectors on short lead lengths. Redesign of the pH electrode assembly provides a quick, easy manual procedure for the extremely small sample. The internal

cooling system in the bath permits its operation up to ambient temperatures of 35°C. Electromagnetic coupling of the water pump eliminates sealing problems and a new peristaltic pump mechanism insures correct vacuum pressure at all times.

Simplified Maintenance
Modular plug-in construction of the electronics measurably aids in reducing any possible down time or service expense. All mechanical parts in the automatic gas calibration, sample presentation and cuvette cleaning system have been carefully chosen for maximum life under the most demanding work loads. The tubing has been specially selected for trouble-free durability. Readily removable covers on the 313's cabinet make maintenance checks fast and simple. Stainless steel is used in all areas where corrosive material can come into contact with the unit.

Electrical Characteristics
The Model 313 is a universal voltage instrument. It can be adjusted to operate from 80 volts, 50 60 Hz to 280 volts, 50 60 Hz. Nominal operating power is 120V (±20%), 60 Hz. Special circuits compensate for line transients. Analog output is standard. Digital binary coded decimal output with computer data ready signals is optional and can be field installed. Circuitry is integrated, plug in and totally solid state. Optional printer and recorder readouts are available.

Advantages to the Laboratory
Clinician, laboratory technician and engineer have joined together to provide a system which simplifies and automates pH/Blood Gas Analysis. The IL Model 313 was designed so that its operation is easily taught and even relatively inexperienced laboratory personnel can readily operate it. Precision is enhanced by the development of a systematic sample handling system. Speed of measurement is insured by special circuits coupled to a display for the simultaneous readout of all three values. The time required for sample flushing and calibration has been appreciably lessened by an automatic cleaning cycle which does not require attention. Maintenance has been simplified by the use of plug-in modules and magnetic cabinet fasteners. Solid-state, space age electronics insure precision and long term reliability. The additions and changes have been developed after years of research and many clinical evaluations. They strictly adhere to the fundamental need in the laboratory for accuracy, speed and ease of operation. The automated Model 313 is the most advanced pH Blood Gas System available. As reflected in laboratory time and effort saved its value is immediately apparent.

Specifications
RANGE: pH 6.00 to 8.000, Pco_2 0 to 200 mmHg, Po_2 0 to 200 or 0 to 2000 mmHg.
PRECISION: pH ± 0.003 pH, Pco_2 ± 0.5 mmHg Pco_2, Po_2 ± 1 mmHg 200 Po_2 or 10 mmHg 2000 Po_2.
REPEATABILITY (with electrodes): pH ± 0.005, Pco_2 1% of Pco_2 reading, Po_2 1% Full Scale Po_2.
SAMPLE: Typically whole blood or other body fluids including expired gases.
SAMPLE SIZE: Automatic 0.4 ml, Manual 0.2 ml.
READOUT: Simultaneous four decimal digital displays for each parameter.
COMPATIBLE OPERATING VOLTAGE & FREQUENCY: 120 Volts ± 20%, 50 60 Hz, 100 and 240 Volt instruments available.
OUTPUTS: Analog and Optional binary coded decimals.
TEMPERATURE RANGE: 36° to 38°C.
TEMPERATURE STABILITY: ± 0.05°C.

#86 GAS ANALYZER, CO_2 SPECIFIC

Purpose

This device is used to monitor atmospheric carbon dioxide levels.

Requirements

Partial pressure range: 130 - 2700 Pa (~1-20 mm Hg)

Hardware Status

Many commercial units are available and several spaceflight type versions have been built. The Perkin Elmer unit described below was developed under Contract NAS9-2255. *

Technical Description

The Perkin Elmer sensor and signal conditioner is a solid state unit utilizing the IR absorption of the sample at two wavelengths. One wavelength corresponds to a strong CO_2 absorption band and the other a zero absorption band by the normal atmospheric constituents. By comparing the IR attenuation in the two bands, a signal is generated proportional to CO_2 partial pressure.

CO_2 pp range:	130-4000 Pa (1-30 mm Hg)
Output voltage:	0-5 v dc
Output impedance:	< 500 ohms
Input voltage:	28 v dc
Power dissipation:	1.0 watt
Weight:	1.18 kg (2.6 lbs)
Envelope:	28 x 17.8 x 2.5 cm (11 x 7 x 1 inches)
Volume:	1260 cc (~ 77 cubic inches) (0.04 ft^3)

Cost -

DEVELOPMENT 75K, UNIT 10K

Development Time - 0.

* Ref. Environmental control and Life Support 1973 Component Specifications, BSM Definition Study, Contract NAS9-6796, Report 18-4-009, General Dynamics/Convair, San Diego, Oct. 1967, p. 78.

#89 GAS ANALYZER, GAS CHROMATGRAPH

Purpose

To measure concentration of gas, liquid, and solid constituents of biological samples.

Requirements

From updated Blue Book under "Biochemistry/Biophysics Analysis Unit"

$-40^{o}C$ $-400^{o}C$
He Carrier
Hydrogen flame detector
Thermal conductivity detector
Fraction collection system

Hardware Status

Commercial earth - laboratory designs are available and a few simplified flight units have been built and tested but may be unsuitable for biological research.

Technical Description:

Illustrative descriptions from Varian Aerograph series 1520B instruction manual and a Beckman unit are attached.

Dimensions	20 x 30 x 21 inch (Varian without accessories)
Weight	200 lbs
Power	2000 W
Volume	7.3 ft^3
Consumables	He, 10 ml/min
	H_2, 20 ml/min
	Chart Paper, 2 ft/analysis
	Rubber septums, syringes, etc.
	(Ref. Beckman Commercial Instrumentation Report FR-1065-101)

Flight unit estimates are:

Weight:	105 lbs
Power:	500 watts
Volume:	7.3 ft^3

Cost

Estimated flight item costs are:

Development	$850K
Unit:	$120K

Commercial unit cost: $5.2K

DEVELOPMENT TIME

1-3 years

COMMENTS

Sharp knobs and corners should be modified.
Hydrogen flame detector effluent should be vented.
Hot-wire detector effluent should be vented.
Special precautions will be required for O_2-rich atmosphere.

Many optional accessories are available which will further increase the capabilities of the Model 1520. Paragraph 1.3 lists a few of these accessories.

1.2 SPECIFICATIONS

Table 1-1 lists the specifications of the Model 1520.

TABLE 1-1 SPECIFICATIONS FOR MODEL 1520

DETECTORS

Thermal Conductivity
- Type: four-filament, tungsten, hot wire.
- Carrier Gas: He. or H_2.
- Current Limit: 300 ma with He or H_2. (For std. wx filaments.)
- Temperature Limit: 400°C.
- Output Attenuation: 1 to 512 in binary steps.

Hydrogen Flame Ionization
- Sensitivity: 10^{-9} gm.
- Linear Dynamic Range: 1×10^6.
- Carrier Gas: N_2, He or Argon.
- Temperature Limit: 400°C.

COLUMNS

Two 1/4-inch columns, each up to 150-feet in length; or two 1/8-inch columns, each up to 200-feet in length: (Two 5-foot by 1/8-inch columns supplied.)

FLOW SYSTEM

Carrier Gas: Single input to on-off valve, independent differential flow controller with separate needle valve and flow meter for each column.

Hydrogen and Air: Separate H_2 and air connections for each flame detector.

TEMPERATURE MONITORING

Indicator: Thermocouple pyrometer.

Range: 0°C to 400°C.

Temperature Readout: Injector tubes, column oven, and detector oven.

(continued on page 1-3)

DETECTOR OVEN

Temperature Range: Ambient to 400°C.

Accuracy: ± 0.5°C by proportional control.

Construction: High-mass cast aluminum.

COLUMN OVEN

Temperature range: Ambient to 400°C.

Cooling Rate: 400°C to 100°C in 3 minutes.

Temperature Limit Protection: Adjustable temperature limiting device prevents overheating of columns.

Air Circulation: Internal centrifugal blower.

Construction: Stainless steel with glass wool insulation.

Usable oven space: 1068 cubic inches.

COLUMN-OVEN TEMPERATURE CONTROL

Type: Matrix Temperature Programmer.

Modes: Isothermal; Linear Programming on time-limit or temperature-limit basis.

Isothermal or Temperature-Base Program Range: Up to 400°C.

Time-Base Program Range: Up to 120 minutes.

Accuracy: ± 0.5°C by proportioning control.

Linear Programming Rates: 2-40°C; rate plugs supplied for 2, 4, 6, 8, 10, 15, 20, 30 and 40°C per minute. Maximum programming rate above 250°C - 25°C/min.

INJECTOR TUBES

Temperature Range: Ambient to 400°C.

Injection Methods: Flash vaporization or on-column; provision for glass injector liner.

Construction: Two stainless steel tubes housed in separate aluminum blocks.

TABLE 1-1 SPECIFICATIONS FOR MODEL 1520 (continued)

DUAL/DIFFERENTIAL ELECTROMETER

Modes: A channel, B channel, differential of A-B, differential B-A, two-channel flame detection, two-channel flame and electron-capture detection.
Sensitivity: 3×10^{-12} amperes input for 1-mv output.
Drift: Less than 10 uv per 15 minutes (input shielded with metal cap; 1-hour warm-up).
Noise: Less than 10 uv (input shielded with metal cap; 1-hour warm-up).
Background Suppression: Equivalent to 4.2×10^{-10} amperes for ranges 1 and 10; 4.2×10^{-8} amperes for ranges 100 and 1000.
Dynamic Range:
Flame Detection: 1 to 128,000.
Electron Capture: 1 to 1,280.
Output Impedance: 10 to 100 ohms.
Detector Cell Voltage: - 190 vdc (FID)-90 vdc (EC).
Hydrogen Flame Ignitor Voltage: 3.2 vac.

SAMPLE COLLECTION

Two-position Manual Collector Assembly provided for post thermal conductivity sample collection.

RECORDER RECOMMENDATIONS

Potentiometric, 1-mv full scale, floating input.

POWER REQUIREMENTS

Nominal 115 volts rms, 50/60 cps, 2300 watts (maximum).

DIMENSIONS

Width: 29-1/2 inches (74.93 cm).
Height: 20-1/4 inches (51.44 cm).
Depth: 21 inches (53.34 cm).

WEIGHTS

Shipping Weight: 250 lb (Approximate) 115 kg.

1.3 ACCESSORIES

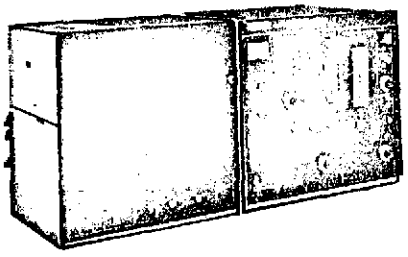
The following optional accessories are available for operation with the instrument:

1) Model 650 Hydrogen Generator - Low Capacity -- Operates one detector only.
2) Model 9662 ELHYGEN Hydrogen Generator - High Capacity - Operates up to four detectors or as a carrier gas source.
3) Model 425 Pyrolyzer
4) Model 695 InDuctor
5) Six-Way Gas Sampling Valve (Part No. 57-000035-00)
6) Electron Capture Detector (Part No. 02-000104-00)
7) Cross Section Detector (Part No. 02-000220-00)
8) Phosphorus Detector (Part No. 02-000388-00)
9) Model 400 Dual Hydrogen Flow Controller with Air Pump
10) Models 475 and 476 Digital Integrators.
11) Fifty/Fifty Effluent Splitter (Part No. 02-000417-00)
12) Micro Collector (Part No. 02-000416-00)
13) Disc Integrator - Specify Recorder Make and Model No.
14) A complete line of 1 mv/1 sec Strip Chart Recorders

Gas Chromatography

For the laboratory, Beckman offers modular gas chromatographs that can be tailored to perform virtually any application suitable to this type instrumentation. Gaseous samples may be introduced through a variety of optional inlets that accommodate samples ranging in character from trace gases to natural gases. Liquid samples for medical research are as readily analyzed as those for petrochemical quality control. Solid samples are vaporizable using pyrolysis techniques or by preparing volatile derivatives. And instrument performance matches the versatility. A uniquely designed hydrogen flame detector with a high sensitivity electrometer exceeds the sensitivity achieved by other laboratory gas chromatographs. A Beckman developed non-radioactive electron-capture detector also is available with higher sensitivity than previously has been available for this type detector. As an outgrowth of the electron-capture detector, Beckman recently has introduced a helium ionization detector with sensitivity in the parts per billion range. All these capabilities are available with the competitively priced GC-5 Gas Chromatograph.

GC-5 Gas Chromatograph



Beckman/Scientific Instruments Div.

#90 GAS ANALYZER, MASS SPECTROMETER

Purpose:

The purpose of the mass spectrometer is to provide an analysis of an unknown ionized gas by atomic mass number. This specific spectrometer is needed to provide a large mass range model to support research activities.

Requirements:

Mass range: 1 to 400 amu in one range, variable scanning range, selectable center mass and selectable scanning width. Variable scanning rate: 50 milliseconds to 600 seconds per scan. Maximum operating pressure: 1×10^{-4} torr. Output: suitable for operating a recorder, oscilloscope, alarm system and the data acquisition system.

Hardware Status:

The essential components of the mass spectrometer are available now. The sensing heads may have to be redesigned for specific applications. The power supplies will have to be modified to operate on the 28 VDC primary power of the Min. payload option. Vacuum for operation of the mass spectrometer is assumed to be available from the ambient vacuum surrounding the laboratory.

Technical Description:

Granville-Phillips Co. Model "Spectrascan 400" Quadruple Residual Gas Analyzer. Mass range: 1-400 aver., variable scanning range, maximum pressure; 1×10^{-4} torr, Resolution; 3/2 (mass number) from mass 4 through 350 r Recorder output connector.

Weight 50 lb. Size 7" h, 16-3/4" w, 16½"d. Power 250 w
Additional sensing head: Weight 7 lb. 7 lb. Size 13" 1 to 3" dia.

#90 (cont.)

Cost: Development - $1000K

Unit 100K

Commercial Model 7K

Additional sensing head, $3.75K for commercial model

Development Time:

2 years

Comments:

If instrument is redesigned, some weight could be saved in the sensing head construction.

GRANVILLE-PHILLIPS COMPANY

SpectraScan 400 Quadrupole Residual Gas Analyzer

Features

- Wide Mass Range: 1 to 400 amu in one range
- Variable Scanning Range: Select center mass and scan width
- Variable Scan Rate: 30 milliseconds to 600 seconds/scan
- High Sensitivity: 50 amp/Torr for N_2 at M/ΔM=42, 1 x 10^{-14} Torr for N_2
- Dual Detector Capability: The first dynode of the electron multiplier may be used as an integral Faraday Collector without breaking vacuum

Applications

SpectraScan™ 400 is useful in identifying and analyzing the gases present in vacuum processes or experiments that take place within the pressure range from 1 x 10^{-4} to 1 x 10^{-12} Torr. By identifying these residual gases, SpectraScan 400 can be used as either a process control or quality control instrument as well as for research studies where budgets are limited.

Typical applications include: gas composition control, microelectronic component processing analysis and control, plasma analysis, analysis of residual and desorbed gases in LEED and HEED systems, on-line monitoring of rocket exhausts, laser vaporization studies, molecular beam studies including those using modulated beams, chemical reaction kinetics studies, organic and inorganic identification, and high-temperature studies of solids from Knudsen cells, among others.

For example, SpectraScan 400 can be used to control gas composition by coupling it through a commercially available electrometer to one or more Granville-Phillips Automatic Pressure Controllers. The pressure of a trace gas can thus be maintained at any desired level hour after hour, day after day. By using a signal commutator, two or more trace gases can be independently controlled.

In microelectronic component processing applications, SpectraScan 400 will provide more rapid process cycling and lower rejection rates because of the precise knowledge gained about environmental conditions.

SpectraScan 400 can also be used to analyze automotive exhaust gases by connecting it to the automobile exhaust system via a suitable inlet/vacuum system arrangement. The exhaust products of other types of internal combustion engines as well as exhaust products from other sources that contribute to air pollution can be analyzed in a similar fashion.

Lamp manufacturers can use SpectraScan 400 to monitor the gas composition and pressure in lamps. In addition, lamp gas composition and filling pressure can be controlled with a Granville-Phillips Automatic Pressure Controller running from the output signal generated by SpectraScan 400.

These are only a few examples of the uses of SpectraScan 400. If your process or experiment requires an inexpensive, dependable instrument for mass analysis on a day-in, day-out basis, you may find SpectraScan 400 to be the answer, whether your work is being conducted in an industrial site, research laboratory, classroom, mobile field setup, airborne installation, or where long-cable operation is required. SpectraScan 400 is directly applicable to programmed operation for applications requiring continuous monitoring of two or more pre-selected mass peaks. Its small size and lightweight make it easy to move from system to system.

SpectraScan 400 brings mass spectrometric analysis in the mass range to 400 amu within the reach of more budgets with greater reliability, convenience, and simplicity of operation than heretofore possible. Specific application assistance is available upon request.

Description

ONE MASS RANGE is used from 1 to 400 atomic mass units (amu). The mass peaks are equally spaced to provide for easy identification and a mass meter is provided for indicating the mass number during slow scans.

The SENSITIVITY of SpectraScan 400 is 50 amp/Torr for N_2 at the output of the electron multiplier at M/ΔM=42. Thus at 1 x 10^{-14} Torr of N_2, the multiplier produces an output current of 5 x 10^{-13} amp at a signal to noise ratio of two. At a total pressure of 1 x 10^{-8} Torr of N_2, SpectraScan 400 can detect as little as one part per million of an impurity in the residual gas in a system. The ionizer-filter-detector assembly has been carefully designed so that high sensitivity is maintained even at high mass numbers.

The RESOLUTION of SpectraScan 400 is at least 3/2 times the mass number from 4 to 350 amu so that identification and exact measurement of peak height is greatly facilitated. The resolution is automatically varied throughout any mass scan so that if the instrument is adjusted to give a resolution of 90 at mass 60, the resolution will be 300 at mass 200.

Resolution is defined as M/ΔM where M is the mass number and ΔM is the width of the mass peak in amu measured at half peak height. As shown in Fig. 1, the higher the resolution, the less effect there is of adjacent peaks on the height of the mass peak being measured. Note that for M/ΔM = 3/2M, an adjacent mass peak of equal height contributes only about 0.2 percent to the height of the peak being measured and that the peaks are separated by a valley whose depth is 58 percent of the height of one peak. (These calculations assume Gaussian peaks. SpectraScan 400 produces approximately triangular-shaped peaks so that the contribution to adjacent peaks is actually less than shown in Fig. 1.)

SCANNING can be performed automatically or manually, extremely fast or very slow. An entire mass range can be scanned in just 30 milliseconds or as long as 600 seconds. If only a portion of the mass range is of interest, that portion can be selected and scanned at the same rates. A mass scan can be started at any time by depressing the SCAN RESET switch on the control panel. The scan will start over again regardless of the time into the prior scan. The scan can also be externally programmed and a single mass peak can be continuously monitored. The crystal-controlled RF/DC generator provides a system of high stability so that a single component of a gas mixture can be monitored over extended periods of time without adjustment.

The short-term peak height reproducibility is better than ±2 percent for N_2 at 1 x 10^{-7} Torr for constant molecular concentration in the ionizer volume. This stability is obtained by very careful mechanical design of the probe and by using highly stabilized electronic circuits.

A SINGLE IONIZER permits the analysis of axial as well as cross molecular beams in addition to analysis of ambient atmospheres. Both electron energy and ion energy are continuously adjustable. The open construction of the ionizer helps insure that the composition and density of gases present within the ionization region are essentially the same as in the surrounding volume.

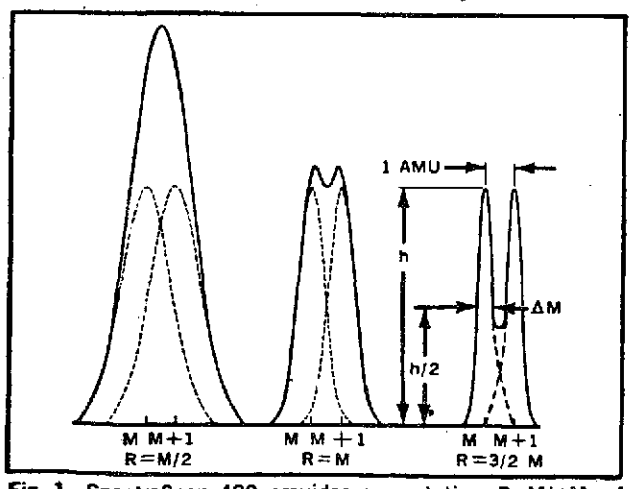


Fig. 1 SpectraScan 400 provides a resolution, R=M/ΔM, of at least 3/2M from 4 to 350 amu.

The MASS FILTER in SpectraScan 400 is designed so that the high precision built into the instrument is maintained even after the analyzer has been baked to 400°C or reassembled. The mass filter can be used with any ion source that generates ions with an energy from a fraction of an eV up to 150 eV and are directed within a 60-degree cone centered on the axis of the mass filter. The mass filter can be removed from its housing, cleaned and reassembled without affecting the precision of its alignment.

ION COLLECTORS: The ions that pass through the mass filter impinge on the first dynode of a 14-stage Be-Cu electron multiplier. The multiplier has a maximum gain of 10^6 decaying to a stable gain of about 10^5 at 3 kV anode voltage. The first dynode can be used as an integral Faraday Collector, thus permitting the gain of the electron multiplier to be calibrated. A front panel control varies the gain of the electron multiplier over its entire useful range to maintain linearity and prolong lifetime whenever high-pressure operation is necessary. Furthermore, the electron multiplier can be baked to 400°C.

The QUADRUPOLE PROBE can be flanged to the user's vacuum system with either 2¾ in. or 4½ in. o.d. bakeable CuSeal* flanges. Special probe housings can be supplied if required.

An attractive INSTRUMENT CONSOLE houses all necessary power supplies, precision RF/DC generator, and controls. The console is blower cooled. The front panel is a durable anodized aluminum finish and the side panels are finished in an attractive grey. The console is designed so that it can be placed on any convenient surface or mounted in a standard rack.

Specifications

Mass Range: 1-400 amu in one range.

Resolution: At least 3/2 times the mass number from mass 4 through mass 350, where ΔM is measured at half peak height.

Maximum Operating Total Pressure: 1 x 10^{-4} Torr.

Min. Detectable Partial Pressure: N_2 equivalent

	Electron Multiplier	Faraday Collector
	1x10^{-14} Torr with 2:1 signal to noise ratio	1x10^{-9} Torr with 2:1 signal to noise ratio
Sensitivity for N_2:	50 amp/Torr	5x10^{-4} amp/Torr

Scanning Range: Continuously variable from 1 to 400 amu.

Scanning Rates: Continuously variable from 30 milliseconds to 600 seconds per scan.

Emission Current: 1 ma ±5%; regulated to ±1%.

Ionizer Controls: Electron energy is variable from 10 to 90 eV. The ion energy is variable from 0 to 35 eV. These adjustments are made internally.

Ion Beam Input: Analyzer will accept ions from any source with energy from a fraction of an eV up to 150 eV directed within a 60-degree cone centered on the axis of the filter.

Electronic Stability: Peak height reproducibility better than ±2% at N_2 for a constant molecular concentration in ionizer volume at 1 x 10^{-7} Torr.

Outputs: Direct output from the electron multiplier for use with an oscilloscope or recorder with an input impedance of 10^5 ohms or higher.

Electron Multiplier: Special high stability 14-stage Be-Cu multiplier with stable gain of about 10^5 at 3 kV dynode voltage; multiplier gain is variable from 10 to 100%; the first dynode of the electron multiplier may be used as a Faraday Collector without breaking vacuum.

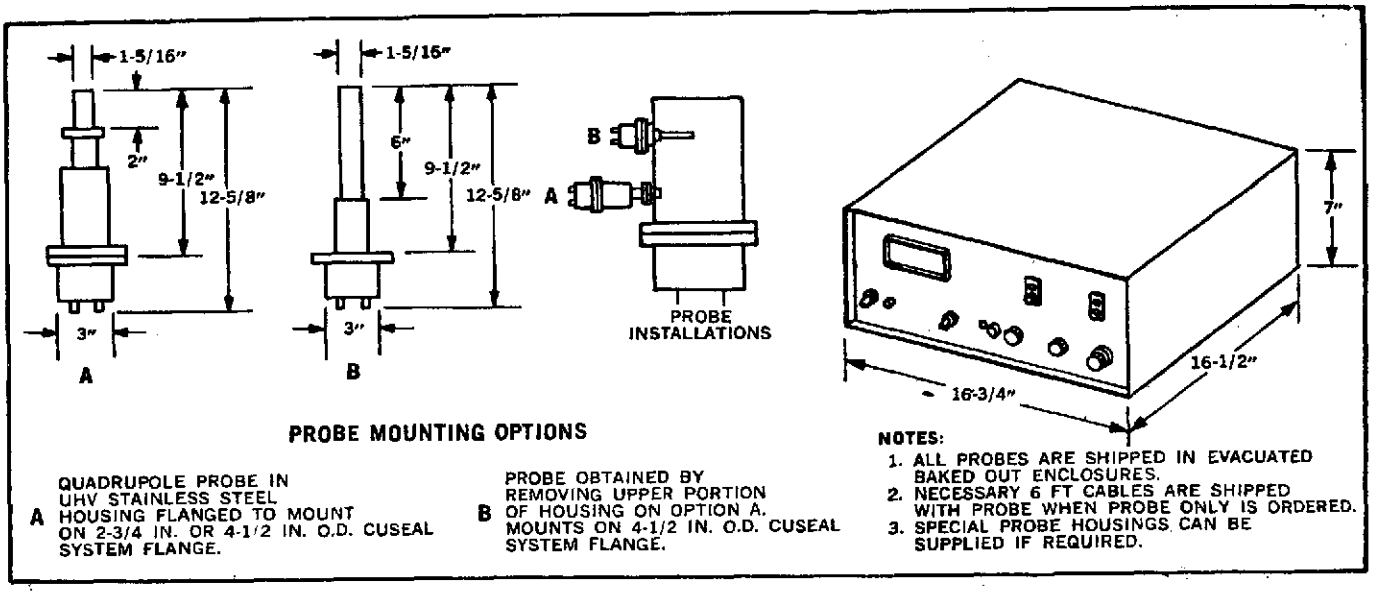
Gain Calibration: Facility for measuring current to the first dynode.
Bakeout: The probe can be baked to 400°C. The operating characteristics will return to specification after cooling to room temperature.
CuSeal® Flange Vacuum Connections: 2¾ in. o.d. or 4½ in. o.d.
Materials in Vacuum: Tungsten-3% Re, copper, stainless steel, alumina ceramics, and Pyrex glass.
Input Power: 115 volts, 50 to 60 Hz, 500 watts.
Instrument Console: Blower cooled, anodized aluminum front panel with textured grey side panels.
Standard Cables: 6 ft

	Net Weight (lb)	Shipping Weight (lb)
Flange-Mounted Probe:	9	60
Electronics Console:	40	50

Optional Equipment: (1) A remote R/F package allows SpectraScan 400 to be operated to specification with cables up to at least 25 ft in length. Longer cable operation is also available with this package at a sacrifice in performance. The RF/DC generator can be easily unplugged from its normal position in the operating console and moved to the remote position where it is then installed near, but not on, the probe. The size of the RF/DC generator is 5 in. high x 6 in. wide x 10 in. deep. Its weight is approximately 5 lb. The remote RF package consists of cables, matching connectors, and instructions. (2) Combination preamp/oscilloscope output package. This is a solid-state, high-frequency preamplifier that has the following characteristics:

Switch Position	Input R-Ohm	Preamp Output	Dynamic Range-Amp	Time Constant
X10^{-5}	10^{5}	10^{-5} amp per volt	10^{-4} to 10^{-8}	30 μsec
X10^{-7}	10^{7}	10^{-7} amp per volt	10^{-6} to 10^{-10}	30 μsec
X10^{-9}	10^{9}	10^{-9} amp per volt	10^{-8} to 10^{-12}	200 μsec

Three output connections are provided, one of which is used for the oscilloscope input. Input resistance of the scope is chosen so that oscilloscope sensitivity in amperes per cm equals sensitivity in volts per cm.
The preamp has an RC type filter with a panel switch marked in amu per second (sweep speed) over the range from 1 to 3,000 in seven steps.
The oscilloscope has a 5-in. face with centimeter marking external graticule. Sensitivity can be varied from 5 mv/cm to 5 volts/cm in 10 steps. The above combination permits measuring currents from the Quadrupole multiplier to 5 x 10^{-12} amps, with a 3:1 signal to noise level at 1.5 x 10^{-11} amps.



PROBE MOUNTING OPTIONS

A QUADRUPOLE PROBE IN UHV STAINLESS STEEL HOUSING FLANGED TO MOUNT ON 2-3/4 IN. OR 4-1/2 IN. O.D. CUSEAL SYSTEM FLANGE.

B PROBE OBTAINED BY REMOVING UPPER PORTION OF HOUSING ON OPTION A. MOUNTS ON 4-1/2 IN. O.D. CUSEAL SYSTEM FLANGE.

NOTES:
1. ALL PROBES ARE SHIPPED IN EVACUATED BAKED OUT ENCLOSURES.
2. NECESSARY 6 FT CABLES ARE SHIPPED WITH PROBE WHEN PROBE ONLY IS ORDERED.
3. SPECIAL PROBE HOUSINGS CAN BE SUPPLIED IF REQUIRED.

Ordering Information

Item	Catalog No.	Price
SpectraScan 400 complete with Probe and cables	289001	$6,975
Accessory Kit for remote operation of the RF/DC generator	289002	195
Preamplifier and monitor oscilloscope	289003	1,295
Probe Only with Cables	289004	3,750
Electronics Console Only	289005	3,750
14-Stage Electron Multiplier with beryllium copper dynodes and connections to the first dynode so that it may be used as a Faraday Collector without breaking vacuum; shipped in a vacuum container	289006	450
Filament Replacement Kit for ionizer; 1 filament premounted and pre-aligned plus 2 spare filaments and 4 spacers	289007	95
OFHC Copper gasket for 2¾ in. o.d. CuSeal flange (pkg. of 10)	214126	12
OFHC copper gasket for 4½ in. o.d. CuSeal flange (pkg. of 10)	214127	16
Bolt, nut, and washer set for 2¾ in. o.d. CuSeal flange (set of 25)	214129	12
Bolt, nut, and washer set for 4½ in. o.d. CuSeal flange (set of 25)	214142	19

#91 GAS ANALYZER, MASS SPEC

Purpose:

The purpose of the mass spectrometer is to provide an analysis of an unknown ionized gas by atomic mass number. This spectrometer differs from #90 in that it is a much smaller unit with a much smaller mass range that is used to automatically monitor environmental gases and for other low mass range measurements.

Requirements:

Mass range: 0-60 amu. Output: suitable for operating a recorder, oscilloscope, alarm system and the data acquisition system.

Hardware Status:

See equipment item #90.

Technical Description:

Flight Unit - Preliminary Estimate

Weight - 7 lbs.

Power - 40 watts

Volume - 0.2 cubic feet

Cost:

Development - $800K

Unit 100K

Development Time:

2 years

#93 GAS ANALYZER, WATER VAPOR SPECIFIC

Purpose

To monitor water vapor content, generally in atmospheric air.

Requirements

Range: tbd.

Hardware Status

Available laboratory devices include those which utilize psychrometers, hygroscopic membranes, and dew point detection methods. Any of these methods could be readily adapted to the biolaboratory application.

The sensing device planned for flight qualification and use on AAP is presented below (ref. Environmental Control and Life Support 1973 Component Specifications, BSM Definition Study, Contract NAS9-6796, Report 18-4-009, General Dynamics Convair, San Diego, October 1967, pg. 76).

Modification of this device to measure higher relative humidities may be required.

Technical Description

The sensing device consists of an oxidized aluminum strip covered by a thin layer of gold. The aluminum oxide acts as a dialectric between the gold and aluminum electrodes and its conductivity varies with the surrounding water vapor partial pressure.

Moisture range:	0.001 μg to 20,000 μg H_2O/liter (0 to 98% RH at 70° F)
Temperature range:	-110° C to +60° C
Output impedance:	200 ohms
Output voltage:	0-100 mv
Power:	6 watts
Input voltage:	110/220 @ 48 to 63 cps
Weight:	5.2 kg (11.5 lbs)
Envelope:	31.4 x 25.7 x 16.5 cm (12-3/8 x 10-1/8 x 6-1/2 in.)

Volume: .013 m^3 (0.47 ft^3)

Sensor size: Approx. 2.5 cm dia. x 10 cm long (~ 1" dia. x 4" long)

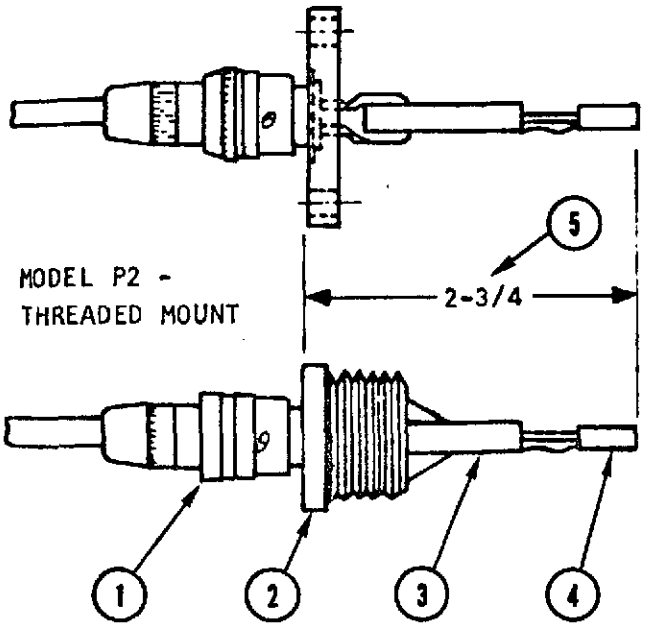
Cost -

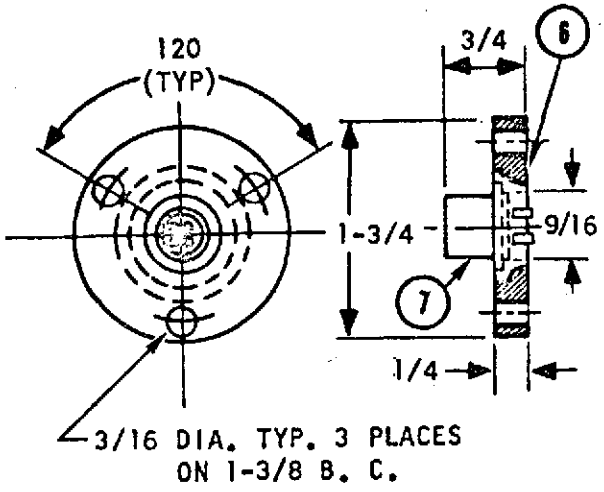
DEVELOPMENT 70K UNIT 10K

Development Time - One year.

STANDARD PROBE MOUNT ASSEMBLIES

MODEL P1 - FLANGED WALL MOUNT WITH O-RING





NOTE:
1. CLEARANCE HOLE 9/16 DIA NEEDED FOR MODEL -1
2. THREADED RECEIVING HOLE FOR 3/4-14NPT NEEDED FOR MODEL -2

1. BENDIX CONNECTOR NO. PT06W-8-4S
2. HEX MOUNT 3/4-14 NPT
3. TEFLON ELEMENT SUPPORT
4. HUMIDITY ELEMENT
5. THIS DIMENSION IS NOMINAL AND WILL VARY ± 1/8
6. O-RING CIRCLE O. D. = 1-1/8
7. BENDIX CONNECTOR NO. PTIH-8-4P

DEW-POINT SENSOR

#93A GAS SUPPLIES

Comments

Various gas storage vessels, for chromatograph operation, biochemical analyses, anesthesia, & sterilization. He, H_2, Air, CO_2, O_2, ETO. Payload specific.

#97A HEMATOCRIT, ELECTRONIC

Purpose

To automatically determine the % hematocrit in blood.

Requirements

Rapid % hematocrit readout

Temperature compensator

Hardware Status

Commercial units available (Scientific Products Catalog 1972, page 114), see page 97A-2. Unit requires conversion to space power and method of cleaning glass cell for reuse. Glass sample cell must contain liquid under zero-gravity.

Technical Description

The following are estimates for a space rated unit:

Weight	2.4 kg (≈ 5 lbs)
Width	18 cm (7 in.)
Length	10 cm (4 in.)
Height	18 cm (7 in.)
Power	10 watts

Cost

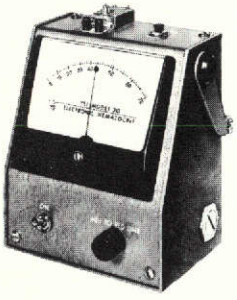
Commercial unit cost: $275.00

Estimated development and unit costs for space: $40K and $5K, respectively.

Development Time

One year.

114 BIOLOGICAL
BLOOD SEDIMENTATION



B4365

B4366-3

B4365
MICRO-HEMATOCRIT READER, Electronic (YSI Model 30)–Provides readings in less than 30 seconds; efficient method for blood bank donor screening. Pipet 0.02ml whole or heparinized blood into instrument, depress button, and read result–meter is calibrated directly in hematocrit percent units. Works under principle of conductivity of blood and insulating characteristics of erythrocytes. Built-in thermistor compensates for ambient temperature. Flush glass cell with acetone for immediate reuse. Power provided by one 6-volt battery; two piece aluminum case, 4" meter face. Dimensions: 5½"w × 4"d × 6½"h. With sample cell.
Order **B4365–Reader** . . . . . Each **$275.00**

#98A HOLDING UNIT, INVERTEBRATES, CELLS, AND TISSUES

Purpose

To hold invertebrate colonies (vinegar gnats, roaches, spiders, beetles, etc.), tissues, and microorganism cultures in a controlled viable environment.

Requirements

1. Total volume required:
   - Mini Lab: 5 ft^3
   - Midi Lab: Multiples
   - Maxi Lab:
2. Hermetically sealed
3. Standard spacecraft atmosphere
4. Pressure: 101 360 $\pm$ 6890 Pa (14.7 $\pm$ 1 psia)
5. T = 283 - 313 °K $\pm$ .1°K
   (10 - 40° C $\pm$ .1° C)
6. Water vapor pp: standard spacecraft okay
7. CO_2 pp: 400 Pa (3 mm Hg)
8. Instrumentation must include temperature measurements every 60 minutes and humidity every 6 hours (to be stored for subsequent display and dump).
9. Holding unit must withstand 14.7 psia in either direction.
10. Mate with laminar flow bench.
11. Air flow not critical except to maintain O_2, CO_2, and RH

Hardware Status: Conceptual Design Item. Similar to cage module, E.I. 103, E.U.40.

Technical Description

Estimated flight properties:

Weight	70 lbs
Power	50 watts
Volume	6.64 ft^3

Cost

Estimated @ $10K unit. Development cost included in E.I.103, E.U.40.

#98C HOLDING UNIT, INCUBATOR - INVERTEBRATES

Comments

Holding Unit for Invertebrates. Basically a cage module. Dev. cost in E.I. 103, E.U. 40.

#100 PRIMATE METABOLIC MASS BALANCE EQUIPMENT

Purpose

The purpose of this equipment is to obtain metabolic mass balance measurements on primates. It would be integrated with the standard primate holding units.

Requirements

This equipment should ideally measure oxygen consumption, CO_2 production, water consumption, food consumption, urine production, feces production, and heat output. The exact requirements have not been determined.

Hardware Status

Individual components to perform the various measurements are available. However, the techniques to be used must be determined in conjunction with the design of the holding units. Precise measurements will be difficult to obtain, especially of a few of the paramaters such as heat output and water output in the form of urine, perspiration, and respiratory water vapor.

Technical Description

This equipment is estimated to weigh 90 lbs, require 70 watts and occupy 5 ft^3.

Costs

Estimated development cost:	$1000K
Estimated unit cost:	$100K

#101 HOLDING UNIT, PLANTS

PURPOSE:

This unit houses plants in their pots or other suitable containers. It provides the necessary support functions or interfaces.

REQUIREMENTS:

1. Plant size: 0 to 20 cm (7.87")
2. Temp. in flight during experiment 288-399°K ±0.5°K (13-27°C ±5°C)
3. Pressure 101360 ±6890 Pa (14.7 ±1 psia).
4. Water vapor partial pressure: 1185-2667 Pa (0.172 - .387 psi, 8.89 - 20 mm Hg).
5. Carbon dioxide partial pressure: 400 Pa (3 mm Hg)
6. Designed for mating with the laminar flow bench.
7. Temp., storage during delivery: 281-297°K ±0.5°K (4-24°C ±0.5°C). (This hold unit may not be used for this purpose)
8. Temp., return: special

HARDWARE STATUS:

Conceptual design item

TECHNICAL DESCRIPTION:

This holding unit can be common to the cage module, see Item #103 E.U.40.

However, extra electrical power is required for lighting. This is estimated at 140 watts.

Cost

Development	- In EI 103.
Unit	$10K

#103 HOLDING UNIT, SMALL VERTEBRATES

Purpose:

This unit contains and supports a range of cage size including those for mice, rats, and rabbits. For these cages, it provides structural support, life support connections, atmospheric control and hermetic isolation, data management connections, etc.

Requirements:

Based on the cage module concept, the following preliminary requirements apply:

1. Must withstand 101, 360 Pa. (14.7 psia) in either direction.
2. Preliminary size: 45.7 x 61 x 61 cm (18 x 24 x 24 inches).
3. Designed to support any of the following max. loads:
   a. 32 mice
   b. 8 rats
   c. 2 rabbits
4. Designed for mating with the laminar flow bench.

Hardware Status:

Conceptual Design Item

Technical Description:

1. See sketch
2. Wt: 60 lbs. excluding cages and instrumentation.
3. Power 0 watts
4. Volume: 6 ft^3

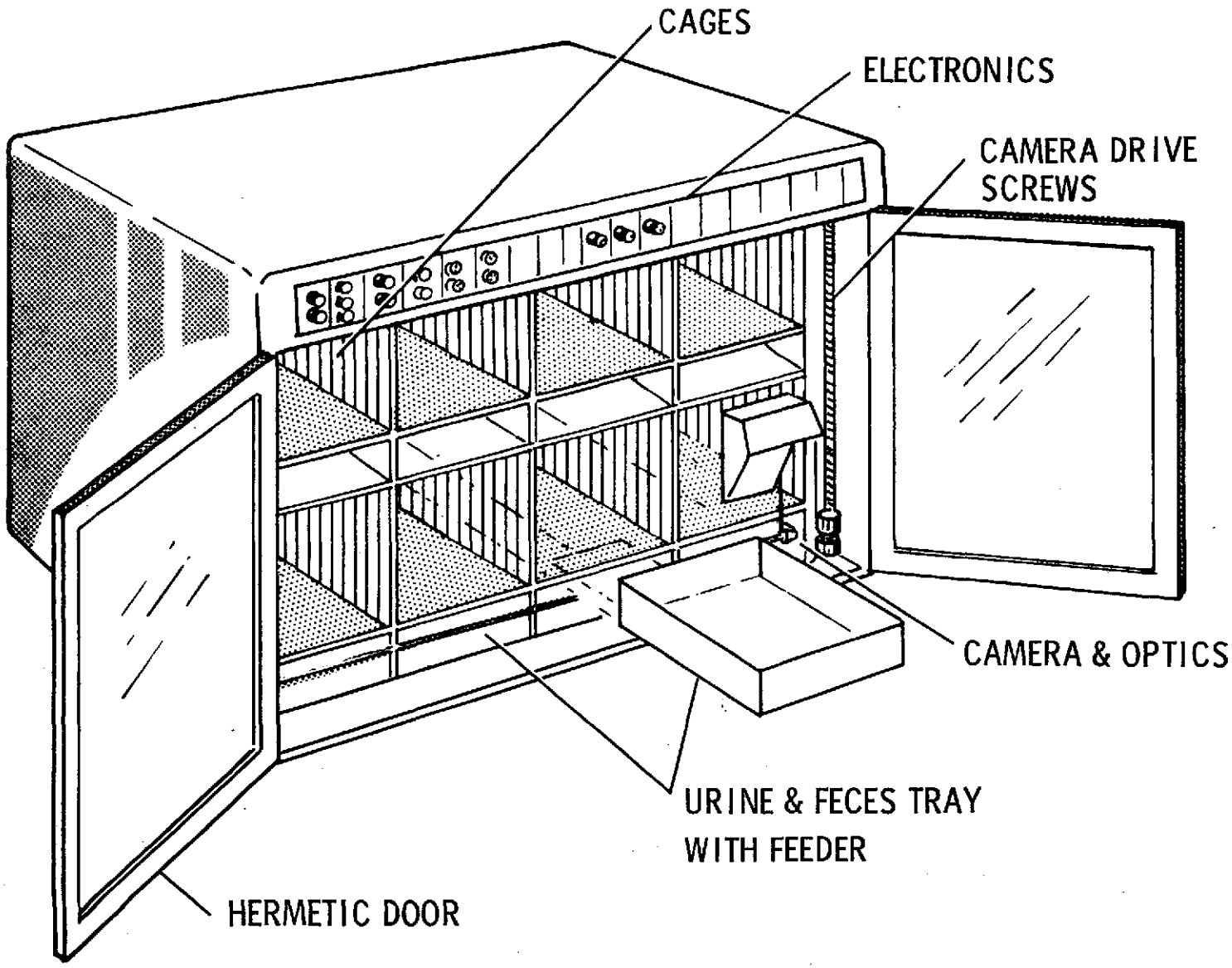
Cost:

Estimated at $500OK development, $10K unit.

DEVELOPMENT TIME: 2-3 years

GENERAL DYNAMICS
Convair Aerospace Division

CAGE MODULE



#104E COUPLER, IMPEDANCE CARDIOGRAM

Comments

Definition sheet for E.I. 156, E.U. 2 applies.

#104F IMPEDANCE PNEUMOGRAPH

Comments

To measure breathing cycle characteristics as well as variations in thoracic conduction during respiration.

#105 KIT, BENCH CHEM ANAL

PURPOSE: This kit contains the tools and equipment to manage chemicals and biologicals during various manual procedures generally performed within the glove box.

REQUIREMENTS:

TBD

HARDWARE STATUS:

Common earth-laboratory items are available as prototypes for orbiting-laboratory adaptations.

TECHNICAL DESCRIPTION:

Solid chemicals transport tools
Gravity-independent pipettes, vials, bottles, and test tubes
Chemicals, stoppers filters, and safety shields.

Volume: 4 ft^3

Weight 40 lbs.

COST: Preliminary estimates for flight kit:

Development: $100K
Unit: 10K

Equivalent commercial unit cost estimate: $300

DEVELOPMENT TIME: 2 years

#106 KIT, HEMATOLOGY

Purpose

To provide tools for sampling,handling, transferring, and analyzing blood.

Requirements

The following is a representative list of items needed in a hematology kit:

	No. in Kit
Hemacytometer Kit	1
10 Lambda **Dispopipettes**	100
Coverslips	100
Slides	150
WBC Diluent	15 cc
RBC Diluent	15 cc
Critoseal (microtube sealer)	3 pkgs
Hematocrit Tubes (micro, heparinized)	100
Hematocrit Tubes (micro, plain)	100
Blood Diluting Pipettes (WBC, RBC)	10
Combistix (Urine test strips)	100
Luer Adapters, Vacutainer	5
Vacutainer Syringe (Large)	2
Pediatric Vacutainer - Needle Unit	6
Vacutainer Tubes, Assorted (2 ml)	12
Alcohol Swabs	25
Lancets	25
Needle, 25 ga, 5/8 in.	12
Needle, 22 ga, 1-1/2 in.	12

#106-2

Hardware Status

Most ground based commercial equipment can be used in space.

Technical Description

Estimated properties for a flight type kit are:

Weight:	10 lbs
Power:	0
Volume:	0.5 ft^3

Cost

Estimated flight item costs are:

Development:	$7K
Unit:	1K

Commercial item costs are approximately $0.1K

DEVELOPMENT TIME: 1 year

#106A KIT, CLEAN-UP

Comments

General purpose sponges, wipes, etc.

#108 KIT, HISTOLOGY

Comments

Fixatives, forceps, slides, operating scissors, plastic bags, etc.

#109 KIT, LINEAR MEASUREMENT

PURPOSE:

To determine size, amplitude, distance, circumference, etc.

REQUIREMENTS:

TBD

HARDWARE STATUS:

Commercial items adaptable

TECHNICAL DESCRIPTION:

Rulers
Tapes
Linear comparator
Grids
Calipers, inside and outside
Vernier calipers
Micrometers, inside and outside

Volume: 2 ft^3

Weight: 20 lb

COST: $500 EST

DEVELOPMENT TIME: 6 months

#110 KIT, MICROBIOLOGY

Purpose

To provide tools to facilitate growing and analyzing microbial organisms.

Requirements

The following list is a representative list of items needed in a microbiology kit:

	No. in Kit
Inoculating Loop	2
Inoculating Needle	1
Cotton Swabs, Packages, Sterile	20
Syringe. 5 ml, Sterile	6
Slides. Micro	75
Alcohol	30 ml
Tubes, 15 x 75mm, Sterile, Capped	10
Zephiran, Tincture, 1:500	50 ml
Bactecinerator (sterilizing unit)	1
Thioglycollate, Tubed	6
Stuart Transport Media, Vials	10
TSA Slants	6

Hardware Status

Most ground based commercial equipment can be used in space.

Technical Description

Estimated properties for a flight kit are:

Weight: 5 lbs
Power: 0
Volume: 1 ft^3

Cost

Estimated flight item costs are:

Development: $40K
Unit: 5K

DEVELOPMENT TIME: 1 year

#110B KIT, ORGANISM HOLDING AND MANAGEMENT

Purpose

To provide tools and devices used in the holding and handling of the organisms.

Requirements

The following items are representative of those required in this kit.

For Small Vertebrates	No. in Kit
Glove powder	2
Cage Shield, Plastic	1
Plastic Liner with Pad	1
Food Pellet Dispenser	1
Alcohol Swabs	2
Towels, Paper, Dispo.	1
Plastic Bag (for expendables)	1
Plastic Bag (for nonexpendables, i.e., food dispensers)	1
Organism Transfer Capsule	1
Animal Tags	8

For Plants	No. in Kit
Watering Device (spray bottle)	1
Labels	6
Fertilizer Packets	1
Stakes (10 cm)	1

For Cells/Tissues/Invertebrates No. i

Use the following kits for Holding Management Operations:

Kit, Microbiology
Kit, Microdissection (Histology)

Hardware Status

Ground based equipment with minor modifications is generally applicable.

Technical Description

Estimated flight kit properties are:

Weight:	20 lbs
Volume:	2 ft^3
Power:	0

Cost

Estimated flight item costs are:

Development:	$25K
Unit:	$ 3K

Development Time

1-2 years.

#110C KIT, PHYSIOLOGY

Comments

Sponges, sponge squeezer, vials, caloric stimulator for ear canal, questionnaires, syringes, thermometer, tonometer, etc.

#111 KIT, PLANT TOOLS

Purpose

This kit provides tools for various plant manipulations.

Requirements

tbd

Hardware Status

Commercially available - minor modifications may be required.

Technical Description

Scissors
Tweezers
Spatula
Applicator
Splints
Tape dispenser
Hypodermic needles
Syringes
Forceps
Pliers
Screwdriver
Scalpels
Sealers

Estimated properties of this kit are:

Weight: 20 lbs

Power: 0

Volume: 4 ft^3

Cost

Estimated flight item costs are

Development $25K

Unit $ 3K

Development Time

2 years

#112 KIT, MEDICAL-SURGICAL

Comments

For various minor surgical procedures. Forceps, knife holder, scissors, retractors, plastic bags, etc.

#113 KIT, GENERAL TOOL

Purpose

This kit includes the mechanical and electrical tools and hardware to provide conventional diagnostic, maintenance, and service functions. It should be noted that most maintenance functions will be of a remove and replace nature.

Requirements - tbd.

Hardware Status

Most of the tools will require some design modification for efficient use in the 0-g environment.

Technical Description

The kit will probably include the following 0-g type tools:

Hammer	Lubricants
Wrenches	Flashlight
Pliers	Scissors
Screw Drivers	Multimeter
Drill	Fasteners
Adhesive Tape	Clamps
Wire Cutters	Lamp
Wire Ties	Etc.
Wire	

The properties of the overall kit are estimated below:

Weight:	9 kg (~ 20 lbs)
Volume:	.03 m^3 (~ 1 ft^3)
Power:	50 watts (for trouble light)

Cost -

Development	$40K
Unit	$5K

Development Time - 1-2 years.

#113A KIT, TOOL - INSECT MANIPULATION

Comments

Tool kit for counting, sorting, examination, etc.

#114A KIT, MICRODISSECTION

Comments

Forceps, knife holder, retractors, scissors, etc.

#115 KIT, VETERINARY

Comments

Dissection equipment, electrophysiology equipment, restraint systems, etc.

#115F LIFE SUPPORT AND PROTECTIVE SYSTEM TEST UNIT

Purpose

This unit is a general purpose console to support tests on various life support and protective systems equipment.

Requirements

It should contain a place for the test apparatus (such as a 0-g gas liquid separator), and the needed support provisions such as electric power, gases, water, cooling fluids, vacuum, etc.

Hardware Status

Individual components which are required are available. An integrated unit will have to be designed and built.

Technical Description

The technical description is yet to be determined. Estimated properties are:

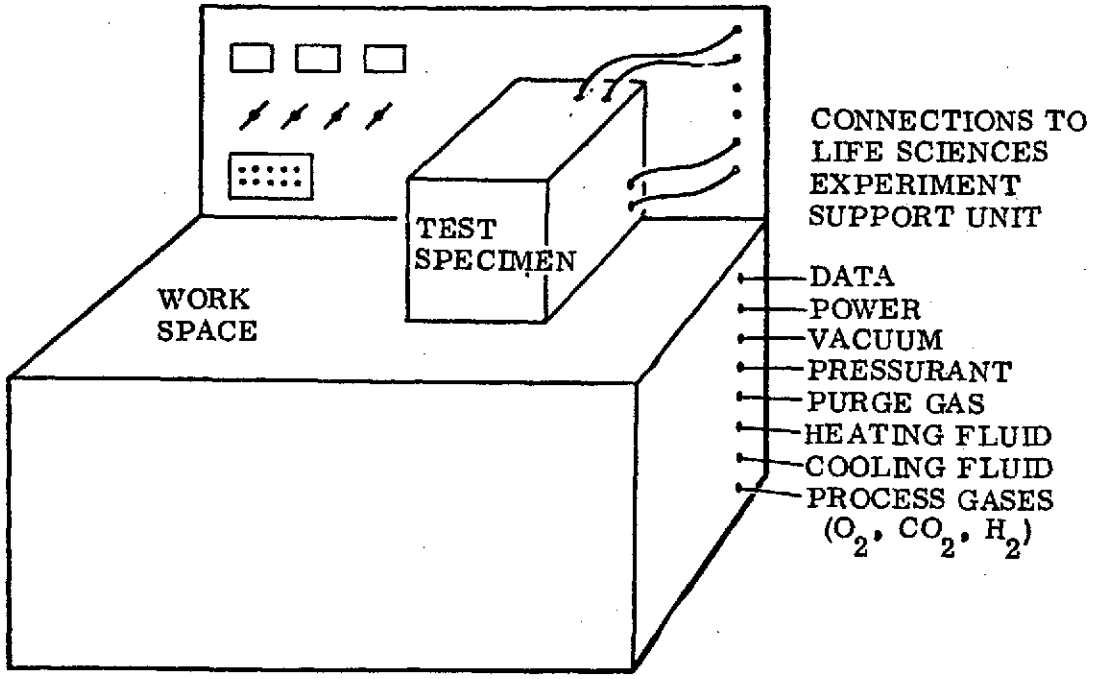
Weight:	100 lbs
Power:	200 watts, including the power required for a typical test apparatus (a Bosch reactor was used as an example).
Volume:	16 ft^3

Cost

Estimated Development Cost:	$1000 K
Estimated Unit Cost	$100 K

Development Time

1-1/2 years.



Concept of Life Support Subsystem Test Unit

#116 LOG BOOKS

Comments

For daily records.

#118 LYOPHILIZER

Purpose

To provide freeze drying of small specimens. Note: This unit could probably be combined with the vacuum oven (see Technical Description below).

Requirements

1. Capacity to hold approximately 20 samples of approximately 16 cc (1 in^3) volume. Freezer chambler size is estimated at 12 x 12 x 20 cm (~5 x 5 x 8 in).

Hardware Status

Mechanical refrigeration systems will require modification for this low temperature as well as for 0-g operation, and units will require positive hold-downs. Space vacuum can be used.

Technical Description

A catalog description of a unit which pro ides both cooling and heating under vacuum conditions is attached (Ref. Scientific Product Catalog, Division of American Hospital Supply Corp., 1210 Leon Pl., Evanston, Ill., 1968). The properties of this unit were used for flight estimates for the present time, until a more detailed definition of this item is developed.

Temperature range:	-40° C to 122°C (-40°F to 250°F)
Overall dimensions:	66 x 47 x 46 cm (26" w, 18½"h, 18"l)
Volume:	143,000 cc (5 ft^3)
Estimated weight:	23 kg (50 lbs)
Estimated Power:	300 watts

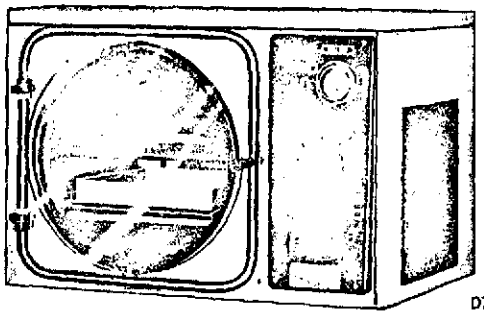
Cost

Preliminary estimates for flight unit:

$200K development
$ 20K unit

Commercial unit: $1.4K

DEVELOPMENT TIME: 1 - 2 years



D7027-5

D7027-5

TRAY DRYING CHAMBER, Vacuum Stoppering (VirTis 10-MR-SA)—Front loading, single shelf tray drying chamber, mounted in a portable epoxy-white coated steel cabinet. To connect to mobile freeze-dryer simply slip fit high vacuum outlet at base of chamber into 3" opening on cabinet top. Built-in refrigeration system cools the process shelf to –40°F for pre-freezing samples. Black anodized aluminum process shelf is electrically heated and thermostatically controlled between +60°F and +250°F to expedite drying. Shelf temperature is clearly indicated at all times whether cooling or heating.

Removable stoppering plate seals serum bottles with split rubber stoppers, preserving freeze-dried materials under the original vacuum. Tray can be used for bulk and radiant drying.

3 phono-plug connections are built into vacuum chamber to enable convenient connection of electronic sample temperature indication control of recording instrumentation. Auxiliary electrical outlet also provided. Large, glass clear adjustable Lucite® vacuum chamber closure with pressure latch permits full visibility of the samples. Overall dimensions: 26" w, 18½" h, 18" l; tray measures 10" x 10"

Order **D7027-5—Chamber** ..... Each **$1390.00**

#118D MANIFOLD, ORGANISM WATER

Comments

Manifold for organism watering. Laboratory specific.

#1181 MANIFOLD, VACUUM

Comments

To provide vacuum line connections to various test apparatus. Small tubing (about 3/8 inch) should be sufficient. Valves, etc.

#119 MSI TASK SIMULATOR

Comments

For testing astronauts' ability to do maintenance, repair, assembly, etc. Experiment specific.

#119A TELEOPERATOR CONTROL CONSOLE

Purpose:

An experimental control console for studying man's ability to perform EV tasks from within the space vehicle. Its configuration will vary depending on the class of teleoperator (remote manipulator, free-flying satellite manipulator, etc.) and configuration of teleoperator that it controls.

Requirements:

1. Provide a control station for EV teleoperators.
2. Requires appropriate controls - master arms, hand/wrist/forearm harness, switches, etc. - depending on configuration of teleoperator.
3. Requires direct viewing window and video monitor depending on visual feedback experimental conditions.
4. Requires replaceable end effectors on teleoperator arms for a variety of experimental tasks.

Hardware Status:

The remote manipulator with replaceable end effectors that is being considered for the space shuttle may be satisfactory for remote manipulation experiments. Other categories such as free-flying satellites with remotely-controlled arms require control consoles that are conceptual design items.

Technical Description:

Weight: 200 pounds

Volume: 10 cubic feet

Power: 40 watts (ave.)
800 watts (peak)

Cost:

Development cost: $1000K

Unit cost: $50K

Development Time: Approximately 3 years

#121 MASS MEASUREMENT DEVICE, MACRO

Purpose

To measure the mass, in the 0.1 to 30 kg range, of items such as bags of food, beverage containers, containers of urine and feces, large specimens, etc.

Requirements

1. A device which is easy to use, accurate, small, lightweight, and requires little electrical power.
2. A device capable of measuring masses in the 0.1 to 30 kg range in the zero-gravity environment.
3. A device that requires minimum stowage volume, can be rigidly mounted in its deployed configuration, and provides sufficient controls such as a locking control, cocking lever, and release trigger for easy and accurate operation.

Hardware Status

Conceptual design item. Modification of IMBLMS Specimen Mass Measurement Device (SMMD) may be possible to meet requirements.

Technical Description

Estimated values:

Weight:	30 pounds
Power:	30 watts
Volume:	5 cubic feet

Development Time

1 year.

COST

DEVELOPMENT 20K SKYLAB UNIT
UNIT 10K

#122 MASS MEASUREMENT DEVICE, MICRO

Purpose

To measure small test specimens in the 1 mg to 100 g range.

Requirements

Mass measurements in the 1 mg to 100 g range in the zero-gravity environment.

Compact stowage.

Rigidly mounted when deployed.

Controls for ease and accuracy of operator use such as locking levers, cocking levers, and release triggers.

Hardware Status

Conceptual design item.

Technical Description

Estimated values:

Weight:	10 pounds
Power:	15 watts
Volume:	0.5 cubic feet

Development Time

3 years.

Cost

Development	$2,000 K
Unit	$20 K

#122A MASS, TEST (VARIABLE SIZE, WEIGHT, SHAPE, ETC.)

Purpose:

Masses of various sizes, shapes, etc. to be used as simulated cargo, equipment, etc. during cargo handling studies designed to evaluate the mass handling limits of one or more crewmen.

Requirements:

Must be existing equipment, containers, etc. that are required on board for some other purpose but can be specially designed to function as test masses (the inclusion of dead weight in a payload, strictly to serve as test masses, is unnecessary and prohibitive).

Size range should vary from 25 pounds to in excess of 150 pounds in approximately 10-pound increments (the largest mass should be greater than 300 pounds for two-man studies).

Packages should be designed to allow attachment of a variety of handholds, body tethers, etc. at multiple locations on the package.

Hardware Status:

Conceptual design item

Technical Descriptions:

Weight = no additional
Power = " "
Volume = " "

Cost:

None or minimal additional cost if requirement is specified early in design cycle of selected equipment items.

Development Time: See comment under Cost.

#124 MEDIA, PREPARED

PURPOSE:

To support organism growth

REQUIREMENTS:

Isolation from contaminants

HARDWARE STATUS:

Commercially available.

TECHNICAL DESCRIPTION:

Microorganism culture media can be stored in sterilized and sealed bottles, aluminum foil packets, metal containers, vials, etc.

Volume	0.5 ft^3	EST
Weight	10 lb	EST

COST: Estimated at 0 for development and $1K unit.

DEVELOPMENT TIME: 0-1 year

#125B METERS, ASSORTED

Comments

Needed throughout the laboratory, laboratory specific,

#125C METER, AOTS

Comments

Americal Optical (AO) total solids (TS) refractometer. A hand-held optical device for the measurement of total dissolved-solids in liquids.

#125D METABOLIC ANALYZER

Comments

Measures respiratory parameters, such as air way resistance, lung compliance, gas concentration, etc. Item developed for Skylab.

#126 MICROSCOPE, COMPOUND

Purpose

To provide the experimenter with a general purpose binocular microscope for microscopy studies of tissues, etc. To permit the taking of photographs of selected specimens at the same time.

Requirements.

Magnification 10 x to 1000 x

Binocular Construction

Photographic Capability:

Polaroid film, 4 x 5 film and 35 mm roll film.

Camera to use film back of items # 34 and 35.

Lighting

Dark field or Light field and phase contrast

Hardware Status

Existing model of Carl Zeiss Co.; Model "Ultraphot II"

Magnification: 2.5 x to 2500 X

Camera Attachment:

Polaroid, 4 x 5 film, 35 mm roll

Technical Description.

Size 0.8 cu ft.

Weight 15-20 lbs.

Power 25 W
(illumination)

Cost $8000 com. 252

FLIGHT COST

DEVELOPMENT - 20K

UNIT 12K

Development Time

C-1

#126A MICROSCOPE, DISSECTING

Purpose

To permit detail dissecting of biological specimens such as plants, animal tissue and organs.

Requirements

Stereo eyepiece head

Adjustable bright and drak field illumination

Hardware Status

Commercial units are available with zoom or trinocular heads for simultaneous viewing and photography. See pages 126A-1 through 126A-4. Space rating minimal — requires materials and electrical systems compatible for crew safety.

Technical Description

The following estimates are applicable for space:

Weight:	9 kg (20 lbs)
Volume:	28 dm^3 (1 ft^3)
Power:	63 watts

Cost

Commercial costs approximately $900.00. Estimated development and unit costs are $10K & $5K, respectively.

Development Time

1 year.

OLYMPUS DARKFIELD ZOOM–STEREO MICROSCOPE

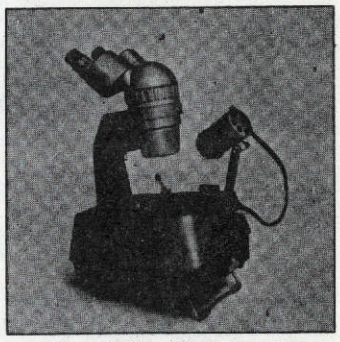
MODEL JM

The optical system of the JM provides instant, smooth and continuous selection of any desired magnification over a 5.7-to-1 range, with no change in focus or working distance and no image blackout during magnification change. Normally equipped for a magnification range of 7× to 40×, the JM may be adapted for other magnifications from 3.5× to 160× with a choice of 0.5×, 0.75×, 1.5× and 2× auxiliary lenses.

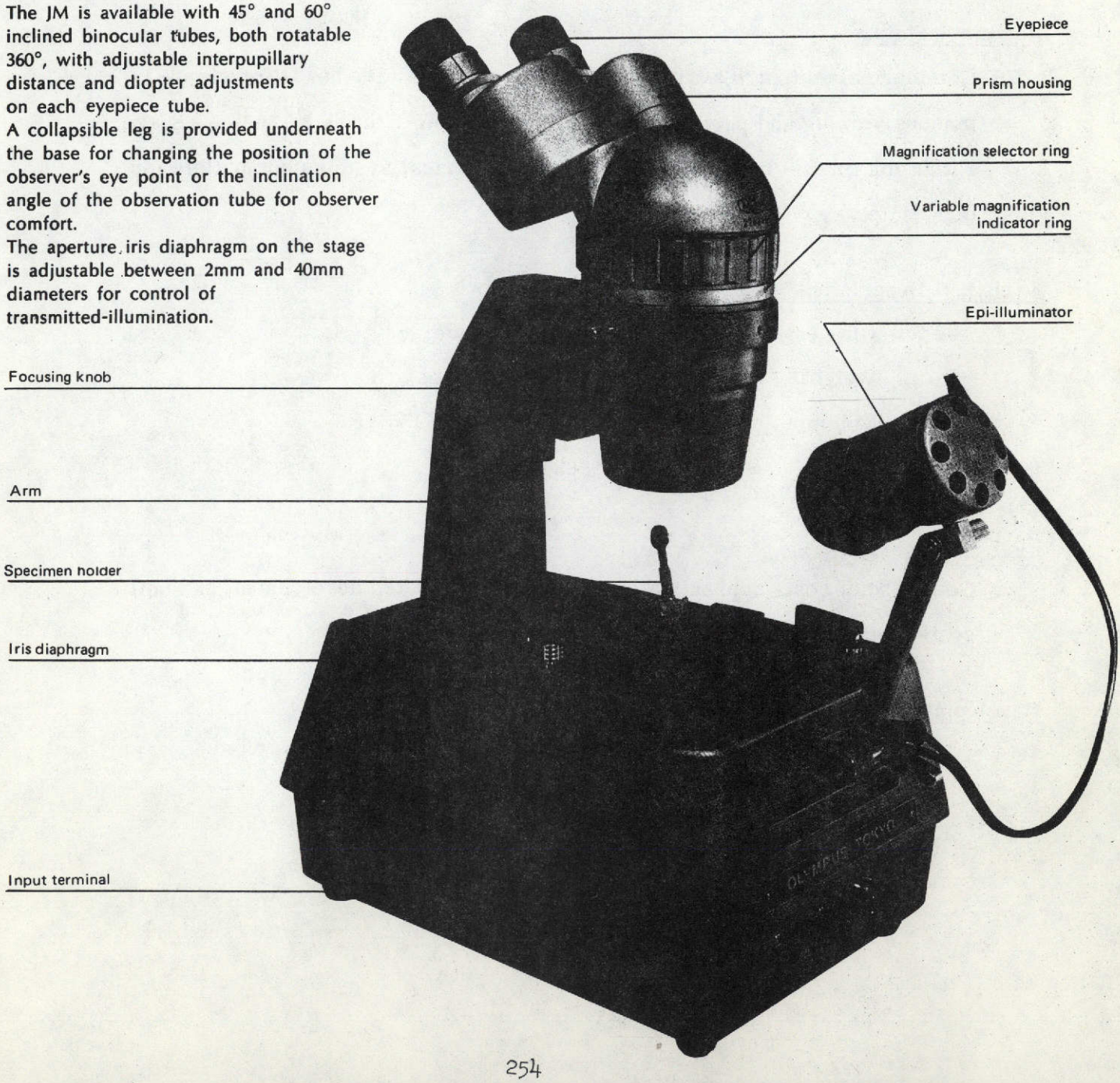
The JM is available with 45° and 60° inclined binocular tubes, both rotatable 360°, with adjustable interpupillary distance and diopter adjustments on each eyepiece tube.

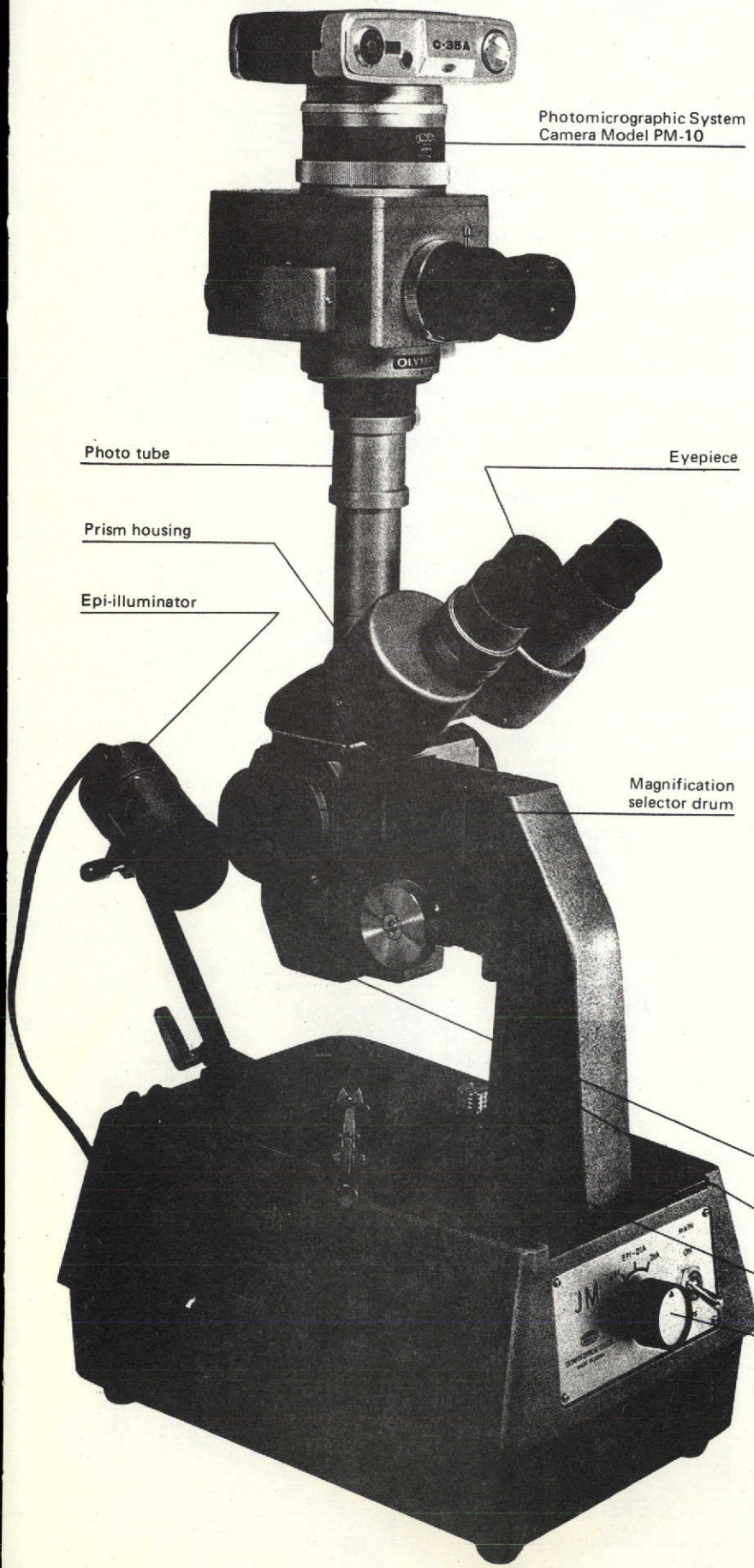
A collapsible leg is provided underneath the base for changing the position of the observer's eye point or the inclination angle of the observation tube for observer comfort.

The aperture iris diaphragm on the stage is adjustable between 2mm and 40mm diameters for control of transmitted-illumination.



Collapsible leg





OLYMPUS DARKFIELD STEREO MICROSCOPE

MODEL JM-Tr

The JM-Tr, thanks to its unique trinocular optical system, allows photographs to be taken at any time, with no interruption in viewing and no need to re-focus.
In every field where stereoscopic examination and photomicrographic documentation is required the trinocular darkfield stereo microscope JM-Tr presents significant advantages.
The convenient trinocular tube consists of a binocular tube inclined 45° and a vertical photo tube for photomicrographic, cinematographic or television work.
The total visual magnification with the new turret 5-step magnification changer ranges from 6.3× to 80×, for photography from 6.3× to 40× with the standard photo eyepiece P10× for both viewing and photomicrography.
A collapsible leg is provided beneath the base for changing the position of the observer's eye point or the inclination angle of the observation tube for observer comfort.
The aperture iris diaphragm on the stage is adjustable between 2mm and 40mm diameters for control of transmitted-illumination.
Photographic accessories available include 35mm, 3¼″×4¼″ Polaroid® and 4″×5″ sheet film cameras, a viewing screen, and a combination exposure/color-temperature meter. These photo accessories require use of flat-field P7×, P10× or P15× photo eyepieces.

® "Polaroid" is a registered trade mark of the Polaroid Corporation, Cambridge, Massachusetts, U.S.A.

Specifications

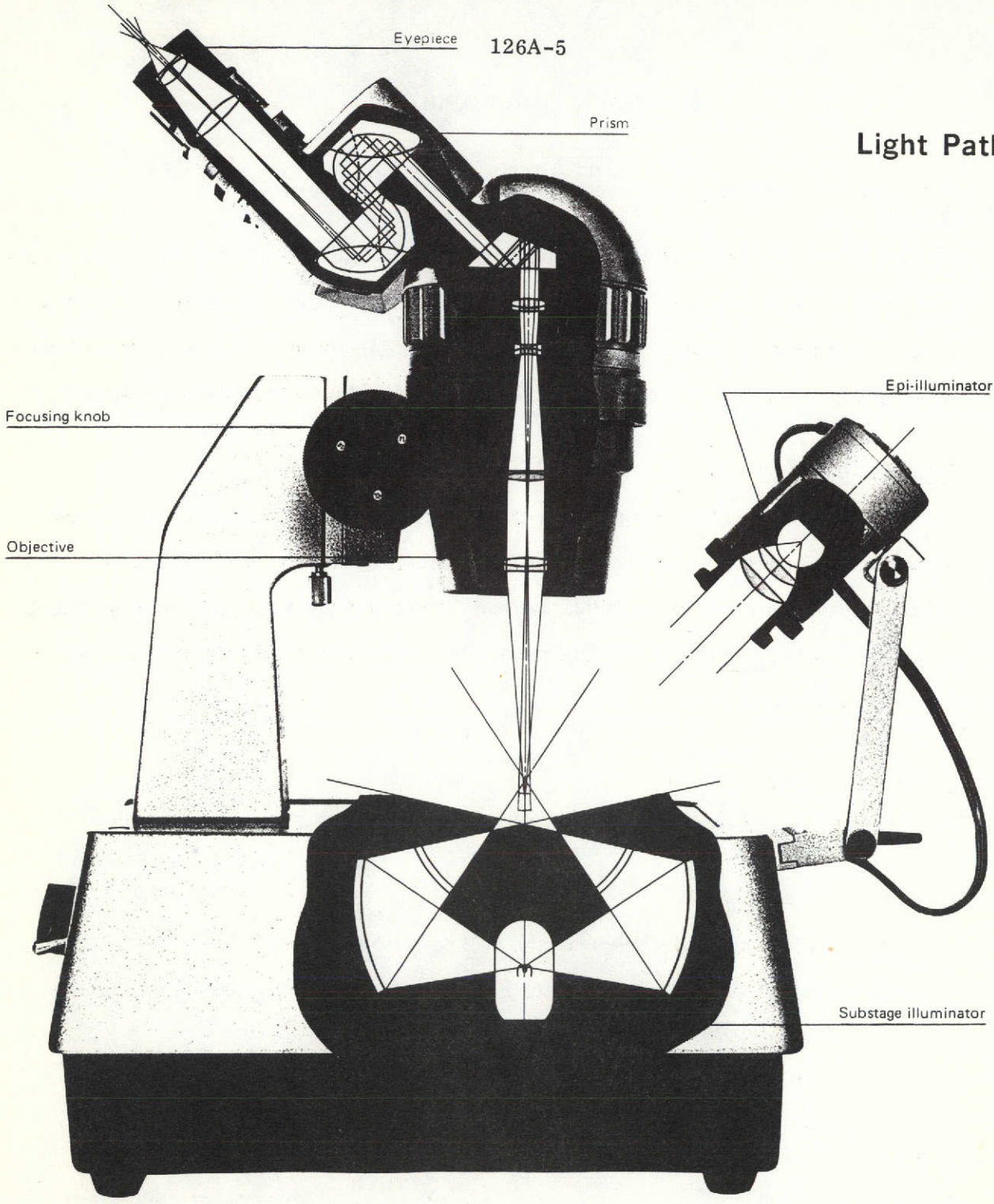
	JM	JM-Tr
Main Body	Binocular tube, inclined 45°, rotatable 360°, with locking screw. For maximum observer comfort 60° eyepiece tube is available on special order. Angle of visual axes is 12° for optimum image coincidence. Zoom ratio 5.7 : 1	Trinocular tube, including 45°-inclined binocular tube with locking screw plus vertical photo tube. Prism housings geared together. Angle of visual axes is 12° for optimum image coincidence. Auxiliary magnifiers are incorporated on a built-in revolving turret; for easy choice of total magnifications of 6.3×, 10×, 16×, 25× and 40× with standard G10× eyepiece.
Interpupillary Adjustment	With G10× eyepiece : 53mm–79mm (2.09″–3.11″) With G20× eyepiece : 49.5mm–75.5mm (1.95″–2.97″)	With G10× eyepiece : 50mm–80mm (1.97″–3.15″) With G20× eyepiece : 46mm–80mm (1.81″–3.15″)
Diopter Adjustment	±2.5 diopters on each eyepiece tube, accommodating individual eye differences up to 5 diopters.	
Total Magnification	14×—80×	6.3×—80×
Focusing	By vertical movement in a range of 55mm (2.17″). Focusing by diagonal-cut rack and pinion; tension adjustable by counter-rotation of right- and left-hand focusing knobs.	By vertical movement in a range of 38mm (1.50″) by rack and pinion.
Illuminators	Built-in 20 watt transmitted illuminator with brightfield-darkfield selector switch, available or 100V, 120V, 220V or 240V. The diameter of the aperture iris diaphragm is continuously variable from 2mm to 40mm (0.09″ to 1.57″). A 12 watt epi-illuminator, built on a swivel-joint arm with focus adjustment, may be used individually or simultaneously for oblique illumination.	
Working Distance	88mm (3.46″)	86mm (3.39″)

Optical Data : Model JM

Auxiliary Objectives	Working Distance mm (inch)	G10× Eyepiece	G15× Eyepiece (Optional)	G20× Eyepiece	Field of View		
					With G10×	With G15× (Optional)	With G20×
1×	88mm (3.46″)	7×–40×	10.5×–60×	14×–80×	31.4–5.5mm (1.24″–0.22″)	18.8–3.25mm (0.74″–0.13″)	17.4–3.1mm (0.69″–0.12″)
0.5×	159mm (6.26″)	3.5×–20×	5.25×–30×	7×–40×	62.9–11.0mm (2.48″–0.43″)	37.1–6.5mm (1.46″–0.26″)	34.8–6.1mm (1.37″–0.24″)
0.75×	105mm (4.13″)	5.25×–30×	7.875×–45×	10.5×–60×	41.9–7.3mm (1.65″–0.29″)	24.7–4.3mm (0.97″–0.17″)	23.2–4.1mm (0.91″–0.16″)
1.5×	45mm (1.77″)	10.5×–60×	15.75×–40×	21×–120×	20.95–3.7mm (0.82″–0.15″)	12.3–2.2mm (0.48″–0.09″)	11.6–2.0mm (0.46″–0.08″)
2×	30mm (1.18″)	14×–80×	21×–120×	28×–160×	15.7–2.75mm (0.62″–0.11″)	9.3–1.6mm (0.37″–0.06″)	8.7–1.5mm (0.34″–0.06″)

Model JM-Tr

Eyepiece / Objective	G10×		G15× (Optional)		G20×	
	Magnification	Field of View	Magnification	Field of View	Magnification	Field of View
Objective 1× *Working Distance 86mm (3.3″)*	6.3×	32mm (1.26″)	9.45×	20.6mm (0.81″)	12.6×	16.0mm (0.63″)
	10×	20mm (0.79″)	15×	15.8mm (0.62″)	20×	10.0mm (0.39″)
	16×	12.5mm (0.49″)	24×	8.1mm (0.32″)	32×	6.25mm (0.25″)
	25×	8.0mm (0.31″)	37.5×	5.2mm (0.20″)	50×	4.0mm (0.16″)
	40×	5.0mm (0.20″)	60×	3.2mm (0.13″)	80×	2.5mm (0.10″)



Standard Equipment

	JM	JM-Tr
Main Body with binocular tube	1	0
Main Body with trinocular tube	0	1
Stand with substage transmitted illuminator	1	1
Eyepieces: Wide Field G10× (paired)	1	1
Wide Field G20× (paired)	1	1
Photo Eyepiece, Wide Field P10×	0	1
Specimen Holder	1	1
Epi-illuminator, model LSG-II	1	1

	JM	JM-Tr
Glass Stage Plates, 70mmφ (clear and frosted)	2	2
Eyepiece Caps	2	2
Dust Cap for photo tube	0	1
Eye Shades (for G eyepieces)	2	2
Dust Cover	1	1
Wooden Carrying Case	1	1
Spare Bulbs: 20W	2	2
6V, 12W	2	2

#126B MICROPHONE

Purpose

Microphones are used in the laboratory for biology, biomedicine and manned systems integration. Uses include (1) monitoring organism produced sound levels, (2) monitoring background noise, (3) voice data recording, (4) recording the verbalizations of human subjects in test environments, and (5) arterial blood pressure measurements.

Requirements

No unique requirements are anticipated, beyond a reasonably flat frequency response in the audible range. Several different types might be useful, including omni-directional for background noise, uni-directional for subject monitoring, lavalier (neck cord) for subject monitoring or data recording, and miniature for blood pressure measurements.

Hardware Status

Off-the-shelf hardware with possible minor modifications should be suitable.

Technical Description

Many suitable microphones are available. The following properties are estimates of average properties including mounting bracket for use in payload planning:

Average Weight - 0.5 lbs

Average Volume - 0.005 ft^3

Power - Negligible

Cost

Average cost estimate of commercial microphones = 0.1 K

Development Time

Less than one year.

#126C MICROPHONE AMPLIFIER

Comments

For microphone signals to provide output to speakers. Will probably be provided on a solid state plug-in type card.

#126G MONITOR, VIDEO

Comments

For on-board observations of experiment phenomena by the crew. Located near the cage modules.

#126I MOBILITY UNIT - PROTECTIVE CORRIDOR

Purpose:

A device to allow mobility and cargo handling studies within the confines of the space vehicle without risk of damaging permanently installed hardware.

Configuration would vary from simple protective covers, bumpers, restraining tethers, etc. for sortie missions to an elaborate expandable fully instrumented "tunnel" for the maxi max mission.

Requirements:

Protect existing hardware within the space vehicle interior from potential damage by out of control test masses, etc.

Provide attachment points for a variety of experimental mobility and cargo-handling aids.

Provide instrumentation to allow sensing of forces and accelerations experienced during a test session.

Hardware Status:

Conceptual design item.

Technical Description:

Estimated values for sortie missions:

Weight = 50 pounds

Power = 0 watts

Volume = 2 cubic feet

Cost:

Estimated costs for sortie missions:

Development costs = $30,000

Unit cost = $2,000

Development Time:

Two years

#128 MILLIPORE FILTER

Comments

For liquid and gas purification and sterilization.

#131D MOTORIZED PLANT GROWTH MONITOR

Comments

Motorized Device for monitoring plant growth and movement. Contact on plant makes or breaks switch to stepping motor device. FPE specific.

#131E NON-VISUAL DIRECTION INDICATOR

Comments

Pointer and display device to test human subjects' non-visual orientation capability.

Skylab device.

#131H OPTISCAN-FIELD AND FIXATION POINT RECORDER

Purpose:

An instrument to permit the recording of the visual field as well as the subject's fixation within the field without restriction of head movements.

Requirements:

1. Provide a movie camera or TV camera and recorder to record a major portion (approximately 30°) of the central field of view as the subject performs a task.
2. Provide a means of recording the points of eye fixation within the visual field (accurate to within 2° of arc).
3. Provide a lightweight unit (if head mounted) with means of indicating when unit is out of proper alignment.
4. Provide a unit that can operate on a non-interference basis with the subject performing normal operational tasks.

Hardware Status:

A head-mounted eye camera, called an optiscan, is commercially available which meets the field of view and accuracy requirements. (Mackworth, N.H., American Society of Mechanical Engineers, Paper No. 60-WA-304,1961).

Technical Description:

Weight: 5 pounds

Volume: 0.3 cubic feet

Power: 5 watts

Cost:

Development cost: $21K

Unit cost: $3K

Development Time: Approximately 2 years

#132 OSCILLOSCOPE

Purpose

To provide a means for visually presenting experimental data of a recurrent or non-recurrent nature. To provide for a secondary means for voltage and frequency measurement.

Requirements

For mini payload, unit must be capable of operating in a 5 psia atmosphere, 3.7 psia O_2. Unit must have a frequency response of DC - 5 MHz min., a storage mode of operation, and a wide selection of capabilities through the use of plug-in modules. Typically, unit must provide a 10 μvolt/div. min. sensitivity, and a dual trace capability.

Hardware Status

With exception of oxygen-rich environment, most hardware is available now. Remainder will need launch environment qualification.

Technical Description

Selected unit is Hewlett Packard Model 141B Storage Oscilloscope with the 1403A, 1404A, and 1420A plug-ins. Oscilloscope Camera, Hewlett-Packard Model 197A with Polaroid back and "Graflok" back (as used on the still camera, unit 34, 35.)

Oscilloscope Wt.	40 lbs
Plug-ins (Wt.)	16 lbs
Camera Wt.	10 lbs

Preliminary Estimates for Flight Unit

Wt.	30 lbs
Power	50 watts
Volume	1 ft^3

Cost

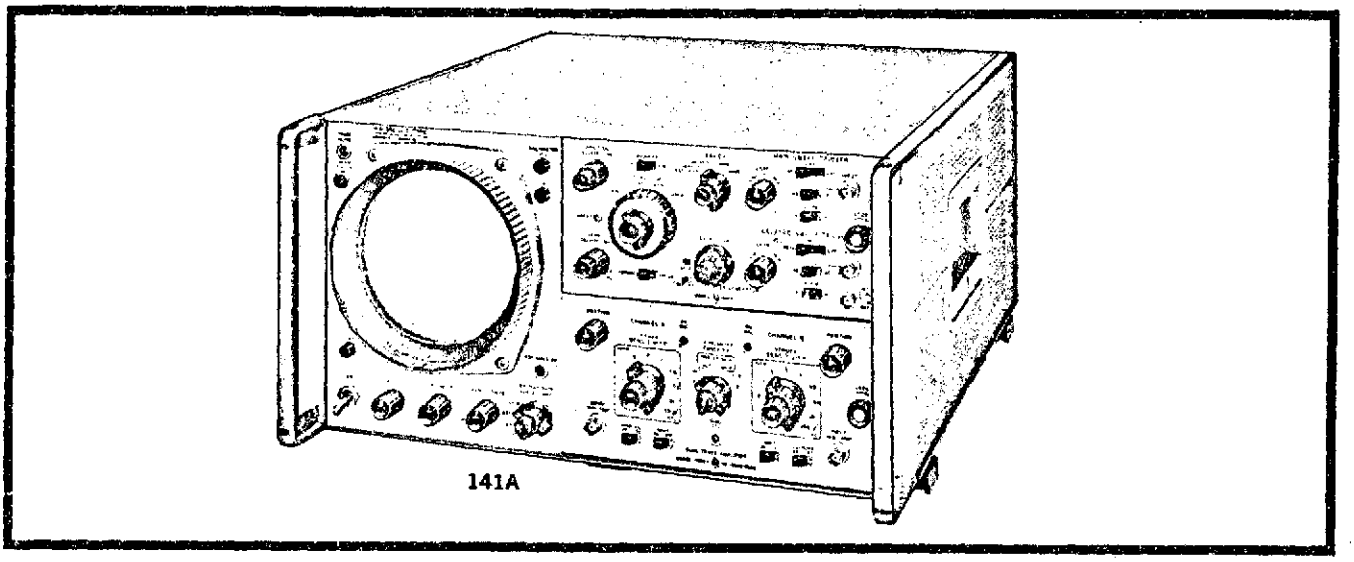
COMM

Oscilloscope	$1500
Plug-ins	$1000
Camera	$ 600

Development	$150K
Unit	$20K

The 141A gives you storage for side-by-side comparison of waveforms. In this mode, traces can be held intact for more than an hour (days, in fact, with the scope turned off). Fast 1 cm/μsec storage writing rate enbales you to capture single-shot transients.

The Model 141A mainframe contains the same basic circuitry for low-frequency, high frequency and sampling applications as the 140A mainframe. It also accepts all of the 1400—series plug-ins. In addition the 141A mainframe contains the Cathode-Ray-Tube and associated circuitry for the unique variable persistence and storage capabilities.



Specifications

Plug-ins: same as Model 140A.

Cathode-ray tube:

Type: post-accelerator storage tube, 7300-volt accelerating potential; aluminized P31 phosphor; etched safety glass face plate reduces glare.

Graticule: 10 x 10 divisions (approximately 9.4 x 9.4 cm) parallax-free internal graticule; 5 subdivisions per major division on major horizontal and vertical axes, and on second and tenth horizontal graticule lines.

Intensity modulation: ac coupled, +20 volt pulse will blank trace of normal intensity; input terminals on rear panel.

Warranty: CRT specifications (persistence, writing rate, brightness, storage time) warranted for one year.

Persistence:

Normal: natural persistence of P31 phosphor (approximately 0.1 second).

Variable:

Normal writing rate mode: continuously variable from less than 0.2 second to more than one minute (typically to two or three minutes).

Max writing rate mode: typically variable from 0.2 second to 15 seconds.

Erase: manual; erasure takes approximately 0.5 sec; scope ready to record immediately after erasure (see options for remote erase).

Writing rate (conventional operation): (using HP Model 197A Camera with f/1.9 lens and Polaroid® 3000 speed film): 100 cm/μsec.

Writing rate (storage):

Normal mode: greater than 20 cm/msec.

Max. mode: greater than 1 cm/μsec.

Calibrator:
Beam finder:
Power requirements:
Dimensions:
} same as Model 140A

Weight: net, 40 lbs (18 kg); shipping, 51 lbs (23 kg).

Price: HP Model 141A (without plug-ins), $1395.00.

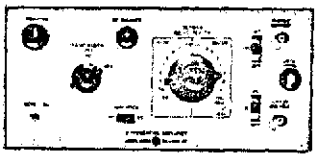
Options: (specify by option number).

09: Remote erase. BNC input on rear panel; shorting to ground for at least 200 ms erases screen; input draws 20 mA from ground through a 600-ohm impedance to a −12 volt supply. Add $25.

Special order: chassis slides and adapter kit; fixed slides, order HP Part No. 1490-0714, $32.50; pivot slides, order HP Part No. 1490-0718, $40; slide adapter kit for mounting slides on scope, order HP Part No. 1490-0721, $20. New-fast writing rate CRT option for HP 141A, 5 cm/μsec. Order Model C05-141A. Price $1495.

"Polaroid"® by Polaroid Corporation

Capabilities	Vertical plug-ins									
	1400A	1401A	1402A	1403A	1405A	1406A	1407A	1410A	1411A	1430A
1. Wide band			•		•					
2. Sampling								•	•	•
3. High gain differential	•			•		•	•			
4. Dual trace		•	•		•			•	•	
5. X-Y	•	•	•	•	•	•	•	•	•	
6. Delayed sweep	1421A for real time						1425A for sampling			
7. No drift						•	•			
8. High common mode rejection				•		•	•			
9. Algebraic addition		•	•		•			•	•	
10. Time domain reflectometry										
11. Wide band TDR									•	•
12. Swept frequency										

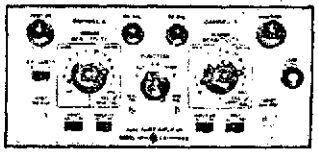


Price: $250.

1400A

- 100 μV/cm
- dc to 400 kHz
- Differential on all ranges

Page 469

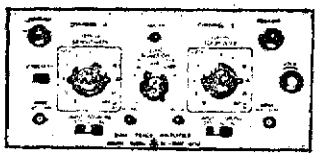


Price: $425.

1401A

- 1 mV/cm-dual trace
- dc to 450 kHz
- Convenient dual trace triggering

Page 469

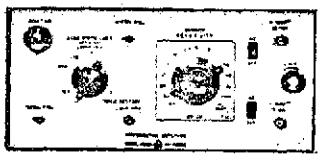


Price: $575.

1402A

- 5 mV/cm
- dc to 20 MHz-dual trace
- Signal delay for fast rise viewing

Page 466



Price: $475.

1403A

- 10 μV/cm.
- 0.1 Hz to 400 kHz
- 106 dB common mode rejection

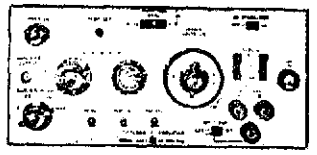
Page 470

Price: $325.

1405A

- 5 mV/cm-dual trace
- dc to 5 MHz
- Algebraic addition

Page 467

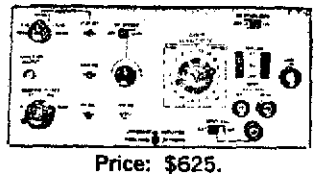


Price: $850.

1406A

- 50 μV/cm-dc to 400 kHz
- No drift
- Calibrated offset for accurate ac and dc measurements

Page 470

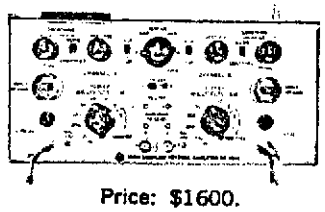


Price: $625.

1407A

- 50 μV/cm
- No drift
- 80 dB common mode rejection

Page 470

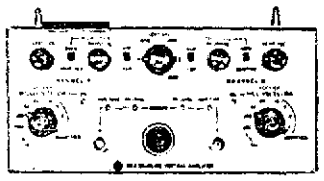


Price: $1600.

1410A

- 1 mV/cm at 1 GHz-dual trace
- Internal triggering
- High impedance probes and 50Ω inputs

Page 473

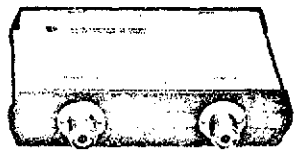


Price: $700.

1411A

- 1 mV/cm-dual trace
- Bandwidths to 12.4 GHz
- Remote samplers

Page 475



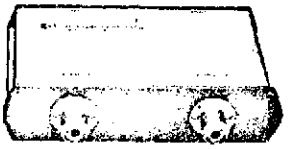
Price: $3000.

1430A

- 28 ps rise time—

Page 476

Capabilities	Vertical plug-ins		Compatible time bases						Double size plug-ins	
	1431A	1432A	1420A	1421A	1422A	1423A	1424A	1425A	1415A	1416A
1. Wide band			•	•		•				
2. Sampling	•	•					•	•		
3. High gain differential			•	•	•	•				
4. Dual trace			•	•	•	•	•	•		
5. X-Y	Use 2 vertical or ext. horizontal									
6. Delayed sweep				•				•		
7. No drift			•	•	•	•				
8. High common mode rejection			•	•	•	•				
9. Algebraic addition			•	•	•	•	•	•		
10. Time domain reflectometry									•	
11. Wide band TDR							•	•		
12. Swept frequency										•

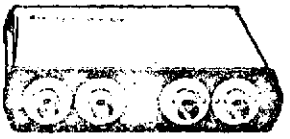


Price: $3000.

1431A

- 12.4 GHz bandwidth

Page 476



Price: $1000.

1432A

- 90 ps rise time—

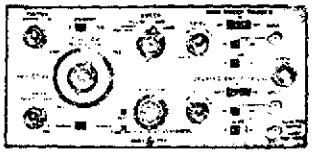
Page 475

Price: $325.

1420A

- 10 MHz triggering
- Sweeps to 50 ns/cm
- Auto triggering

Page 471



Price: $625.

1421A

- 20 MHz triggering
- Delayed sweep
- Sweeps to 20 ns/cm

Page 472

Price: $225.

1422A

- 500 kHz triggering
- Sweeps to 200 ns/cm
- Auto triggering

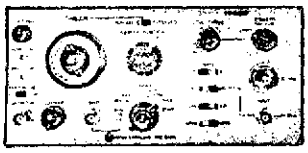
Page 471

Price: $450.

1423A

- 20 MHz triggering
- Sweeps to 20 ns/cm
- Trigger hold-off

Page 471

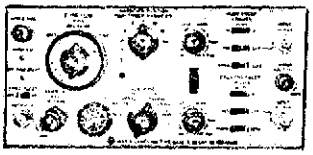


Price: $1200.

1424A

- Triggering to 5 GHz
- Sweeps to 10 ps/cm
- Direct readout on all sweeps

Page 477

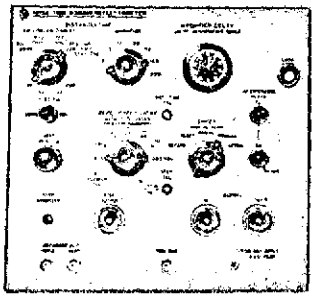


Price: $1600.

1425A

- Delayed sweep
- Sweeps to 10 ps/cm
- Triggering to 1 GHz

Page 478

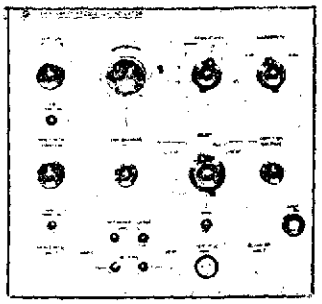


Price: $1050.

1415A

- Complete TDR system for testing cables, connectors, striplines
- Determines location, meaning, and nature of each discontinuity
- Resolves discontinuities—an inch apart
- Easy to operate

Page 481



Price: $675.

1416A

- Speeds and simplifies swept frequency measurements
- High resolution readout directly in dB

Page 480

OSCILLOSCOPE CAMERA

Permanent records of oscilloscope traces

Model 197A

The Model 197A Oscilloscope Camera provides an accurate, convenient way of recording oscilloscope displays. It is a precision instrument, meant for long, hard use.

The Model 197A employs a new electronic shutter which provides accurate exposure times from 1/30 to 4 s. The shutter may be tripped electrically from a remote source, and a sync output provides a contact closure when the shutter is opened, allowing synchronizing of other equipment with the camera. Circuitry is all solid-state.

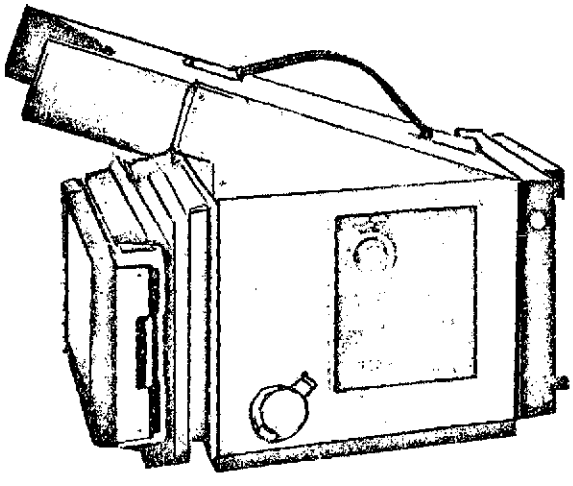
The new *f*/1.9 lens, designed for Hewlett-Packard by Wollensak, is mounted in a direct line with the film and transmits a maximum amount of light for photography of dim traces.

An ultra-violet light is included in the Model 197A for illuminating the internal graticule used on HP oscilloscopes. The "black" light, adjustable in intensity to suit conditions, excites the phosphor on the tube face and causes it to photograph an intermediate gray. The gray background clearly distinguishes the thin black graticule lines by contrast. Trace intensity is not degraded by this induced fluorescence, and the resulting photographs are actually easier to read, since the black graticule lines also contrast clearly with the trace, and their exact crossings can be accurately located. This black light has the additional advantage of presensitizing the film at the same time that the photograph is taken. The uniform glow of the CRT face lowers the apparent threshold sensitivity of the film, enabling it to record dimmer traces and making possible clear, sharp photographs of both repetitive and single sweep phenomena (see Figure 1). In addition to continuously adjustable ultraviolet intensity, the Model 197A also provides a "flash" feature which automatically turns the UV on and off. The "flash" permits recording of slow single-shot events and complete graticule information in a single exposure. In other cameras a double exposure is usually required.

All Model 197A controls are located outside the camera. Shutter speed, f-stop, and UV light brightness are color coded to provide an optimum starting point for the inexperienced photographer. The lightweight Model 197A is quickly and easily mounted on any oscilloscope, and swings away from the CRT face when not needed. The face-fitting, flexible hood has a low viewing angle for accurate alignment of the trace with an external graticule. The hood may be removed and replaced with a flat panel, allowing a series of cameras to be mounted on stacked oscilloscopes with heights as low as 7 inches.

Figure 1. "Half-and-half" photo made with special cathode ray tube compares photographic qualities of conventional external graticule (left) and UV-lighted internal graticule.

The Model 197A back may be rotated from the normal horizontal position to a vertical position, allowing two smaller pictures to be taken on one photograph. The back also can be moved through 11 detented positions for multiple exposures (see Figure 2) or it can be removed and replaced with a 4 x 5 inch Graflok® back. The entire film area of the back may be utilized through the use of the Model 197A's easily adjustable continuous reduction ratio feature. The camera may then be quickly refocused with a simple knob adjustment, using the furnished split image focusing plate stored in the camera.



197A

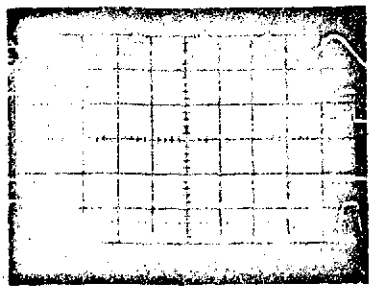


Figure 2. Multiple exposure photographs are easily made with the Model 197A Camera.

Specifications

Reduction ratio: continuously adjustable from 1:1 to 1:0.7; reference scale provided on focus plate.

Lens: 75 mm, *f*/1.9 high transmission lens, manufactured exclusively for HP by Wollensak; aperture ranges *f*/1.9 to *f*/16; optional 88 mm *f*/1.4 OscilloRaptar lens available.

Shutter: electronically operated and timed shutter, with all solid-state circuitry; shutter speeds are 1/30, 1/15, 1/8, 1/4, 1/2, 1, 2, 4 s, Time and Bulb; shutter has a sync contact closure output for triggering external equipment and input jack for remote operation.

Camera back: Polaroid® Land Camera using pack film Type 107 supplied; Graflok® back available (see Options); backs may be interchanged without refocusing and may be rotated in 90-degree increments.

Mounting: quick lift on-off mounting with positive lock; swing away to left.

Viewing: low-angle, direct viewing flexible face mask; hood may be removed and replaced with panel to allow stacking on 7-inch high oscilloscopes (see Accessories Available).

Multiple exposure: back moves vertically through 11 detented positions at ½ cm per detent at 1:0.9 object-to-image ratio.

Focus: adjustable focusing with lock; split image focusing plate provided.

Dimensions: 14" long, 10½" high, 7⅜" wide (356 x 267 x 194 mm) with hood; 12" long, 6½" high, 7⅜" wide (305 x 165 x 194 mm) without hood.

Weight: net 10 lbs (4,5 kg); shipping 19 lbs (8,6 kg).

Power: 115 V ±10%, 50 to 1000 Hz, 6 W.

Accessories furnished: combination split image focusing plate and reduction ratio scale.

Price: HP Model 197A, $540.

Option 01: without ultraviolet light, deduct $50.

Option 02: *f*/1.4 lens, add $270.

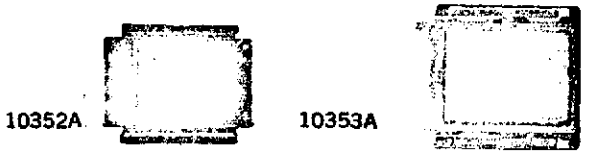
Option 03: Graflok back in place of Polaroid back; no charge.

Option 12: modified for 230 V operation; no charge.

"Polaroid"® by Polaroid Corp.
"Graflok"® by Graflex, Inc.

Accessories available

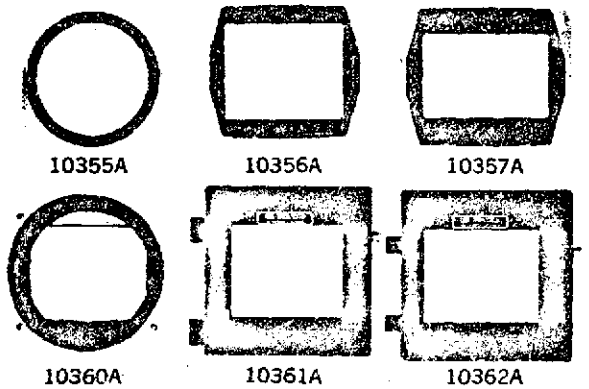
Camera Backs



10352A 10353A

The Model 197A is supplied with a Polaroid® Pack Film back as standard or a 4 x 5 Graflok® back as Option 03. These backs can also be ordered separately. Polaroid back Model 10353A, $85; Graflok back Model 10352A, $85.

Oscilloscope Bezel Adapters

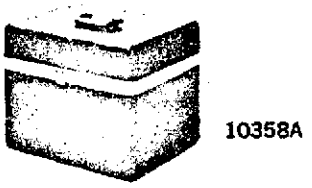


10355A 10356A 10357A

10360A 10361A 10362A

The Model 197A fits all HP oscilloscopes and can easily be fitted to other types by means of bezel adapters. Model 10355A adapts to Tektronix and Fairchild 5-inch round bezels, $15. Model 10356A adapts to Tektronix 560 Series rectangular bezels, $15. Model 10357A adapts to Tektronix 640 Series rectangular bezels, $15. The Model 10360A adapts the Model 196A/B camera to the HP rectangular bezel, $15. The Model 10361A adapts the Tektronix C12 camera to the HP rectangular bezel, $15. The Model 10362A adapts the Tektronix C27 camera to the HP rectangular bezel, $15.

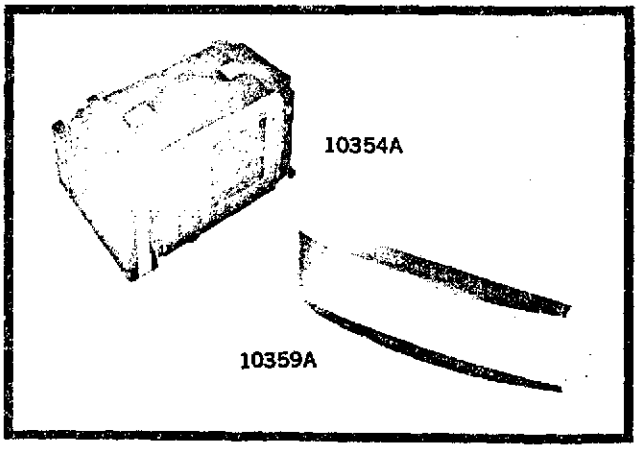
Carrying Case



10358A

The Model 10358A carrying case is a sturdy fiber-glass and aluminum construction with foam padding to provide maximum protection for the Model 197A in transit or storage, $65.

Other accessories



10354A

10359A

Model 10354A Viewing Hood Replacement Plate is used in place of the Model 197A viewing hood and permits camera mounting on stacked oscilloscopes with heights as low as 7 inches, $7.

The Model 10359A Viewing Lens is a ground plastic lens which fits inside the viewing hood for easy trace viewing by those with farsighted vision, $25.

#132A OSCILLATOR, VCO

Comments

Voltage Controlled Oscillator, standard type.

#133 OTOLITH TEST GOGGLES

Comments

Goggles with special built-in optics and visual images.

#134B PAPER, RECORDING

Comments

For strip chart recorders.

#138 pH METER

Purpose

This meter or sensor measures the hydrogen ion concentration of solutions.

Requirements

1. pH range: 0-14
2. Measurement accuracy: 0.02 pH

Hardware Status

One-g meters are readily available and should be adaptable to zero-g. The main modification will probably involve liquid containment and compatible sensor design. Also, sensors and electronics could operate in conjunction with general purpose display console.

Technical Description

A. Electronics/Display Meter:

Weight: 5 lbs

Size: 0.5 ft^3 (6 x 12 x 12 inches)

Power: 5 watts (when on)

B. Electrodes:

For about 6 electrodes -

Weight: 2 lbs

Volume: 0.3 ft^3 (500 in^3, 5" x 10" x 10")

Power: 0

Cost: Commercial unit $0.6K

Flight item estimates:

Development: $150K

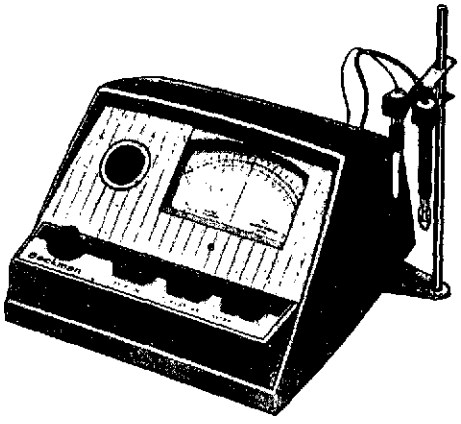
Unit: 20K

BRAUN-KNECHT-HEIMANN-CO. BRAUN CHEMICAL COMPANY SCIENTIFIC SUPPLIES COMPANY
DIVISIONS OF VAN WATERS & ROGERS, INC.

34306 EXPANDED SCALE pH METER, Line Operated, Beckman Model 76—A highly stable, direct reading instrument designed for clinical, university or industrial laboratories requiring extremely precise pH or millivolt readings. In addition to a standard 0 to 14 pH scale, it incorporates an expanded scale with a 2.0 pH full scale range graduated in 0.01 pH units. Any two pH units can be chosen from the full 0 to 14 pH range and read on the expanded scale. For example, the meter may be read from 2 to 4, 3 to 5, 6 to 8 or 10 to 12, or any two pH unit span chosen by the operator. Readability to 0.003 pH can thus be made, a sevenfold increase in readability over the standard scale. Millivolt readings on the expanded scale are attainable over any 200 mv span in the range of 0 to 1400 mv with a readability of 0.3 mv. Will make pH measurements accurate to ±0.02 pH, repeatable to ±0.003 pH. Can be used for pH titrations and for oxidation-reduction and Karl Fischer titrations. Millivolt readings are accurate to ±2 mv and repeatable to ±0.3 mv.

Push-button operation. A chopper amplifier insures drift-free performance. Etched circuits and transistors. Acid and alkali resistant melamine case 7¼" high, 12" wide, 12" deep. The rear panel has outlets for a standard potentiometer recorder (**See No. 55420**), the Beckman automatic temperature compensator, and polarizing current.

Complete with general purpose electrode, **No. 34386**; fibre-type reference electrode, **No. 34412**; one pint of concentrated pH buffer **No. 34486**; bottle of Saturated KCl Solution **No. 34488**; electrode holder, **No. 34457-1**; electrode support rod; bracket; terminal connector-adapter for metallic electrodes, **No. 34455**; polarizing-jumper adapter for Karl Fischer titrations, **No. 34463-2**; short circuit strap and dust cover. For 115 volts, 50/60 cycles. .....**Each 445.00**



34306

#138A PHOTOCELLS

Comments

For monitoring light levels.

#138B PHOTOTRANSISTOR (COUPLER)

Comments

Photocell couplers, for E.I. 138A.

#139 PLETHYSMOGRAPH, LIMB (INCLUDING COUPLER)

Purpose

To measure changes in blood volume and vascular responses.

Requirements

Determine changes in biological segments that occur during cardiac and breathing cycles.

Hardware Status

Commercial units are available. Honeywell unit described on pages 139-1 through 139-5. Minimal effort required for space use.

Technical Description

The following are estimates of a space unit:

Weight	2.4 kg (5 lbs)
Volume	6 dm^3 (.2 ft^3)
Power	5 watts

Cost

Estimated development and unit costs for space: $10K and $10K, respectively.

Development Time

One year.

ELECTRONIC MEDICAL SYSTEMS • TEST INSTRUMENTS DIVISION
HONEYWELL — 4800 EAST DRY CREEK ROAD • 303 771-4700 • DENVER, COLORADO 80217

ADVANCE PRODUCT INFORMATION

ELECTRICAL IMPEDANCE PLETHYSMOGRAPH
Model EIP-4
D-5191

DESCRIPTION:

The impedance plethysmograph, manufactured by Bagno Alertronics (EIP-4) is designed to measure the impedance (basal) of biological segments as well as the pulsatile changes in impedance that accompany cardiac and breathing cycles.

The solid state unit employs a selectivity tuned 50 Kc oscillator, buffer amplifier and a four-electrode modified Kelvin double bridge. One pair of electrodes are connected to the 50 Kc constant voltage oscillator. A second pair of electrodes detects the variations on impedance. Both electrode pairs are connected internally in a modified Kelvin double bridge. The output of the bridge is amplified by a phase distortion free amplifier which feeds a push-pull phase detection system. In practice, electrodes are connected to the examined segment, the internal bridge is manually adjusted by means of a balancing control, and the bridge balance is read on a front panel mounted null meter. The output of the amplifier is adaptable to a wide range of recording devices and pulsatile activity can be compared with a calibration switch and recorded deflection representing 0.1% and 1% of the measured impedance.

APPLICATION:

Changes in pulsatile blood volume have been recorded from the surface of the cranium, the tooth, the eye, precordium, limb segments and selected arteries. In addition, variations in thoracic conduction during respiratory activity have been used as an index of renal blood flow. Drug and local environmental effects on vascular responses in experimental animals have been studies and the rheological properties of blood have been evaluated as an important determinant of conductivity changes. The four electrode system minimizes contact resistance and electrode polarization and bridge balance represents the resistance of the biological segment being examined as defined by the distance between detecting electrodes. These electrical characteristics permit a quantitative approach to the determination of blood pulse volume and flow rate and the determination of pulmonary gas volumes. The plethysmograph is useful for long and repeated studies of healthy subjects and clinical patients both in the laboratory and at the bedside providing meaningful information concerning arterial and venous volume changes in peripheral sigments.

SPECIFICATIONS

RANGE OF MEASUREMENT:

. High range: 15 - 500 ohms
. Low range: 1.5 - 50 ohms

CALIBRATION:

. Shunt: 0.1% of balanced resistance
1.0% of balanced resistance

. Substitution: Integral 10 turn 500Ω potentiometer provides a resolution of 1 ohm per two dividions.

VOLTAGE ACROSS TEST SEGMENT:

. Low range: Approximately 10 mV at balance
. High range: Approximately 100 mV at balance

CURRENT ACROSS TEST SEGMENT:

. 2 ma and 0.2 ma at 1.5 ohm and 500 ohms, respectively.

IMPEDANCE:

. Input: Maximum allowable impedance in series with each voltage electrode from each measuring point is 100 ohms.

. Output: 20,000 ohms.

ACCURACY:

. ±2.5% of actual value.

OUTPUT:

. 20 mV across 20,000 ohms or 40 mV open circuit.

. 40 mV open circuit.

POWER SUPPLY:

. 5.6 - 6.2 volt zener voltage regulated from internal 7.5 volt battery with automatically regulated integral charging circuit.

OSCILLATOR FREQUENCY:

. 50 Kc ±2%

Other selected frequencies available for minimal harmonic distortion when multiple units are used simultaneously.

ENVIRONMENTAL:

. Designed for room temperature service.

DIMENSIONS:

. Rack mount: 3-1/2" high, 19" wide x 6" deep.

. Table top: Same size with rubber feet.

WEIGHT:

. 7.5 pounds.

FRONT AND REAR PANEL CONNECTORS:

. 4 pin input connectors, Amphenol Type 91MC4M

. Phone jack output connector, Smith Type 277

ACCESSORIES SUPPLIED:

. 1 input cable, 6-foot length, with mating input connector on one end and alligator clips on the other end for attachment to aluminum electrode tape.

. 2 output connectors, Smith Type 227.

. 1 roll of aluminum electrode tape.

. 1 tube of electrode paste.

Specification subject to change without notice.

HONEYWELL INC. - Denver Division
4800 East Dry Creek Road
Denver, Colorado 80217

December, 1965

Model 105 Gage Control Unit

Vibration:
MIL-T-21200, Class 3.

Humidity:
0 to 95% R.H.

Altitude:
Operational: 0 to 10,000 ft.
Storage: 0 to 50,000 ft.

Rear Connectors (All Accudata 105 Units):
Gage input: MS3102A-16S-1S (Honeywell No. 750101-033), 7-pin female, chassis-mounted receptacle. Mating connector, 750101-034 is supplied.

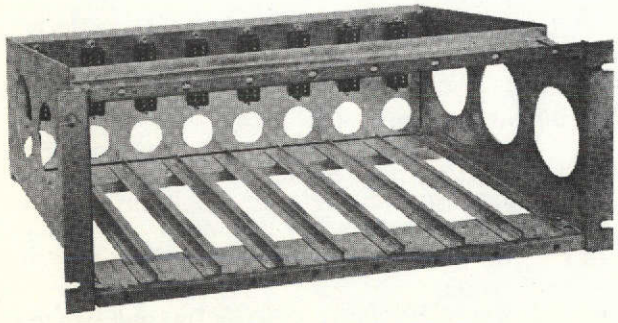
Power input and signal output: Cinch 36-41000-24P(345) Honeywell No. A-100790, 24-pin male plug. Mating connector, 200053, not supplied. Cinch mating connectors are in Rack Adapters.

ACCUDATA	105-1	105-2	105-3	105-4
Power Requirements:	12VDC	105-129VAC, 48-62Hz	44VDC at 50ma	210-258VAC, 48-62Hz
Output Voltage:	1.5 to 11.5 volts	12VDC variable over ± 1% range.	12VDC ±7%	12VDC variable over ± 1% range.
Output Current:	0 to 42ma	0 to 350ma	0 to 40ma	0 to 350ma
Regulation:				
Load:		±0.02% no load to full load	±1% no load to full load	±0.02% no load to full load
Line:		±0.01% for a 10% line change	±0.1% for ±1% change in supply voltage (44VDC)	±0.01% for a 10% line change
Drift:		±0.005%/°F.	±0.05%/°F.	±0.005%/°F.
Ripple:*		0.5mv peak-to-peak maximum	Less than 1mv peak-to-peak	0.5mv peak-to-peak maximum
Output Resistance:		1 ohm maximum		1 ohm maximum
Transient Response:		Line voltage transients within the specified range will not cause overshoot or ringing.		Line voltage transients within the specified range will not cause overshoot or ringing.
Output Protection:		Power supply is electronically protected when the output is shorted.		Power supply is electronically protected when the output is shorted.

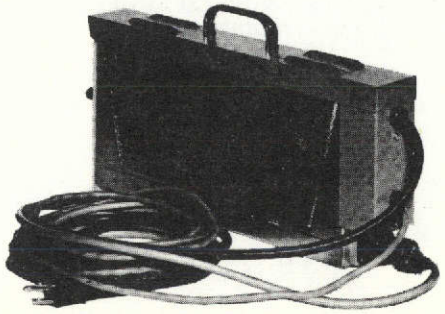
*With a gage factor of 2, ripple will be reduced on gage output by a factor of 500.

OPTIONAL EQUIPMENT:

Item	Part No.
Portable adapter (single channel)	790793
8-channel rack module, prewired with 40-inch galvanometer lead (panel space 7"x19")	902634-001
8-channel rack module, unwired except for power (panel space 7"x19")	902634-002
8-channel rack module, unwired except for power and 6-channel galvo cable and connector (includes blank plates in channels 7 and 8)	902634-003



8-Channel Rack Module, Available with Accudata 105



Accudata 105 with Optional Portable Adapter

ORDERING INFORMATION:
Order Accudata 105 with proper suffix (see "MODELS").

Printed in U.S.A. D-2292

Honeywell

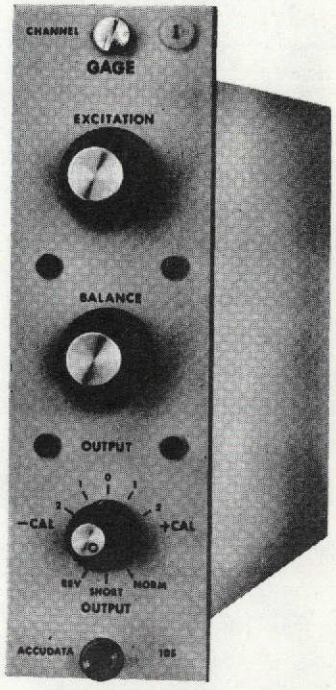
Accudata 105 Gage Control Unit

The Accudata 105 gage control unit is a signal conditioning device used to control balance, calibration, and sensitivity of strain gage type transducers. The gage control unit may be mounted in the Honeywell 7-inch 8-channel rack adapter (Part No. 902634).

The Accudata 105 unit has a three-position reversing switch for operating convenience. In the normal position, the signal is coupled directly to the galvanometer or amplifier. The short position removes the transducer from the load, galvanometer or amplifier, and places a short across the galvanometer or amplifier determining true zero base line. In the reverse position, the polarity of the galvanometer is reversed automatically without the need for rewiring any cabling.

Accudata 105-2 contains an integral power supply and voltage regulator. The power supply provides a fixed precision voltage of 12 VDC for strain gage excitation of up to eight channels. One Accudata 105-2 may be used with seven Accudata 105-1 units to provide the voltage, current, and control of eight channels.

Accudata 105-3 contains an internal voltage regulator. This unit draws power from the 44 VDC power source of the Accudata 104, 109, or 120 DC Amplifiers.



SPECIFICATIONS

MODELS:

Accudata 105-1 (Integral strain gage control, 12 VDC)
Accudata 105-2 (Integral strain gage control and power supply, 120 VAC, 50-60 Hz)
Accudata 105-3 (Integral strain gage control and voltage regulator, power may be supplied by Accudata 104, 109, and 120 DC Amplifiers)
Accudata 105-4 (Integral strain gage control and power supply, 220 VAC, 50-60Hz)

Size:
2⅛ in. wide x 7 in. high x 12¼ in. deep

Weight:
105-2, 4 — 3¾ lbs.
105-1, 3 — 3 lbs.

Power Consumption:
10 watts maximum (105-2 and 105-4 only)

Frequency Response:
DC to 10KHz within ± 0.5%

Temperature Range:
Operating: 0 to 50°C.
Storage: −65° to 60°C.

Excitation:
Bridge excitation with a 12-volt supply is variable from 3.5 to 11.5 volts for 350-ohm strain gage and 1.5 to 5 volts for 120-ohm gages.

Balance:
Ten-turn potentiometer with locking knob provides excellent stability and resolution.

Output Control:
Reversal, short, and normal positions. Short position removes the transducers from the load (galvanometer or amplifier and places a short across the galvanometer or amplifier for determining true zero base line).

Calibration:
4-point calibration; two positive and two negative shunt calibration steps. Spring loaded terminals for calibration resistors; terminals easily accessible for changing calibration values.

Monitor Jacks:
Two pairs of jacks on front panel monitor gage output as well as gage excitation voltages.

#140 COUPLER, PHONO/VIBROCARDIOGRAM

Comments

E.I. 156, E.U. 2 definition sheet applies.

#142 PORTABLE LSS

Comments

Portable Life Support System (PLSS). Backpack type units to be used for pressure suit tests.

#143C PUMP, GAS CIRCULATING

Comments

Pump for sealed plant growth chamber, for radiobiology tests.

#143D CATALYTIC OXIDIZER SYSTEM

Purpose

This item is used to oxidize contaminant gases resulting from various experiment environments and procedures.

Requirements

Specific requirements are yet to be determined. It was assumed that an oxidizer with an air flow rate of approximately 2 cfm at 14.7 psia and 70°F would be adequate. Such a unit, including pre-and post-filters is described below.

Hardware Status

Catalytic oxidizers for spacecraft use have been undergoing development and testing for at least 10 years. To date, they have not been used in spacecraft because of the short mission durations and therefore the absence of requirements for such devices. Although no space qualified hardware is immediately available, a unit could probably be built without any major problems.

Technical Description

The catalytic oxidizer system consists of a pre-filter, the oxidizer, and a post filter.

The oxidizer usually includes a recuperative heat exchanger, heaters, and a catalyst (usually palladium) bed, all contained in an insulated cylindrical canister. The catalyst bed operates at approximately 700°F.

The oxidizer requires pre and post-sorbent beds to prevent catalyst poisoning and to remove undesirable products of combustion. Lithium hydroxide is used for both these purposes. The following properties are estimated for an oxidizer system:

Catalyst operating temperature	700°F	
Overall system pressure drop	5 psi	
Power required (28 v.d.c.)	100 w	
Air flow rate (14.7 psia 70°F)	2	(9 lb/hr)
System weight	75 lbs.	
System Envelope volume	4 ft^3	

Cost Estimating development cost: $100K
Estimated unit cost: 20K

DEVELOPMENT TIME: 2 years

#143E PRESSURE CUFF

Comments

With transducer for blood pressure measurement.

#143F PRESSURE CUFF PUMP

Comments

Air pump for automated measurement of primate blood pressure.

#143G COUPLER - PRESSURE

Comments

Coupler (signal conditioner), for pressure transducer - solid state plug-in card.

See E.I. 156 for definition sheet.

#144 PSYCHOMOTOR PERFORMANCE CONSOLE

Purpose:

An integrated test bed for testing various displays and controls and performing a variety of psychomotor measurements such as tracking skills, etc.

Requirements:

1. Provide a reprogrammable test bed for evaluating a variety of display-control configurations.

2. Provide the capability for measuring the following parameters:
   Tracking ability
   Manipulative ability - arm/hand steadiness, finger dexterity
   Gross positioning ability - multilimb coordination, position reproduction/estimation
   Skill maintenance

Hardware Status:

IMBIM's Psychomotor Measurement Assembly may be adaptable for this purpose.

Technical Description:

Estimated values:

Weight:	100 pounds
Volume:	4 cubic feet
Power:	100 watts

Cost:

Development Cost: $150K

Unit cost: $50K

Development Time:

Approximately 2 years.

#144B PSYCHOGALVANOMETER, GSR

Comments

For measuring galvanic skin response. Coupler. May be incorporated in E.I. 65B.

#144C

RADIATION DETECTOR,
DOSIMETER

PURPOSE

To provide the crew with a portable device which will alert them to radiation levels in excess of some preset threshold, and to provide a direct readout of the total cumulative radiation dose.

REQUIREMENTS

Rate Measurement Ranges -

from 0 - 0.1 mr/hr to
0 - 50 r/hr.

Adjustable Level Radiation Alarm:-

from 0.05 mr/hr to
50 r/hr.

Cumulative Dosage Ranges:

0 - 200 mr

0 - 500 r

Measurements to be within ±10% accuracy on both X-Ray and Gamma radiation. Readout and charging equipment for the cumulative dosage portion of the instrument to be a part of the basic equipment, i.e. self contained.

Equipment Operation and Calibration to be checked by the use of a self-contained radiation standard.

Accessory equipment to include a neutron detector system, utilizing the metering circuits of the basic equipment.

REQUIREMENTS (Continued)

Cumulative Dosage Ranges: (Continued)

The dosimeter portion of the assembly must be detachable and operable as a separate instrument. These instruments can be used for measuring total dosage to several hundred biological specimens.

HARDWARE STATUS

Instruments specifically designed for radiation rate measurements * or for cumulative dosage measurements are available. Required instrument would combine these two functions and utilize common equipment when possible.

TECHNICAL DESCRIPTION (Preliminary)

Weight	10 oz.
Size	6 in H., 3 in. W., 1.5 in. D.
Power	Self powered, rechargeable (Charger built in; 28 VDC input)
Cost	$2000
Development Time	1 Yr.

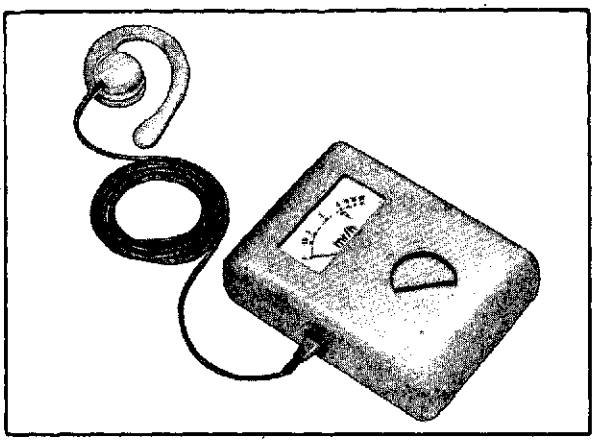
DEVEL. $15K
UNIT 2K

* See attached Catalog Sheet

FH 40K MINIATURE RADIAMETER — A fully transistorized universal surveying instrument designed to determine the presence of radioactive material or contamination. It is recognized as a professional instrument and it is built to the highest standards of quality and workmanship. Due to its simplicity in design it is used both as a testing instrument and a training device; the recessed single control knob permits its operation by inexperienced personnel. It has been bought in quantity by the Red Cross, various government, municipal, and public health groups.

Measurements are indicated on the meter scale which is practically logarithmic. With the slideable plastic window removed, one can note both Beta and Gamma radiation. Indication is either by means of the accessory earphone unit or by the direct reading meter scale. It may be used anywhere, indoors or in the field. The plastic carrying case with neck-band has openings for the meter scale, control knob, and earphone connector. Both the instrument and the carrying case are washable; the instrument case is molded of styrene and is splash-proof.

TECHNICAL DATA



FH 40K Miniature Radiameter

ACCURACY — For Gamma ± 15% throughout scale range of 0-50 mr/h, insensitive to temperature over range of 15-130°F (-10/50°C)

Differentiation between Beta and Gamma radiation: Density of Radiation Entrance Window, for Gamma $\geqq$ 500 mg/cm^2. Ditto, with plastic window removed: for Gamma and Beta $\leqq$ 30 mg/cm^2

BASIC COMPONENTS — 1 sturdy plastic case containing a stabilized Halogen filled Geiger counter tube, 2 Transistors, 2 Germanium diodes, 1 Selenium high voltage rectifier, 1 high voltage stabilizer, 1 moving coil meter, a single 3-position control knob and 2 batteries.

POWER PACK — 2 miniature commercial 1-1/2v batteries (Eveready #904) which give approx. 10 hours continuous service.

DIMENSIONS — 4" x 2-7/8" x 1-1/8" (100 x 7 x 30 mm). Weight: 7 oz. (200 g.).

ACCESSORIES — Magnetic earphone assembly with cable and plug. Washable plastic carrying case with neck-band.

The Kahl Scientific Instrument Corp., directly or through its agents, can supply other FH high quality instruments, including the unsurpassed Continuous Air Monitor which is now universally used at important research centers, the Continuous Water Monitor, Discontinuous Air Monitor, Methane Flow Counter, Scintillation Counter, Scaler, Ratemeter, Automatic Planchet Changer, Laboratory Monitor, Stationary Air Monitor, Dosage Calculator, Pocket Dosimeter, and other approved instruments. Write for literature.

N.Y.C. Rep: 12 E. 12 St.
New York 3, N. Y.
PHONE: 212-WAtkins 4-5630

KAHLSICO

KAHL SCIENTIFIC INSTRUMENT CORPORATION
EL CAJON (SAN DIEGO), CALIFORNIA, U. S. A.
PHONE: 714-HIckory 4-5944
CABLE: KAHLSICO SANDIEGO

BROCHURE NO. FH 12-62 PRINTED IN U.S.A.

#145

RADIATION DETECTOR, GENERAL

PURPOSE

To provide an accurate measurement of either alpha, beta, gamma, x-ray or neutron radiation as it is applied to a biological specimen.

REQUIREMENTS

Rate measuring ranges -

from 0-0.1 mr/hr
to 0-1000 r/hr

Also calibrated in counts /sec, counts/min. and total counts.

Data Readout -

Total counts or rate displayed on numeric display,

Adjustable discrimination levels,

Interfaced with data management system

Radiation Detectors:-

Provisions must be made for; (1) Conventional photomultiplier scintillation detectors using a variety of scintillation attachments such as sodium iodide crystals, liquid scintillation system and plastic detectors, (2) Solid State detectors such as the germanium lithium-drifted detectors, (3) Conventional gas proportional detectors.

Included in this range of detectors must be the ability to accurately measure low and high energy gamma, X-ray, alpha, beta and neutron radiation.

REQUIREMENTS (Continued)

Signal Processing -

Pulse height discrimination must be availabe.

Co-incidence and anti-co-incidence capability must be available.

Pre-amplification equipment suitable for use with all detector systems with a minimum of modification.

HARDWARE STATUS

Currently available commercial equipment is suitable for these measurements. Such a system would need only a power supply modification to permit operation at 28 VDC. A typical system made by Hewlett-Packard Co. would include: (1) HP 5551A High Voltage Supply,

(2) HP 5880A NIM Power Supply,

(3) HP 5583A Analyzer,

(4) HP 5590A Scaler-Timer,

(5) HP 5554A Preamplifier,

(6) HP-10601A Scintillation Detector and

(7) HP 5582A Linear Amplifier

TECHNICAL DESCRIPTION

Weight		50 lbs.	
Size		10 in. H, 19 in W, 22 in. D (2.42 ft^3)	
Power		150 W	
Cost	(Electronics)	$10,000	COMM
	(Typical Detector, (Several)	$10,000	
	$350K Development		
	$50K Unit		
Development Time		1 Yr.	

Detectors, Shielding, and Guard

CHOICE OF WIDE VARIETY OF DETECTORS EFFICIENT AND UNIFORM DETECTION 10^6 CPM AVAILABLE WITH 1% LOSS BACKGROUNDS AS LOW AS 0.1 CPM α-γ, β-γ, γ-γ COINCIDENCE CAPABILITY

The core of the sample changer is the counting cavity. Protected from background radiations by a surrounding wall of lead and OFHC copper, the cavity contains the detector which senses the radiations from the sample. In the ultra-low background systems offered by Hewlett-Packard, a guard detector covers the sample detector. Intercepting cosmic and other extraneous radiations from above the sample detector, the guard sends out a pulse to cancel any count from the sample detector due to such radiations.

A significant advantage of the Hewlett-Packard Sample Changing Systems is their adaptability to a wide variety of detectors. Systems are offered with gas-flow Geiger or proportional detectors or with scintillation detectors. Systems are so designed that they can accept compatible semiconductor detectors.

GAS-FLOW DETECTORS

Gas-flow Geiger and proportional detectors are offered for use in the measurements of α and β radiations and are available in three window diameters, 2.2 in., 1.2 in., and 0.5 in., and in two window densities, thin and microthin (< 100 $\mu g/cm^2$). These detectors all use the same sample changer and are interchangeable.

The sensitive volume of the detectors in each case has sufficient thickness to ensure that at least 99% of all α and β particles penetrating the window get counted. Efficiencies for various types of radiations are shown in Table I; note the increased efficiency for low energies offered by the microthin window available optionally.

TABLE I

Radiation	Efficiency with Standard Window	Efficiency with Microthin Window
C^{14} β	>25%	>32%
Sr^{90} β	>45%	>45%
$Pu^{239}\alpha$	>25%	>32%

The multiple anode design of all the detectors, together with their quality windows, render a high uniformity of efficiency, a uniformity of within ±5% over the area of the planchets for which the window is designed. This allows meaningful measurements of non-uniform deposits and permits excellent reproducibility of measurements for a given sample.

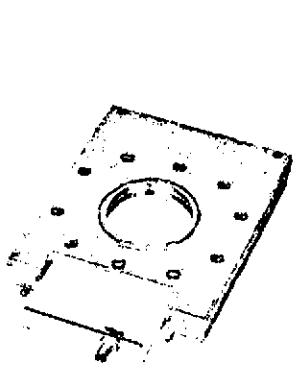
Plateaus for these detectors can be verified because the high-voltage power supply includes a continuously variable control.

Detector windows are gold plated on both sides to prevent stray pulses caused by static charge buildup. Special materials and quality construction enable Hewlett-Packard to offer detectors of minimum inherent background and completely insensitive to light (including ultraviolet).

SCINTILLATION DETECTORS

A scintillation detector system finds application in measuring gamma radiation. The scintillation system employs the 10601A Scintillation Detector which has a 2 in. dia x 2 in. deep NaI(Tl) crystal. The HP 10602A detector with a 3 in. x 3 in. crystal may be substituted on special order. Both detectors have an excellent resolution (less than 8% FWHM measured at the Cs^{137} photopeak) of great value in gamma-ray spectroscopy.

A second scintillation detector can be installed below the cavity (on special order) for use in β-γ or γ-γ coincidence measurements.



GAS-FLOW 2 IN. SAMPLE DETECTOR

HP 10601A SCINTILLATION DETECTOR

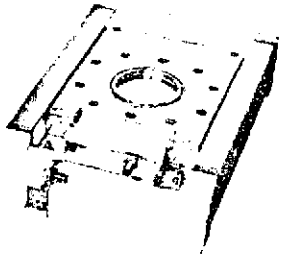
LEAD SHIELD

The low-background gas-flow Geiger and proportional systems have a 4 in. lead shield surrounding the cavity on all sides, top and bottom. The lead beneath the detector shields against radiation that can come from concrete flooring. The standard-background gas-flow systems have a surrounding 2 in. shield. The scintillation systems have 4 in. lead shielding. Special low-activity lead further treated at HP is used in the shields to help ensure the lowest possible background. OFHC copper shields the detector from X-rays arising in the lead shielding. Special design of the cavity, detector, and guard make possible a 4 in. shield weighing only 650 lb (equivalent shielding has commonly required up to 1600 lb).

GUARD DETECTOR

The low-background gas-flow Geiger and proportional systems employ a gas-flow guard detector operated in the same mode as the sample detector. A special wrap-around design allows the guard detector to intercept virtually all the cosmic rays that are sensed by the sample detector. The anticoincidence veto of these pulses reduces background by a factor from 15 to 30. Loss of counts due to the guard intercepting α and β particles from the sample is virtually eliminated by means of a ⅛ in. OFHC copper shield between the guard and sample detectors. Anticoincidence loss due to the simultaneous emission of energetic gamma rays by the sample is reduced to about 0.01% by the low efficiency of the guard-detector combination for such rays.

GUARD AND DETECTOR INVERTED TO SHOW WRAP-AROUND DESIGN



BACKGROUND

The combination of shielding and guard detector render a background specified to be below 0.1 cpm for the 0.5 in. gas-flow Geiger and proportional detectors.

The true significance of this low and stable background lies in the valuable counting time saved. For instance, suppose net sample activity to be very low, say 0.1 cpm, and that it is desired to count to an accuracy such that standard deviation is 10%. If background count can be trusted to be 0.1 cpm, counting time will be 2000 minutes; if background is 0.5 cpm, counting will take 6000 minutes. Thus, the ultra-low background system would save the user more than two days of counting time per sample.

Table II shows figures that demonstrate the importance of the extremely low and stable background the Hewlett-Packard systems offer. The heading "background stable" refers to the HP system, where background count can be relied upon to remain within statistical fluctuations. Where this is not the case, background must be counted prior to each measurement.

Table III shows backgrounds for gas-flow detectors.

TABLE II
TOTAL COUNTING TIME FOR LOW ACTIVITY SAMPLES

Net Activity in Sample, cpm	Background Count, cpm	Percent Standard Deviation	Counting Time Required Minutes	
			Background Stable	Background Not Stable
0.1	0.1	10	2000	5,828
0.1	0.3	10	4000	13,928
0.1	0.5	10	6000	21,954

TABLE III
BACKGROUNDS FOR GAS-FLOW GEIGER AND PROPORTIONAL DETECTORS

Ultra-low Background Systems, cpm	Standard Background Systems, cpm	Window Diameter, in.
<0.1 (typ, 0.08)	<3 (typ, 2)	0.5
<0.5 (typ, 0.38)	<9 (typ, 7)	1.2
<1.3 (typ, 1.2)	<24 (typ, 20)	2.2

DYNAMIC RANGE

High performance Hewlett-Packard preamplifiers and linear amplifiers allow high count rates to be achieved with the gas-flow Geiger and proportional detectors. With the Geiger detectors, count rates up to 2×10^4 cpm can be achieved with less than a 1% counting loss. With the proportional detectors, corresponding rates are 5×10^4 cpm or 10^6 cpm, depending on the system chosen.

COUNTING GAS

For the gas-flow detector (and guard) operated in Geiger mode, the recommended gas is a mixture of helium and isobutane. For proportional mode, the counting gas is a mixture of argon and methane. Composition and availability of these gases is noted under "Accessories Available," page 18.

SPECIFICATIONS

AUTOMATIC SAMPLE CHANGER (HP 5560A)

PLANCHET-HOLDER CAPACITY: 120 in. drum, 1 in. manual drawer.

METHOD OF LOADING: Magazines of 10 holders each, random access, and 1 holder by manual drawer.

PLANCHET SIZES: Standard holder is recessed to accept the common planchet sizes shown. Holders to accept sizes up to 2 in. dia x ¾ in. deep are available on request.

ROUND PLANCHET SIZES

Diameter	Depth
½ in.	0.120 in.
½ in.	0.313 in.
1 in.	0.094 in.
1 in.	0.120 in.
1 in.	0.187 in.
1 in.	0.219 in.
1 in.	0.913 in.*
1⅛ in.	0.094 in.
1¼ in.	0.120 in.
1¼ in.	0.156 in.
1¼ in.	0.170 in.
2 in.	0.120 in.
2 in.	0.913 in.*
25 mm	3 mm
25 mm	6 mm*
50 mm	3 mm
50 mm	6 mm*

* Specify deep-dish holder, option 06.

HOLDER AND MAGAZINE COLOR: Blue gray. Light gray and black available.

TRANSPORT SYSTEM: Monel chain shuttle in horizontal guided channel and manual drawer.

CONTROLS:

Pushbuttons: START, CLEAR, STORE, NEXT SAMPLE.

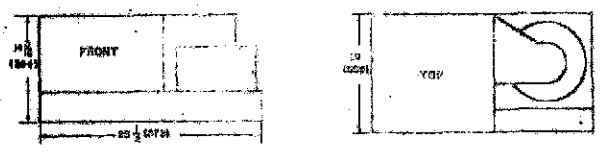
CYCLE MODE Switch: SINGLE and CONT.

MULTIPLE COUNT Switch: 1 through 10 and CONT.

Gas-Flow Valve: 0.01 to 0.03 SCFH.

INDICATORS: Sample Number, SAMPLE POSITION - CAVITY, SAMPLE POSITION - TRANSIT, MANUAL MODE, ON/OFF, and CAUTION (when off, indicates drum is released for manual positioning).

DIMENSIONS:



DIMENSIONS IN INCHES AND (MILLIMETERS)

DETECTORS, SHIELDING, AND GUARD

GAS FLOW DETECTORS: Geiger or Proportional.

SENSITIVE WINDOW DIAMETER: 2.2 in., 1.3 in., or 0.6 in.

WINDOW DENSITY: 850 $\mu g/cm^2$ std standard. <100 $\mu g/cm^2$, optional.

DETECTOR EFFICIENCY for β^-s: >25% (std window), >32% (μthin window).

DETECTOR EFFICIENCY for αs: >45% (std and μthin windows).

DETECTOR EFFICIENCY for Pu^{239}: >25% (std window), >32% (μthin window).

UNIFORMITY OF EFFICIENCY: <±5% over central 90% window area.

OPERATING VOLTAGES: Typically 950 ±50 V (Geiger), 1050 ±50 V (α prop), 1450 ±50 V (β prop).

SCINTILLATION DETECTORS:

CRYSTAL: 2 in. dia x 2 in. d, NaI(Tl), 3 in. dia x 3 in. d on special order.

CRYSTAL WINDOW: 0.015 in. Al

RESOLUTION: <8% FWHM (Cs^{137} photopeak).

SHIELDING: 4 in. or 2 in., 4π, low-background lead in gas-flow systems. 4 in. low-background lead in scintillation systems. ¼ in. OFHC copper on bottom of cavity. ⅛ in. OFHC copper between guard and sample detectors.

GUARD DETECTOR: Gas-flow detector, ultra-low-background systems only. Operating voltages, 850 ±50 V (Geiger), 1450 ±50 V (prop). γ-anticoincidence loss nominally 0.01%.

BACKGROUND: Ultra-low-background gas-flow systems, <0.1 cpm (0.5 in. window), <0.5 cpm (1.2 in. window), <1.3 cpm (2.2 in. window). Standard-background gas-flow systems, <3 cpm (0.5 in. window), <9 cpm (1.2 in. window), <24 cpm (2.2 in. window).

MAXIMUM COUNT RATE FOR 1% COUNTING LOSS: 2 x 10^4 cpm (Geiger), 5 x 10^4 cpm (prop), 10^6 cpm, systems for high count rates.

OUTPUTS: Gross detector counts, gross guard counts, and net counts are available from front panel connectors.

PREAMP-AMPLIFIER (HP 5554A)

All systems except scintillation system. Two in low-background gas-flow systems.

CHARGE SENSITIVITY: Switch selected nominally 10, 100, or 1000 mV/pC (without shaping); nominally 3, 30, or 300 mV/pC (with shaping).

VOLTAGE GAIN: Switch selected, 1, 2, 4, or 8 for $R_L = 50\ \Omega$.

OVERALL GAIN: Conversion gain x voltage gain.

OUTPUT: 5 V range into 50 Ω. Up to 10 V into 500 Ω. 50 ns rise time and 100 μs tail time constant (without shaping). Shaping applies 1 μs RC differentiation and integration.

NOISE: <2.5 keV FWHM(Ge) at zero capacitance. <0.038 keV/pF slope.

HP 10601A: Scintillation System only.

GAIN: Switch selected, 0.30 V/MeV nonshaped (LTC), 1.8 V/MeV shaped (x10), 18 V/MeV shaped (x100), for detector at 25°C, high voltage at 1000 V.

OUTPUT: 4 V no-load range (without shaping), 10 V (with shaping). 0.25 μs rise-time; 12.5 μs fall time constant (without shaping), 1 μs fall time constant (with shaping).

SCALER-TIMER (HP 5590A)

DISPLAY: 6 (optionally, 7) in-line digital display tubes. Count or time data selected by pushbutton. Count range, 1 to 10^6—1 counts. Time range, 0.1 to 10^5—0.1 s or min. Storage switch.

PRESET MODES: PRESET COUNT, PRESET TIME, and PRESET COUNT/PRESET TIME.

PRESET COUNT RANGE: 10 to 19,990 in steps of 10, 100 to 199,900 in steps of 100, and 1000 to 1,999,000 in steps of 1000.

PRESET TIME RANGE: 0.1 to 999.9 s or min.

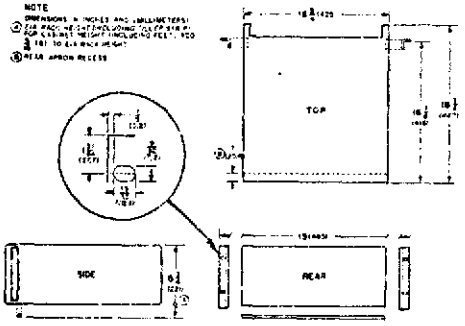
TIME BASE: Crystal.

INPUT SENSITIVITY: 100 mV peak, 20 ns width at half maximum.

DISCRIMINATOR RANGE: —1 V to 10 V.

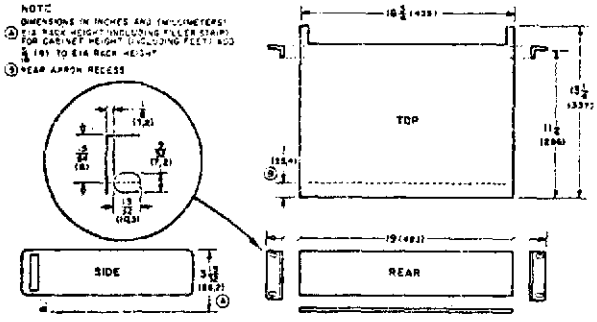
PRINTER
(HP H042-5050A)

PRINT CYCLE TIME: 50 ms.
COLUMN CAPACITY: Up to 18 columns.
DATA INPUT: Parallel entry BCD.
LINE SPACING: Adjustable, 3.5 to 4.5 lines per inch.
INKING: Ink roller or pressure sensitive paper.
DIMENSIONS:



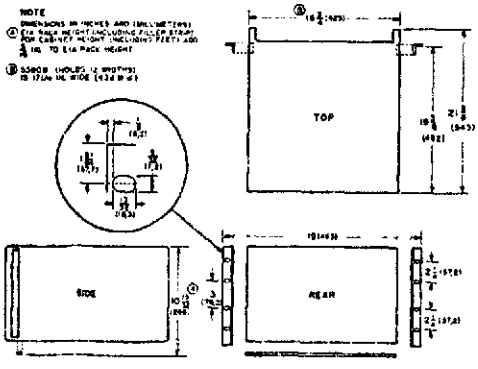
HIGH-VOLTAGE POWER SUPPLY
(HP 5551A)

OUTPUT: 170 V to 1615 V continuously adjustable; up to 1 mA.
RESETTABILITY: Nominally 5 V.
LONG-TERM VOLTAGE DRIFT (24 hours): Nominally 0.03%.
LINE REGULATION: ±0.01% for ±10% line change.
DIMENSIONS:



NIM POWER SUPPLY
(HP 5580A)

OUTPUTS: Line; ±24 V, up to 2 A; ±12 V, up to 4 A; ±6 V, up to 5 A; maximum dc power 120 W.
DIMENSIONS:



ANTICOINCIDENCE UNIT AND SINGLE CHANNEL ANALYZER
(In low-background gas-flow and scintillation systems)
(HP H32-5583A)

MODES: SINGLE CHANNEL (E_{min}, E_{max}), SINGLE CHANNEL (E_{min}, ΔE), DUAL INTEGRAL and anticoincidence (E_{min} channel A, E_{min} channel B).

DISCRIMINATOR RANGE: 50 mV to 10.05 V for E_{min} and E_{max}, 5 mV to 1.005 V for ΔE. Two controls.

OUTPUTS:

SINGLE CHANNEL AND ANTICOINCIDENCE: Slow positive, nominally +5 V into 100 Ω, 100 ns width; fast negative, nominally −0.8 V into 50 Ω, 5 ns rise time, 20 ns width.

DUAL INTEGRAL, CHANNELS A AND B: Nominally +5 V into 100 Ω, 100 ns width.

LINEAR AMPLIFIER
(HP 5582A)

In gas-flow systems having 10^6 cpm maximum count rate.

PULSE SHAPING:

RC MODE: Separate controls for integration, first and second differentiation.

Time Constants: 20 ns to 5 μs in 1, 2, 5 sequence.

Delay Line. Single or double, 1.0 μs.

GAIN:

RANGE: 640:1 range by coarse and fine control. Gain depends on shaping.

RESETTABILITY: 0.2% of full range at constant temperature.

GENERAL
(For All)

OPERATING VOLTAGE: 115 V or 230 V, 60 Hz. 50 Hz optionally available. (Specify 5551A High-Voltage Supply, Option 01.)

GAS REQUIRED*: 99.05% He, 0.95% isobutane for Geiger detector; 90% Ar, 10% methane for proportional detector. Pressure 5 PSIG recommended, 10 PSIG maximum.

GAS INPUT CONNECTOR: Accepts ¼ in. copper tubing; adapter supplied for 0.094 in. I.D. plastic gas tubing.

GAS CONSUMPTION: <0.07 SCFH (33 cc/min). A 200 ft^3 gas tank will last about 4 months with continuous flow.

* See page 18 for gas availability.

POWER REQUIREMENTS AND WEIGHTS

	Power, Watts	Shipping Wt., Instruments	Shipping Wt., Lead	Shipping Wt., Total
5560A SAMPLE CHANGER	90	85	—	85
5561A SYSTEM	380	216	692	908
5562A SYSTEM	425	226	692	918
5563A SYSTEM	360	208	270	478
5564A SYSTEM	380	213	270	483
5565A SYSTEM	400	221	692	913

SCALER-TIMER

The scaler-timer controls the length of the counting interval and registers the data obtained. The HP 5590A Scaler-Timer with a readout made up of 6 (optionally 7) in-line digital display tubes is supplied with all systems.

Three preset modes, preset-count, preset-time, and preset-count/preset-time are selected quickly with two lever switches. The preset-count/preset-time mode permits preset-count measurements with a time limit. With dual preset, an operator can avoid overly long counting intervals due to weak samples.

A thumbwheel preset switch allows the operator to choose any preset time to the nearest 0.1 minute or second up to 999.9 minutes or seconds. The timing intervals are accurately controlled by a crystal oscillator.

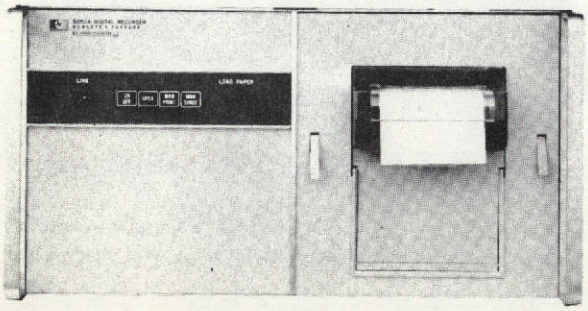
A separate thumbwheel switch sets the count limit. The operator can choose limits from 10 to 1,999,000 counts.

Two separate registers accumulate counts and time data, and pushbuttons select the data for display at any time. Whenever a preset limit in counts or time is reached, the display will automatically switch to the other. The printer prints out the data from both registers. ,

The 5590A has an adjustable discriminator which is especially useful in systems not having an anticoincidence unit or a single channel analyzer.

PRINTER

A printed record is produced in each system by the H042-5050A Digital Recorder. An exceptionally clear record as indicated here is provided by this versatile instrument. The sample number, or *** for a manual sample, is printed on the same line with the corresponding data, and the time always appears beneath the count. Note the space separating the data, and note the suppression of leading zeros. It is recommended that this printer be used with pressure sensitive paper. An ink roller and regular paper are also available.



HP H042-5050A DIGITAL RECORDER

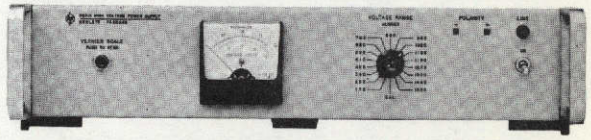
Sample Identification	99	41551 - count	direction of paper movement
	99	1000 - time	
	***	385853 - count	
	***	100 - time	
	99	873 - count	
	99	21 - time	

Being a versatile instrument in its own right, the HP 5050A features high speed (20 lines/sec), quiet operation, an easy method of code changes, and a column capacity expandable to 18 columns. During times when it is not required in a planchet counting, it can quickly be set up to serve the experimenter's needs elsewhere.

HIGH-VOLTAGE POWER SUPPLY

High voltage is provided for the detectors in each system by the HP 5551A High-Voltage Power Supply. In systems employing a guard, a potentiometer on the back of the sample changer sets the proper voltage difference between the guard detector and sample detector.

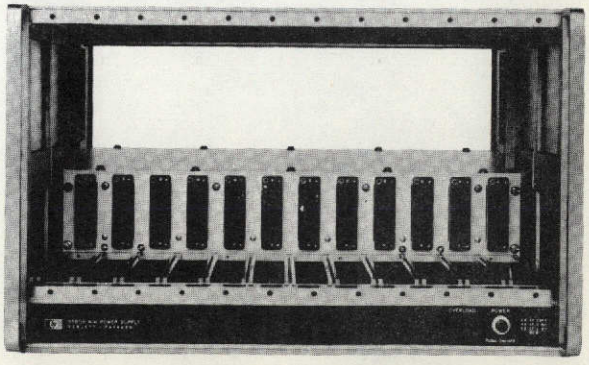
The HP 5551A has a continuous range from 170 V to 1615 V with excellent resettability and stability.



HP 5551A HIGH-VOLTAGE POWER SUPPLY

NIM POWER SUPPLY

The HP 5580A NIM Power Supply houses and supplies power to modular instruments such as the 5590A



HP 5580A NIM POWER SUPPLY

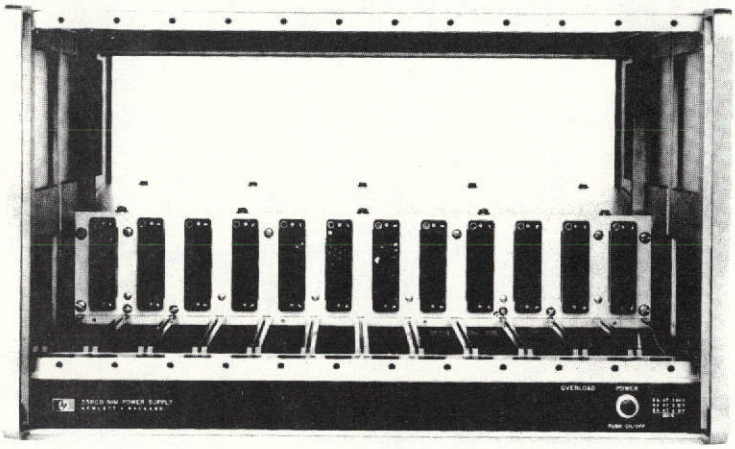
HEWLETT hp PACKARD

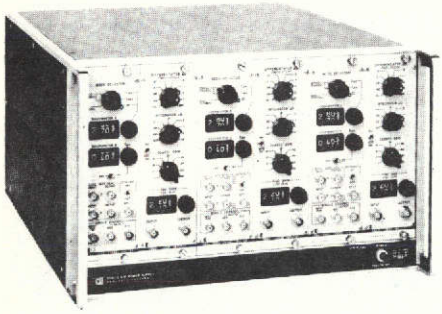
#145-8

NIM POWER SUPPLY

model 5580A/B

TECHNICAL DATA 15 FEB 68





Provides ± 24V, ± 12V, ± 6V DC

Blower Cooled for Reliability

Output Power 120 Watts

Compatible with AEC Modules

Protects Modules Against Short Circuits and Over-voltage

The Hewlett-Packard 5580A/B NIM Power Supply provides output voltages required to conform to AEC/NBS standards (TID-20893), houses any combination of modular instruments (NIM) in a sturdy bin, and promotes trouble-free operation by generous power capability, blower cooling, and protection circuits.

Total power output capability is 120 watts and current ratings allow heavy drain without overload: ± 24 V at 2A, ± 12 V at 4A, and ± 6 V at 5A. In addition to the standard output voltages specified by the NIM program, the 5580A/B supplies +6 V and −6 V, voltages that are often needed by newer modules that use integrated circuits. Power connector blocks are wired to meet TID-20893 recommendations and include in addition to the dc output voltages 115 V ac and reference and power return grounds.

The 5580A and the 5580B are electrically identical. Both are rack-mount or bench-top convertible, all hardware included. The 5580A has space for 11 single widths in the NIM standard configuration and the 5580B has space for 12 widths.

The 5580A is packaged to be compatible with the standard Hewlett-Packard modular enclosure system which provides a complete solution to instrument packaging and mounting problems. The 5580A can be stacked on a bench with other HP equipment.

The 5580B has space for 12 module widths and because of this has its side frames one-half inch wider than the standard HP enclosure.

BLOWER COOLING

Hewlett-Packard has built the 5580A/B to HP's own exacting standards. Experience has shown that protection against heat build-up is a prime requirement for instrument stability and reliability. For circuitry close-packed in modules, adequate heat removal can mean the difference between stable operation and drift or even premature failure. The 5580A/B is equipped with an efficient blower to force air through each instrument module in the bin and also through the supply itself. The air is drawn first through the modules so that no heat is carried from the supply to the modules.

LOW MUTUAL IMPEDANCE

Mutual impedance between modules is held to less than 0.005 ohm by wiring that joins each connector block to a common point having very low impedance. This assures the absence of spurious voltages at the dc regulated terminals of one connector block when heavy currents are drawn at an adjacent block.

1501 Page Mill Road, Palo Alto, California, U.S.A., Cable: "HEWPACK" Tel: (415) 326-7000

Europe: 54 Route Des Acacias, Geneva, Switzerland, Cable: "HEWPACKSA" Tel. (022) 42.81.50

PROTECTION FEATURES

The 5580A/B incorporates a number of features that protect the nuclear instrument modules to which it is supplying power. A warning light advises the operator when operation could be marginal and protection circuits act automatically to prevent costly damage due to shorts and overloads.

OVER-VOLTAGE PROTECTION

The plug-in arrangement whereby an entire set of modules is served by the same power supply carries with it the hazard that a short circuit or other fault in one module could cause a damaging and expensive chain reaction of malfunction or failure throughout the set. The 5580A/B guards against this unpleasant possibility with an over-voltage protection circuit.

This over-voltage circuit imposes limits on lower voltage circuits should they accidentally be shorted to higher voltage circuits, and prevents positive supplies from going negative and vice versa. Suppose that in an extreme case the + 24 V shorts to the + 6 V; the protection feature limits the voltage to a safe + 7.5 V. This protection is valuable for modules that utilize integrated circuits, since these are easily damaged by an over-voltage and are costly to replace.

OVERLOAD LIGHT

A front panel lamp glows to warn of any short circuit or when the overload limit is reached. Current limiting is set at approximately 10 percent above the rated output current, before voltage starts to drop. This prevents operation of the supply and modules at reduced voltage without the operator's being aware that conditions are marginal—good insurance against one possible cause of incorrect experimental results.

SPECIFICATIONS

OUTPUTS, DC: ± 24V at 0 to 2A; ± 12V at 0 to 4A; ± 6V at 0 to 5A. Maximum output power, 120 watts.

► **OUTPUTS, AC:** Line. One-half line for 230V operation.

REGULATION: Line, less than 0.05% for a 10% change. Load, output impedance less than 0.040 ohm at connector block for dc; less than 0.3 ohm at 100 kHz.

TEMPERATURE COEFFICIENT: 0.02%/°C.

AMBIENT OPERATING TEMPERATURE: 0 to 55°C.

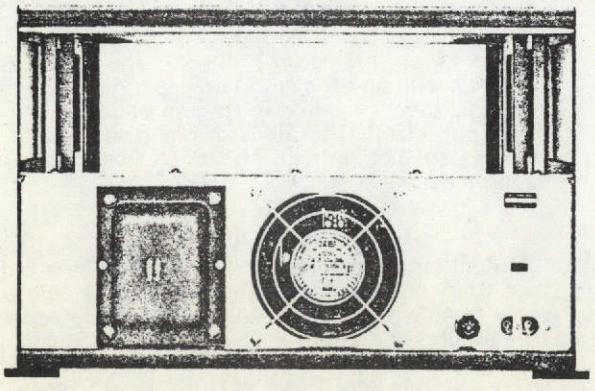
NOISE AND RIPPLE: Peak to peak 3 mV on any power supply voltage line, observed with a 50 MHz oscilloscope.

► **RECOVERY TIME:** Returns to within 0.1% of specified output within 100 μs for a 1A load current change.

INPUT LINE VOLTAGE: 105 to 125V or 210 to 250V, 50 to 60 Hz.

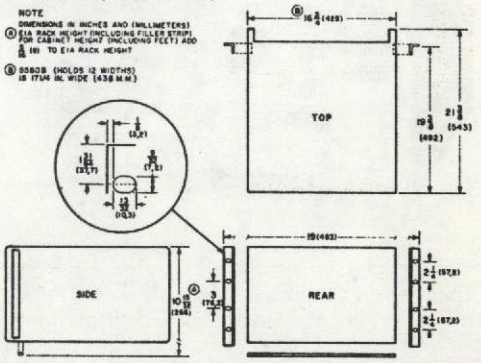
► **WEIGHT:** Net, 35 lb (15,9 kg). Shipping, 54 lb (24,5 kg).

PRICE: 5580A (11 widths), $775.00.
5580B (12 widths), $825.00.



5580A Rear Panel

DIMENSIONS: Mechanical tolerances provide for use of the 5580A/B with standard AEC modular instrumentation (TID-20893).



OPTIONS: For applications not requiring the full set of output voltages, the 5580A/B can be ordered under Options 01-06.

Option	Power Supplies Included	5580A	5580B
01	± 24 V, ± 12 V	$725	$775
02	± 6 V, ± 24 V	725	775
03	± 6 V, ± 12 V	725	775
04	± 6 V	675	725
05	± 12 V	675	725
06	± 24 V	675	725

Options 01-06 can later be expanded to full capability by the addition of plug-in regulator board(s): the circuit is tuned to produce ± 24, ± 12 or ± 6 volts. Model 05580-6004, $75.00.

ACCESSORIES INCLUDED: Detachable ac power cord.

► **ACCESSORIES AVAILABLE:**

10521A NIM Power Supply Extender Cable for ease in servicing modules, $35.00.
10649A Single Width Blank Filler Panel, $15.00.
10649B Double Width Blank Filler Panel, $15.00.
10649C Triple Width Blank Filler Panel, $15.00.

► Indicates change from prior specifications

HEWLETT hp PACKARD

#145-10

SINGLE CHANNEL ANALYZER

model 5583A

TECHNICAL DATA 1 JAN 68

The Hewlett-Packard Model 5583A Single Channel Analyzer is the most versatile instrument of its type ever offered. The 5583A has two basic modes of operation: SINGLE CHANNEL for pulse height analysis and DUAL INTEGRAL where the discriminators operate as completely independent integral discriminators.

In the SINGLE CHANNEL mode, DISCRIMINATOR A may operate as ΔE (narrow window) to determine the window width up to 1.00 volt wide. The window is tied to DISCRIMINATOR B (E_{min}) which determines the window's position relative to 0 volts. DISCRIMINATOR A may also operate as E_{max} and then the two discriminators may be varied independently over their range of 0.05 to 10.05 volts.

In the SINGLE CHANNEL mode there are two trailing edge outputs, fast negative and slow positive, which are generated for input signals whose amplitude falls within the window limits. Also available is a leading edge output, slow positive, generated for input signals that fall above the lower window limit. For single channel analysis work, this instrument may be strobed, either internally or externally. For external strobe inputs, the strobe signal should arrive after the peak of the input signal but prior to another pulse input to the analyzer. A gate input on the rear accepts a 3- to 12-volt signal to inhibit analyzer output.

For spectrometry work, E_{min} (DISCRIMINATOR B) may be provided externally; a 0- to 5-volt source will scan E_{min} over the complete discriminator range.

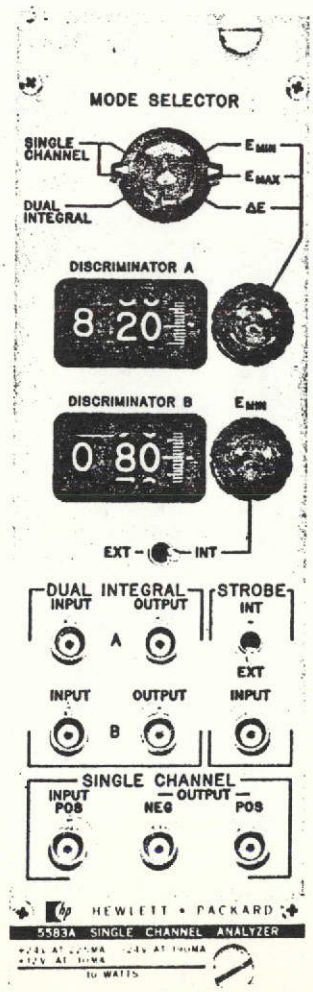
In the DUAL INTEGRAL mode of operation, each discriminator operates independently. Separate inputs are provided for this mode and separate slow positive outputs are derived from the leading edge of the input pulse. Also available in this mode are fast negative and slow positive outputs derived from the trailing edge of the input to discriminator B. These latter outputs of discriminator B can be externally strobed.

The discriminators used in this instrument have a highly readable and in-line display of voltage 0.05 to 10.05 volts, set by 10-turn precision pots. These discriminators are accurately calibrated and can be reset visually with a high degree of accuracy. They are very stable with high count rates, with count rate changes, and with temperature variations.

The HP 5583A Single Channel Analyzer operates with either unipolar or bipolar input pulses that have either RC or delay line shaping. The HP Model 5582A Linear Amplifier is ideal as an input pulse shaping amplifier.

The HP 5583A conforms to the standards of TID-20893. Logic inputs and outputs are in accordance with AEC preferred practice.

200 ns Multiple Pulse Resolution
Single Channel and Dual Integral Operation
Linearity ±0.25%
Strobed and/or Gated Operation
Excellent Temperature Stability



1501 Page Mill Road, Palo Alto, California, U.S.A., Cable: "HEWPACK" Tel: (415) 326-7000
Europe: 54 Route Dei 305 ieneva, Switzerland, Cable: "HEWPACKSA" Tel. (022) 42.81.50

SPECIFICATIONS

MODES OF OPERATION:①
SINGLE CHANNEL—ΔE.
SINGLE CHANNEL—E_{max}.
DUAL INTEGRAL.

MULTIPLE PULSE RESOLUTION: 200 ns.

INPUT CIRCUIT:
Impedance: Single Channel: 500 Ω. Dual Integral: 1 kΩ. Inputs are ac coupled. Maximum input rise time is determined by 1 ms input time constant.

SINGLE CHANNEL AND DUAL INTEGRAL INPUT: < 15 V. Unipolar positive or bipolar with positive portion leading (negative on special order).

DISCRIMINATOR RANGES: ①② E_{min} and E_{max} are adjustable from 0.05 V to 10.05 V. ΔE is adjustable from 0.005 V to 1.005 V.

ΔE ACCURACY: The ΔE window width is within ± 25 mV of the dial reading for NaI shaped pulses.①③

SENSITIVITY TO NARROW PULSES: The discriminator sensitivity to a 30 ns wide pulse drops to 90% of the nominal sensitivity.④

INTEGRAL LINEARITY:⑤ ± 0.25% of full scale for a NaI shape pulse.

TEMPERATURE STABILITY: < 0.01%/°C of full scale (1 mV/°C) change in E_{max} and E_{min} and < 0.1%/°C of full scale (1 mV/°C) change in ΔE, both over 0 to 55°C with allowable dc voltage tolerances as specified per TID-20893.

SPURIOUS OUTPUT PULSES ("leak through"): No spurious output pulses for input pulses outside the window. (As measured with Co^{57}; at 10^5 cps integral count rate there is no contribution from the 122 keV γ ray in the 14.4 keV peak.)

STROBE INPUT: − 0.6 V to − 3 V and > 15 ns wide (50 Ω input, ac coupled).

GATE INPUT: + 3 V to + 12 V inhibits single channel outputs (500 Ω input, dc coupled).

E_{min} BIAS INPUT:⑤ 0 V to + 5 V to scan complete discriminator range (< 100 μA, dc coupled).

OUTPUT: All outputs are available in all three modes of operation. The outputs are dc coupled and are not damaged when shorted. Inputs and outputs conform to AEC preferred practice logic.
Dual Integral A and B: Nominally + 5 V into 100 ohms and + 6 V open circuit, 100 ns wide, triggered from leading edge of input pulse.
Single Channel Positive: Nominally + 5 V into 100 ohms and + 6 V open circuit, 100 ns wide, triggered from trailing edge of input pulse or from strobe input.
Single Channel Negative: Nominally − 0.8 V into 50 ohms, 20 ns wide and 5 ns rise time, triggered from trailing edge of input pulse or from strobe input.

OPERATING TEMPERATURE: 0 to 55°C.

POWER REQUIRED: + 24 V, 225 mA; − 24 V, 190 mA; + 12 V, 10 mA (for count rate < 10^5 cps). Power may be supplied by HP 5580A/B NIM Power Supply.

DIMENSIONS: Standard double width module, 2.703 inches wide x 8.714 inches high x 10.487 inches deep (with connector) (68,6 x 203,0 x 266,0 mm).

WEIGHT: Net, 3.6 lbs. (1,6 kg). Shipping, 5 lbs. (2,3 kg).

CONNECTORS: All signal inputs and outputs, BNC. Power input, AMP 202515-5.

PRICE: $550.00.

ACCESSORIES AVAILABLE: HP 10519A 50 Ω cable, 6 ft., BNC-BNC male, $7.00. HP 10100A 50 Ω feedthrough termination, $15.00. HP 10100B 100 Ω feedthrough termination, $18.00.

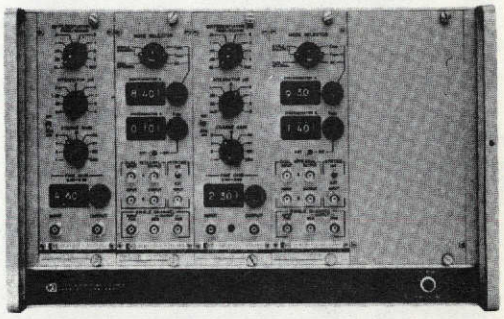
(1) **Single Channel—ΔE,** pulses between E_{min} and E_{min} + ΔE are counted. **Single Channel—E_{max},** pulses between E_{min} and E_{max} are counted. **Dual Integral,** pulses greater than E_{min} are counted.

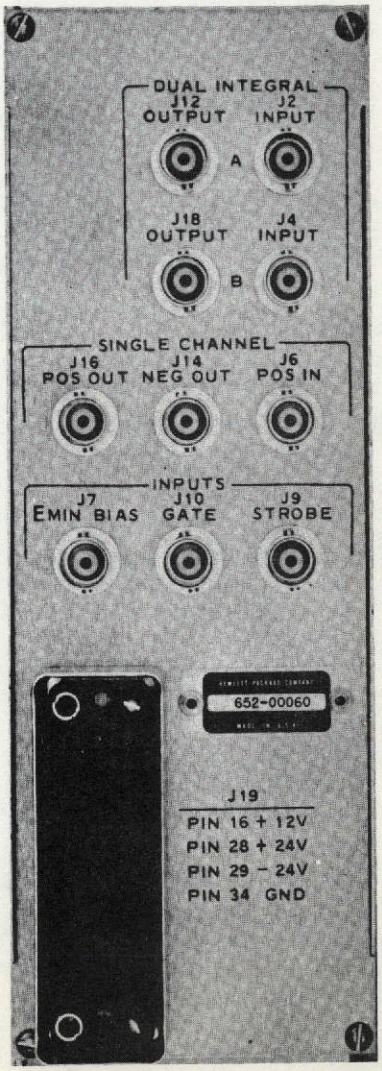
(2) The lower level discriminator may be controlled externally to allow use of the Model 5583A for automatic gamma ray spectrum scanning. Consult HP 5552A Technical Data Sheet for applications information.

(3) NaI shaped pulse specifies an input pulse with a rise time constant of 0.25 μs and a decay time constant of 1 μs. These time constants correspond to the pulses generated by HP 10600 Series Scintillation Detectors. Single or doubly differentiated pulse shapes derived from other NaI (Tl) detectors may be used with similar performance.

(4) Nominal sensitivity is defined as sensitivity to the NaI shaped pulse. See Note 3.

(5) Integral linearity is defined as the maximum deviation from the best fit straight line of discriminator threshold vs dial reading.





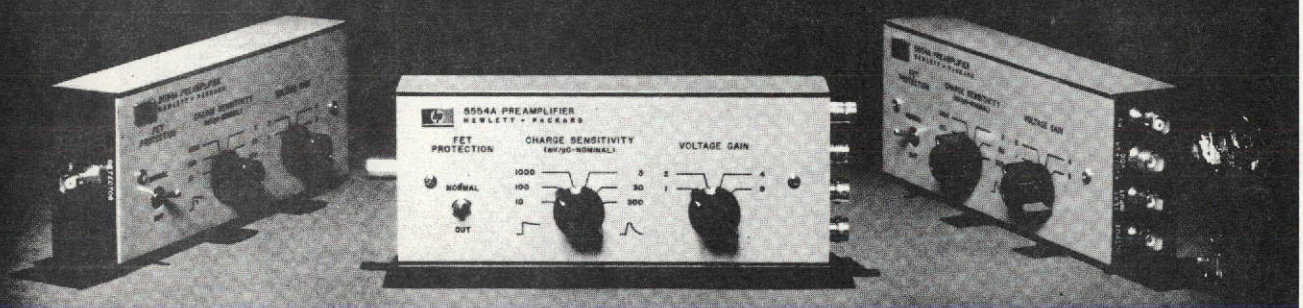
HEWLETT hp PACKARD

PREAMPLIFIER model 5554A

TECHNICAL DATA 15 JUN 69

A GENERAL-PURPOSE PREAMP-AMPLIFIER

The 5554A ends the experimenter's need for a multitude of special-purpose preamplifiers by providing a single unit that can serve with a variety of detectors, including semiconductor, gas proportional, Geiger, and scintillation.



GENERAL PURPOSE

Many conflicting requirements make it difficult to optimize the noise performance of a detector-preamplifier system. This has led to a proliferation of preamps, each one suited to a particular detector. The HP 5554A is general purpose. It can be adapted for different detectors simply by resets of charge sensitivity and gain switches, and replacement of the bias resistor in its clips.

FET PROTECTION

Switch-in diode protection of input against high voltage spikes.

VERSATILE, CONVENIENT

Switch-selected charge sensitivity, voltage gain.
Combination preamp-amplifier with shaping, or preamp only.
Quick-change bias resistor, no soldering needed.

HIGH PERFORMANCE

Low Noise: At Zero External Input C, FWHM (Ge) is 2.2 keV (typical).
Linearity: 0.05% integral.
Stability: 0.01% per °C.

The Hewlett-Packard 5554A Preamp-Amplifier is a low-noise general-purpose instrument for use with nuclear detectors of many types, including semiconductor, gas proportional, Geiger, and scintillation. Simply by turning switches the user can select charge sensitivity, voltage gain, and output pulse shape. The input device is a field-effect transistor (FET) for low-noise performance. The FET is diode-protected against damage from high voltage transients. For low-noise work with semiconductor detectors, the flip of a switch removes the diode circuit.

The versatile 5554A can be set up for a different detector as fast as the user can reset the charge sensitivity and gain switches, and can slip a replacement bias resistor between the quick-connect clips. No soldering of components is needed. Charge sensitivity selection is 10, 100, or 1000 mV/pC nominal (nonshaped output pulse) or 3, 30, or 300 mV/pC nominal (shaped output pulse).

The 5554A has a voltage amplifier with switch-selected gains of 1, 2, 4, or 8 (50-ohm load) and its own capability for pulse shaping—differentiation and integration, 1 μs time constant. The output can be fed directly to a pulse height analyzer, scaler-timer such as the HP 5201L, to a single-channel analyzer such as the HP 5583A, or to a multichannel analyzer such as the HP 5400A.

Where a linear amplifier such as the HP 5582A is needed for additional gain or for selectable pulse shaping to optimize performance for high count rates and conditions of overload, the 5554A operates as a preamp without the pulse shaping network. Pole-zero cancellation is included to prevent undershoots that otherwise could increase system dead-time in the presence of overloading pulses.

The 5554A is ideal for use with HP nuclear instrument modules (NIM) in the AEC-compatible configuration.

Circuit Description

The 5554A accepts a burst of charge (current pulse) from a nuclear detector and produces an output pulse of voltage proportional to the amount of charge in the burst. This, in turn, is proportional to the energy of the incident nuclear particle or gamma ray photon.

The circuit comprises a charge-sensitive stage coupled to a voltage amplification stage either of two ways, switch-selected: via a pole-zero cancellation network that eliminates undershoot and gives an output pulse ideal for input to a linear amplifier; or, via a shaping network that differentiates and integrates the output for direct input to pulse analyzing equipment.

Figure 1 shows a block diagram. The charge-sensitive stage is an operational amplifier boot-strapped for very high open loop gain and with shunt feedback through RC networks switch-selected to provide conversion gain (millivolts per picocoulomb) compatible with the detector being used. To a shunt capacitance always present (1 pF with 1000 M around it), capacitance is added to vary the gain; resistance is changed to keep the time constant the same. Both ends of the added RC pairs are switched to keep stray capacitance a minimum.

The voltage gain stage is another operational amplifier with switch-selected gain. Complementary emitter-followers give ample power to drive an external load, and output impedance is a constant 50 ohms.

Figure 2 shows pulse shapes for the two ways the amplifier is coupled by the selected setting of the CHARGE SENSITIVITY control.

A decoupling network is provided to filter noise from the high voltage supplied for detector bias. The decoupler connects a high voltage power supply such as the HP 5551A to the detector through the bias resistor, see Figures 1 and 3.

A test input accepts a voltage pulse from a pulse generator and injects a small amount of charge into the 5554A's input. This facilitates testing and calibrating all of the electronics in the entire pulse analysis system.

Power to operate the 5554A may be supplied at any voltage from +20 V to +24 V.

Input and Output

Either positive or negative input signals are accepted; the output is inverted and is a tail pulse* (50 ns rise

time, 100 μs decay time constant) ideal for input to a linear amplifier such as the 5582A. For direct input to pulse height analyzers, a shaped output is available. Shaping is by an RC network with 1 μs integration and differentiation time constants.

Output impedance is 50 ohms. Pulse reflections will be insignificant for 50-ohm cables of ordinary length.

The positive output has a dynamic range of 5 V into a 50-ohm load. The values marked on the voltage gain switch (1, 2, 4, 8) assume a 50-ohm load. Into a load greater than about 500 ohms, output range is up to 10 V, and the values on the voltage gain switch are in effect doubled.

The negative output has a range of 3.5 V into 50 ohms, 7 V into 500 ohms or greater.

* A tail pulse is characterized by an abrupt rise followed by an exponential decay.

FET Protection

Because high voltage to bias the detector connects directly to the preamplifier input, large transients can appear at the input whenever HV is switched or changed. The 5554A has a protection diode to conduct negative spikes to ground and prevent damage. The input is reasonably insensitive to positive spikes. For low-noise work, this protection can be switched out after high voltage adjustment is complete. It should be restored before any change is made to the high voltage.

Quick-Change Bias Resistor

Detectors of different types each require a particular value of bias resistance for best performance. The 5554A makes changing the bias resistor a simple matter of slipping a new resistor between two spring-loaded clips. Figure 3 shows this convenient arrangement.

A kit of three resistors, 4.7 M, 100 M, and 1000 M, is supplied with the 5554A, and other values may be used.

In a nuclear preamp the bias resistor provides a path to ground (ac) for the detector signal (see Figure 1); a large value reduces signal loss. On the other hand, the detector's leakage current passes through the bias resistor and lowers the voltage on the detector; a small value reduces this IR drop.

When germanium and silicon detectors are operated at low temperatures, leakage currents are very small. A large bias resistor will give optimum resolution. For room temperature operation, the bias resistor must be decreased in value to compensate for increased leakage current.

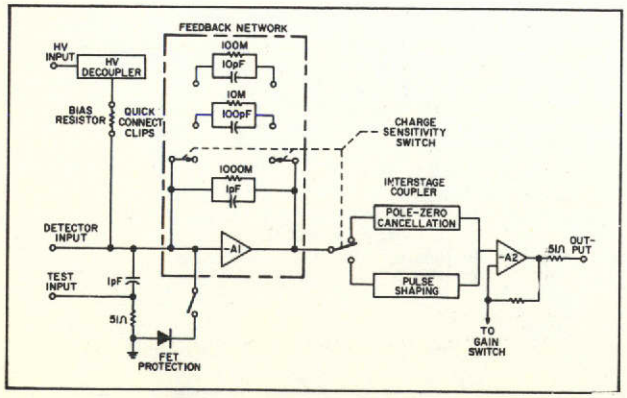


Figure 1. 5554A block diagram

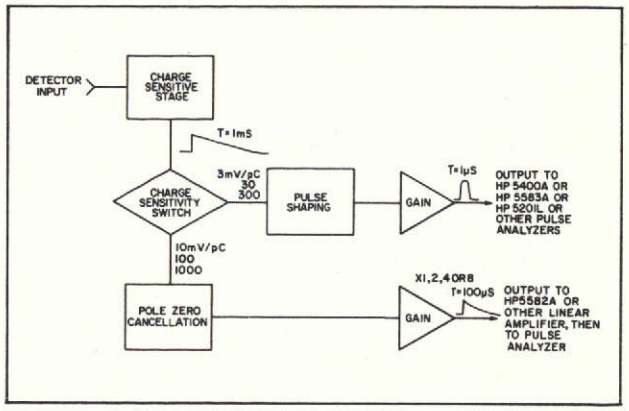


Figure 2. Pulse shapes

With the 5554A, the compromise of these conflicting requirements can conveniently be made without the need for circuit teardown and resoldering. The table below gives typical values for guidance.

TYPICAL VALUES OF BIAS RESISTANCE

Detector	Resistor
Geiger	4.7 M
Proportional	1000 M
Scintillation	Open ckt*
Silicon	
Room Temperature	100 M
Cooled	1000 M
Germanium	1000 M

* PM high voltage is not obtained via the 5554A.

Test Input

The TEST INPUT connector accepts a voltage pulse and couples it to the 5554A's input through a 1 pF capacitor such that this test pulse simulates a charge pulse from a detector. With a precision pulse generator, check-out and calibration are easy; a 1 V signal simulates a 1 pC charge pulse.

Operating Power

Only one voltage — and it can have any value from +20 V to +24 V — is needed to supply the 5554A. Current requirement is 35-80 mA. The HP 5582A Linear Amplifier, the HP 5201L-Series Scaler-Timers, and the HP 5400A Multichannel Analyzer all connect directly.

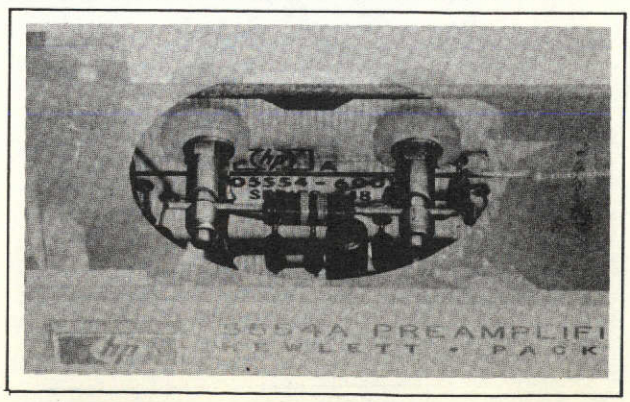


Figure 3. The quick-change bias resistor

Noise

Noise is inevitable in any detector-amplifier system. The unwelcome result of noise is to broaden spectral peak widths.

In a charge-sensitive preamp, noise is strongly a function of input capacitance. This capacitance includes that of the detector itself and stray capacitance arising from cables and connectors.

Detector capacitance varies with the type of detector and from unit to unit. For semiconductor detectors, noise varies with operating conditions — it even varies with applied bias, since these detectors operate as back-biased diodes and their capacity is voltage-dependent.

System noise is also a function of the pulse shaping employed in the main amplifier. This shaping sets the bandpass. Noise also is determined by input resistance, which should be kept as high as possible; an FET input is advantageous.

Noise reduction becomes of critical importance for cooled Ge(Li) and silicon detectors in order to fully exploit their exceptional resolution. The 5554A's noise specifications show it to be capable of serving with these detectors. For scintillation, Geiger, and gas proportional detectors, preamp noise is usually not critical. These detectors have inherent resolution limitations that make preamp noise insignificant.

Noise Specifications

Hewlett-Packard specifies noise two ways: in terms of "full width at half maximum" (FWHM) stated in keV for a germanium detector and in terms of "equivalent rms ion pairs."

For pulse height analysis, the spread of pulses in the peak of interest is a measure of system resolution and is defined in terms of the **width** of the signal distribution at one-half of its **maximum** height, FWHM. This FWHM statement is the one easily interpreted by most users since it is in terms of the consequence to measurements.

However, a FWHM statement is tied to the type of detector, in this case, a germanium detector. The "rms ion pairs" statement is valid regardless of the detector.

As discussed earlier, a meaningful specification must call out input capacitance and pulse shaping. This information is noted for the 5554A (see Specifications).

Another important noise specification is noise slope, which gives the rate of increase of noise with increasing input capacitance. If the noise at zero external capacitance and the noise slope are known, then the noise contribution of the preamp can be predicted for a given experimental setup.

SPECIFICATIONS

DETECTOR BIAS NETWORK
High Voltage: 2.5 kV max, either + or − as required by detector.
HV Decoupling: 3 stages, $R = 1\ M\Omega$, $C = 0.0047\ \mu F$, $T = 4.7$ ms.
Bias Resistor: Inserts between spring-loaded clips. Three resistors are provided (1000 M, 100 M, 4.7 M); others may be used.

FIRST STAGE CHARGE SENSITIVITY
With Tail-Pulse Output: 10, 100, or 1000 mV/pC (millivolts per picocoulomb) nominal.
With Shaped Output: 3, 30, 300 mV/pC nominal.

SECOND STAGE VOLTAGE GAIN
With $R_L = 50\ \Omega$: 1, 2, 4, or 8.
$R_L \geq 500\ \Omega$: 2, 4, 8, or 16.

OVERALL GAIN
First Stage Charge Sensitivity x Second Stage Voltage Gain.
Loss with Input Capacitance: <3% at 100 pF for charge sensitivity 300 or 1000; otherwise much less.

SIGNAL POLARITY
Input: Either.
Output: Either.

OUTPUT
Polarity: Inverted from input.
Linearity Dynamic Range* (with +24 V supply and voltage gain 2, 4, or 8):
Positive: 5 V into 50 Ω load.
10 V into load of ≥500 Ω.
Negative: 3.5 V into 50 Ω load.
7 V into load of ≥500 Ω.
With Voltage Gain =1: about 70% of above values.
With 20 V Supply: +4 V, −2.5 V into 50 Ω.
+8 V, −5 V into ≥500 Ω.
Impedance: 51 Ω.
Note: Outputs measured with power input at +24 V. With power input at +20 V, positive range is 4 V (50 Ω), 8 V (≥ 500 Ω), and negative range is 2.5 V (50 Ω), 5 V (≥ 500 Ω).
Tail Pulse:
Rise Time: 50 ns at zero external capacitance.
Tail Time Constant: 100 μs.
Pole-zero cancellation.
Shaped Pulse:
RC Differentiation Time Constant: 1 μs.
RC Integration Time Constant: 1 μs.

* Range of output peak amplitudes over which the instrument meets its integral linearity spec.

NOISE**

External Input Capacitance, pF	rms ion pairs		FWHM, keV (Ge, 2.98 eV/ion pair	
	Typical	Max.	Typical	Max.
0	310	360	2.2	2.5
10	360	410	2.5	2.9
100	780	900	5.4	6.3

Noise Slope:
Typical: 0.033 keV/pF.
Maximum: 0.038 keV/pF.

STABILITY, LINEARITY
Temperature Stability: 0.01%/°C (nonshaped pulse).
Integral Nonlinearity: 0.05%

POWER REQUIRED
Operating Voltage, dc: +20 to +24 V.
Quiescent: 35 mA at +20 V.
45 mA at +24 V.
Full Load: 60 mA at +20 V.
80 mA at +24 V.

PHYSICAL
Connectors:
Detector Input: BNC, female, high voltage type.
Output: BNC, female.
Test Input: BNC, female, 50 Ω termination. Capacitor, 1 pF ± 0.25 pF.
Low Voltage: TNC, female, +20 to +24 V dc.
HV: BNC, female, high voltage type.
FET Protection Switch: Diode network, normal or out. Note: Be sure switch is set to NORMAL before switching or changing HV.
Dimensions: 3 in. wide x 2¼ in. high x 8¼ in. long (76 x 57 x 210 mm).
Weight: Net, 1.11 lb (0.506 kg). Shipping, 2 lb (1 kg).
Accessories Furnished:
Power input cable, TNC connectors, 6 ft. long (HP 10517A).
Bias resistor kit: 4.7 M, 100 M, 1000 M.
Accessories Available:
High voltage cable, 6 ft. long, HV-type BNC connectors (HP 10516A, $10.00).
Price: 5554A, $325.00.

** With 1000 megohm bias resistance and 5 μs single RC shaping.

HEWLETT hp PACKARD

LINEAR AMPLIFIER 5582A

TECHNICAL DATA 1 JULY 69

Delay Line and RC Shaping, Single or Double
Plug-in Delay Lines
RC Shaping from 20 ns
Crossover Walk $< \pm 0.5$ ns
Excellent Gain Resettability
Gain Variable, 2 to 1280

The Hewlett-Packard Model 5582A Linear Amplifier is an original HP design which provides maximum flexibility for nuclear pulse counting with all types of detectors and with a wide range of counting rates. The plug-in modular design meets the mechanical and power standards set forth by AEC Report TID-20893.

The wide range of integration and RC shaping time constants, selectable by front panel switches, allows the experimenter to choose the optimum pulse shape for the detector and preamplifier used.

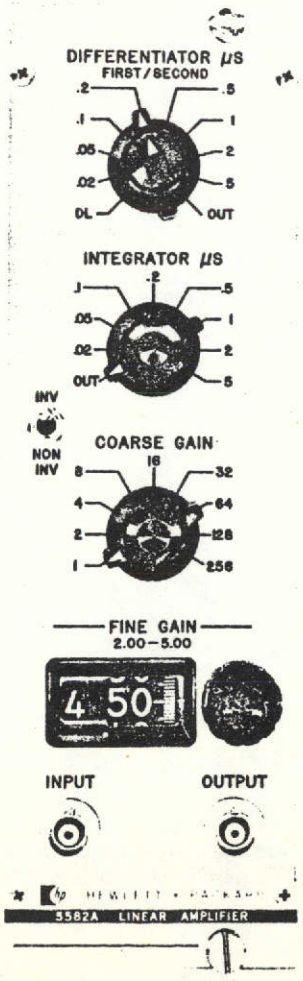
By the use of plug-in delay lines, this linear amplifier allows a choice of shaping times from 1 μs down to 100 ns in 100 ns steps. The standard 5582A is supplied with 1 μs delay lines. Other delay lines are available on special order. This plug-in design simplifies delay line changes to minimize pulse pileup and to match the speed of subsequent signal analyzing and accumulating instruments. The delay lines are temperature compensated to stabilize their balance.

The HP 5582A will accept either positive or negative input pulses. A front panel switch is provided to allow inversion of the output pulse, if desired.

The fine gain control is variable from 2.00 to 5.00 by means of a 3-turn pot with horizontal in-line gain markings which eliminate ambiguity in reading. Gain resettability is one minor division on the fine gain control or better than 0.2% under constant ambient conditions.

Both signal input and output connectors are available on the front and rear panels. A + 24-volt output on the rear is available for preamplifiers, and a gain control input is located on the rear for gain stabilization.

This linear amplifier provides an ideal input for the HP 5583A Single Channel Analyzer in nuclear pulse analysis applications. The 5582A provides pulse shaping for either leading-edge or zero-crossing time detection with the 5584A Dual Timing Pickoff.



SPECIFICATIONS

INPUT:
Polarity: Positive or Negative.
Impedance: 1.5 kΩ, dc coupled.
Maximum Voltage: 15 V peak, 15 V dc, without damage to input.

GAIN:
Range: 2 to 1280* by coarse and fine control.
Controls:
COARSE: Switch from 1 to 256 in binary steps.
FINE: Continuously variable from 2.00 to 5.00 (times coarse gain setting) by 3-turn pot with calibrated in-line digital display.
RESETTABILITY: Fine gain, one minor division (0.2% of full range at constant temperature).

PULSE SHAPING:
RC Mode: Separate controls for integration, first and second differentiation.
Time Constants: 0.02-5 μs in 1, 2, 5 sequence for integration, first and second differentiation.
Delay Line Mode: Single or double; 1.0 μs delay lines are standard. Plug-in delay lines from 100 ns to 1 μs in 100 ns steps available on special order.

AMPLIFIER RISE TIME: < 40 ns, typically 25 ns.

AMPLIFIER BAND PASS: Typically 2 kHz to 6 MHz.

TEMPERATURE STABILITY: Gain shift < 0.05%/°C, typically 0.02%/°C.

OUTPUT:
Amplitude: ± 10 V, except ± 5 V with 0.02 μs and 0.05 μs first and/or second differentiation time constants.
Impedance: < 5 Ω.
Minimum Load Impedance: 90 Ω.
Polarity: Positive and Negative.
Delay: Typically 65 ns (relative to input).

INTEGRAL LINEARITY: < 0.3% with 1 μs DDL and 0.1 μs integration time constant.

DIFFERENTIAL LINEARITY: < 1%, 0.3% below 8 volts (typical).

NOISE: < 15 μV RMS, referred to input at maximum gain with 1 μs integration time constant and 1 μs single differentiation time constant. Typically 9 μV with input terminated in 50 Ω.

CROSSOVER WALK: < ± 0.5 ns shift at constant gain from 10% of rated output to rated output with 1 μs DDL shaping and 0.1 μs integration time constant. For a 16:1 change in gain setting, walk is < ± 5 ns (with constant fine gain setting).

COUNT RATE SHIFT: < 0.05% with inputs to 10^5 counts/s, for Cs137 (typical).

OVERLOAD: Amplifier recovers from a 200X overload to 2% of the baseline in less than 3 non-overload pulse widths with 100 μs preamp fall time constant (for 1 μs DDL and 100 ns integration shaping). In 1 μs double RC differentiation and 1 μs integration shaping, the recovery from a corresponding overload to 2% of baseline is 2 non-overload pulse widths from end of non-overload pulse.

GAIN STABILIZATION INPUT: For external fine gain control, contact factory for applications information.

OPERATING TEMPERATURE: 0 to 55°C.

POWER REQUIRED: + 24 V, 260 mA; − 24 V, 325 mA. Power may be supplied by HP 5580A NIM POWER SUPPLY.

PREAMP POWER OUT: + 24 V.

CONNECTORS: Signals, input, output, front and rear panels—BNC, Preamplifier Power—TNC, Gain Stabilization Input—BNC, Power—AMP 202515-5.

DIMENSIONS: Standard NIM double-width module 2.699 in. wide by 8.709 in. high (68,6 x 221,2 mm) per TID-20893 (Rev. 2).

WEIGHT: Net, 3.6 lb (1,6 kg). Shipping, 5 lb (2,3 kg).

PRICE: $695.00.

OPTIONS AND ACCESSORIES
OPTION 01: 5582A without delay lines, $645.00.
5582A PLUG-IN DELAY LINES

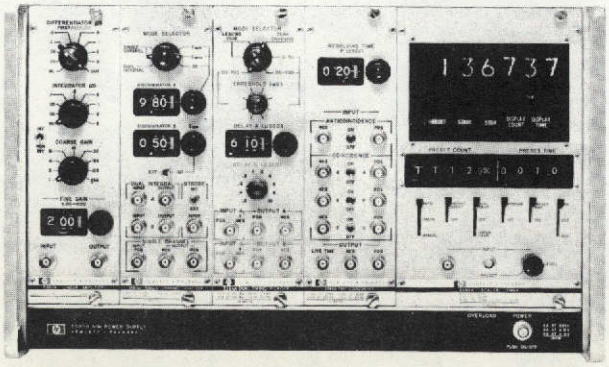
Time Constant, ns	Delay Line Kits	5582A with Special Delay Lines Installed
100	K01-5582A	H01-5582A
200	K02-5582A	H02-5582A
300	K03-5582A	H03-5582A
400	K04-5582A	H04-5582A
500	K05-5582A	H05-5582A
600	K06-5582A	H06-5582A
700	K07-5582A	H07-5582A
800	K08-5582A	H08-5582A
900	K09-5582A	H09-5582A
1 μs	10630A	—

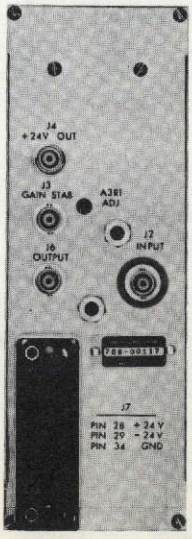
Each kit contains two delay lines, each with the same time constant, price $75.00 per kit. The 5582A may be ordered with special delay lines installed, add $75.00 to the Option 01 price. **Note:** Kit 10630A is the standard set (1 μs) supplied separately.

CABLES AND TERMINATIONS: HP 10519A 50-ohm cable 6 ft. long, BNC Connectors, $6.50. HP 10517A cable 6 ft. long, TNC Connectors, $7.50. HP 10510A 50-ohm BNC termination, $5.00. HP 10100A 50-ohm feedthrough termination, $15.00. HP 10100B 100-ohm feedthrough termination, $18.00.

* Voltage gain is valid for DL shaping with short integration time constants or with differentiation time constants switched out. Exact voltage gain with RC differentiation depends on time constants used.

► Indicates change from prior specifications





#147

RADIATION COUNTER, BIOCHEMICAL SAMPLE

PURPOSE

To provide a fast, accurate and easy to use biochemical radiation counting system for use with standard sized biochemical samples.

REQUIREMENTS

Sample Holder -

Must accept any standard planchet up to 2" diameter in a zero-g environment. Total sample capacity - 120.

Transport Mechanism -

Must reliably transport a planchet from the main storage area to the radiation detector and back in zero-g conditions. This mechanism must reliably keep track of the sample identification and provide for skipping empty holders.

Detector Mount -

Must accept all conventional radiation detectors including gas-flow detectors, semiconductor detectors and scintillometer detector systems.

Data Management Interface -

Must include remote sample changing, logging of radiation levels from the detector system and logging of sample identification.

REQUIREMENTS (Continued)

Radiation Counter System -

This instrument must be interfaced, through the detector mount and sample changing equipment, to the General Radiation Spectrum Analyzer and/or the equipment listed in #145, Radiation Detector, General.

HARDWARE STATUS

With modification of the planchet holder/transporting scheme for suitability in zero-g, the existing systems are suitable for use. The interface to the data management system and conversion to 28 VDC primary power would also have to be done.

An existing system which could be made to meet these requirements is the Hewlett-Packard Model 5560A Automatic Sample Changer.

TECHNICAL DESCRIPTION

Hewlett-Packard Unit

Weight (Includes lead shield for ultra-low counting)	600 lbs
Size	27 in. W, 15 in. H, 20 in. D (4.7 ft^3)
Power	90 w

(Does not include counting systems)

Preliminary estimates for flight unit

Weight	200 lbs
Vol.	2.0 ft^3
Power	90 w

COST Preliminary estimates for flight unit

$350K Development

$ 50K Unit

Hewlett-Packard Unit

$ 50K Unit

DEVELOPMENT TIME 2 yrs

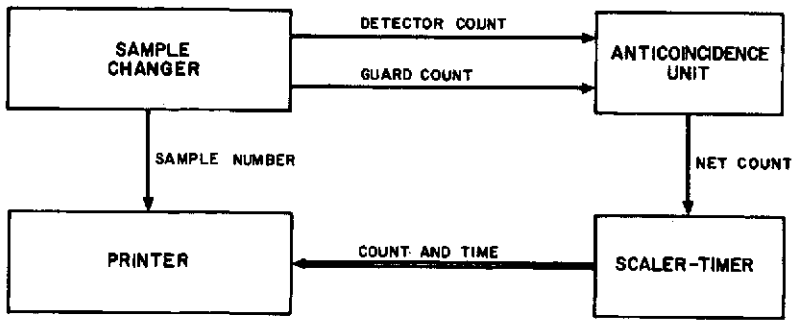
ULTRA-LOW BACKGROUND—0.1 cpm
10^6 cpm WITH 1% COUNTING LOSS
120 SAMPLE HOLDERS—CHOICE OF SIZES
GAS-FLOW OR SCINTILLATION DETECTORS
EASY SYSTEM EXPANSION AND CONVERSION

HEWLETT-PACKARD
NUCLEAR
COUNTING
SYSTEMS

An automatic sample changer together with other Hewlett-Packard nuclear instruments and the HP 5050A Digital Recorder form the elements of the 5560A Series of Nuclear Counting Systems. Operation is directed from the sample changer which handles up to 120 samples on holders in 12 convenient-to-use magazines loaded onto a drum. Samples are carried into the counting cavity both by an automatic transport system connecting the rotating drum with the cavity and by a manually operated drawer.

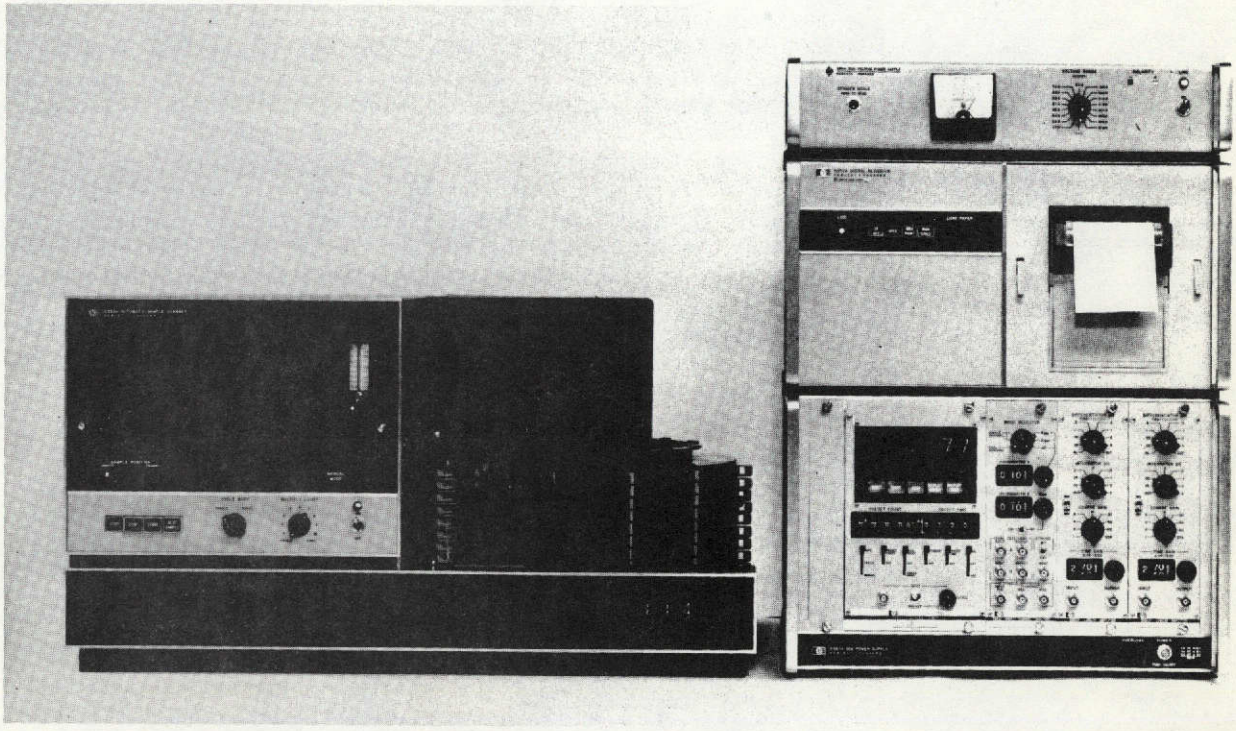
Inside the cavity the sample is accurately positioned beneath a gas-flow Geiger or proportional detector or scintillation detector for measurement. Protection against cosmic rays and other background radiation is provided by a lead shield surrounding the cavity in all directions (4π shielding), and by oxygen-free high-conductivity (OFHC) copper shielding, and in special ultra-low background systems also by a guard detector. Fed to an anticoincidence unit, an output pulse from the guard vetoes the counting of a simultaneous pulse from the sample detector, thus providing cancellation for background intercepted by both detectors.

Count pulses are fed to the HP 5590A Scaler-Timer which registers them, controls the counting time for each sample, and commands the HP 5050A Digital Recorder for a printed record. Count pulses may also be sent simultaneously to other nuclear instruments for a variety of measurements, such as to the HP 5400A Multichannel Analyzer for spectroscopy.



The following pages describe in greater detail the major points of the automatic sample changer and systems; the automatic sample changer (pp. 3-5); the detectors, guards, and shielding (pp. 6 and 7); the systems and instruments (pp. 9-14); and, finally, a complete set of specifications. Ordering information and prices are presented on a separate sheet available upon request.

NUCLEAR COUNTING SYSTEM WITH AUTOMATIC SAMPLE CHANGER



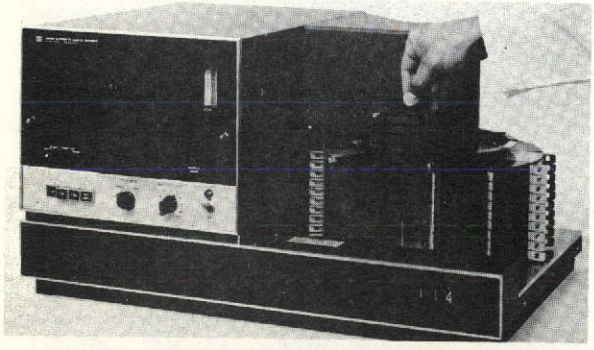
5560A
Automatic Sample Changer

120 PLANCHET HOLDER CAPACITY
EASE OF LOADING AND UNLOADING
CONVENIENT-TO-USE MAGAZINES
MULTI-CAPACITY HOLDERS

STORAGE DRUM

Up to 120 planchet holders are placed in the 12 magazines which fit onto a storage drum. This drum rotates to position the magazines in sequence before the channel leading to the counting cavity. Magazines can be instantly removed and replaced in nine of the twelve magazine positions at any time, even during operation.

Individual magazines can be loaded and unloaded at each experimenter's own lab bench. There is no ambiguity as to the sample number of a holder, as there are numbered compartments for the holders in each magazine. A lock-in feature prevents the holders from falling out, no matter in what position the magazine is held. Extra magazines and holders are available for the experimenter's convenience. Three different colors are offered to aid in identifying magazines and holders.



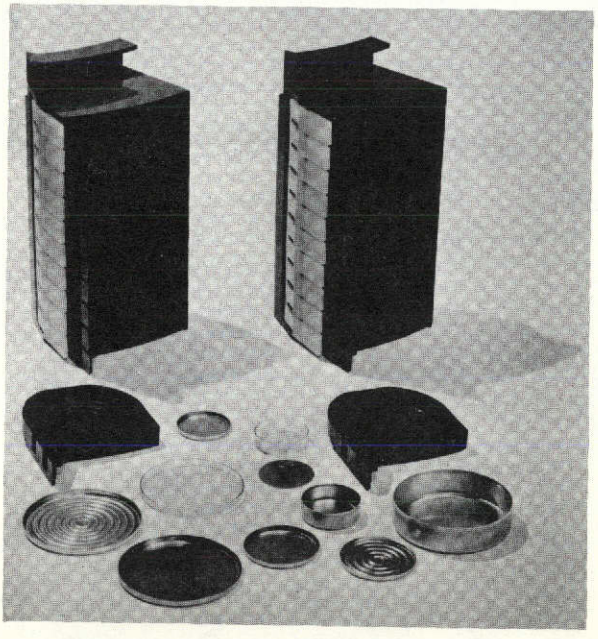
EASE OF LOADING AND UNLOADING

One need not place a holder in every magazine compartment or have a magazine at every position on the drum. Counting intervals are automatically omitted in the case of missing planchet holders, and positions of missing magazines are passed over.

PLANCHET HOLDERS

Two types of holders, standard and deep-dish, are offered to handle the popular planchet sizes from 0.5 in. to 2 in. in diameter and up to 3/16 in. depth. The holders are recessed for the various planchet sizes so that each planchet will be accurately positioned beneath the detector for reproducibility of measurements. Holders are available in three colors: light gray, blue gray, and black. Magazines and holders for deeper planchets may be obtained on special order. Planchets of different sizes can be intermixed for operation.

EASE-OF-USE MAGAZINES



MULTI-CAPACITY HOLDERS

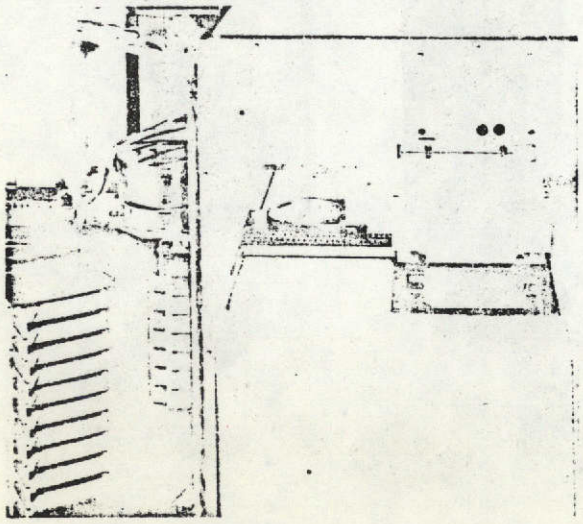
TRANSPORT SYSTEM ENGINEERED
FOR RELIABILITY
MANUAL DRAWER
EASE-OF-USE CONTROLS
VERSATILE OPERATION
PROTECTION AGAINST DATA LOSS
INTEGRATED CIRCUIT LOGIC

TRANSPORT SYSTEM

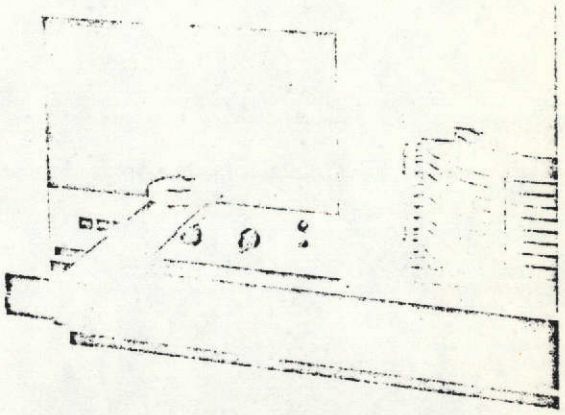
A motor-driven chain pulls the planchet holder from drum to counting cavity along a horizontal guided channel. The magazine is gently raised by a pulley to bring each successive holder before the channel. Action is sufficiently gentle so that liquids may be handled. Engineered for reliability, the transport mechanism has few moving parts; a system of interlocks and safety features protects the mechanism from troubles caused by operator error.

To ensure reproducible geometry and highly efficient measurements, the transport mechanism accurately positions the planchet holder beneath the detector and at a close distance to the window.

The control electronics uses integrated circuits in modular construction. There are no relays anywhere and motor control is by solid-state switching. Three digital display tubes give a clear presentation of the sample number of the holder in cavity or in transit.



MOTOR-DRIVEN CHAIN GIVES POSITIVE ACTION



MANUAL DRAWER PLACES SAMPLE UNDER SAME DETECTOR AND IN SAME POSITION AS IN AUTO MODE

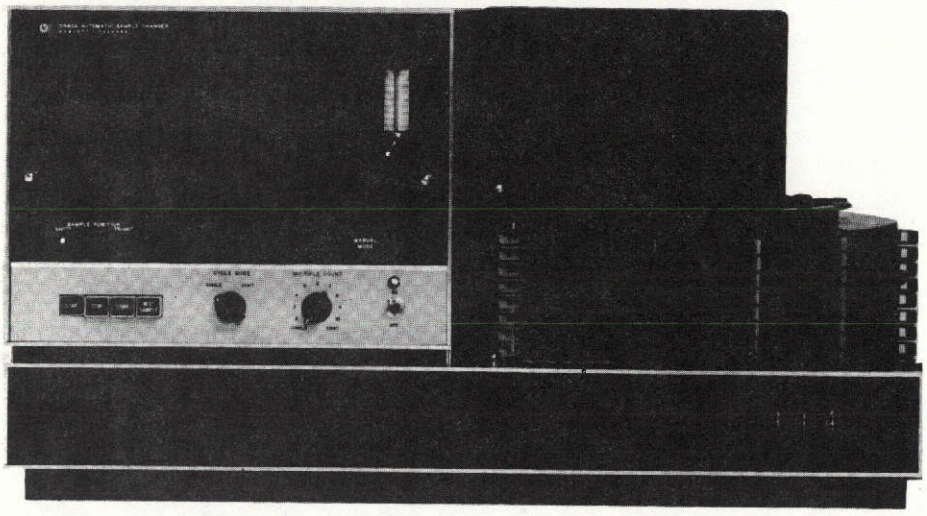
MANUAL DRAWER

A special feature of the Hewlett-Packard Nuclear Counting Systems is a manual drawer, standard on all systems, that places a sample under the same detector and in the same position as in automatic operation. Easily used at any time, such a drawer not only allows the user to make a quick count of a sample but permits meaningful comparisons to be made between measurements obtained manually and those obtained automatically. This drawer will be a great convenience to those wishing a quick recount on a sample, especially should a new experiment be in progress.

CONTROLS

Basic operation is directed from the sample changer. Here a master switch controls power to the entire system. A START button initiates or resumes automatic operation. A STOP button immediately halts operation at any time. A STORE button returns the sample to the drum and releases the drum for manual positioning, and a NEXT SAMPLE button returns the current sample to the drum. Held down, the last causes an advance of subsequent samples past the entrance of the channel leading to the cavity. This operation is useful when the user wishes to skip to a particular sample of interest.

ENGINEERED FOR EASE-OF-USE AND RELIABILITY



A CYCLE MODE switch selects between SINGLE and CONTINUOUS modes. In the SINGLE mode the changer automatically stops following the last sample. In the CONTINUOUS, it recycles automatically following the last sample. A MULTIPLE COUNT switch selects the number of counting intervals for the sample in the cavity, 1 to 10 intervals or continuous repeating, and is operable for a sample brought into the cavity either manually or automatically.

For manual operation the experimenter simply pulls out the manual drawer; automatic operation is interrupted with the immediate and automatic return of the current sample to the storage drum. Positioning a sample on the drawer, shutting the drawer, and pressing the start button initiates measurements on this sample, including printout. Removal of this sample, shutting the drawer, and pressing the start button resumes automatic operation with the original sample returned to the cavity for a complete set of measurements.

INDICATORS

Three digital display tubes provide a highly legible readout of the sample number of the holder in cavity or in transit. Indicator lamps tell at a glance the presence of system power, the location of the sample (in transit or in cavity), when the manual drawer is being used, and when the drum is released for manual positioning. Display of the count data, as well as control of the length of the counting interval, is performed by the 5590A Scaler-Timer described on page 10.

GAS FLOW CONTROL

An indicating rotameter controls gas consumption in gas-flow systems from 0.01 to 0.08 standard cubic feet per hour (SCFH). The low consumption rate, made possible by the excellent sealing of components handling the gas, enables the continuous use of a 200 ft^3 gas tank for about four months.

PROTECTION AGAINST DATA LOSS

Protection against loss of data is provided in the event of a power failure. Upon resumption of power a signal from the 5590A Scaler-Timer commands the sample changer to recommence a complete set of measurements on the sample being measured at the time of the power failure. Often an operator will prematurely terminate a series of measurements such as by using the manual drawer, returning a sample to the drum by pressing the STORE button, or going on to the next sample by pressing the NEXT SAMPLE button. In all such cases a print command is sent to the printer; because the printed record for each measurement shows both counts and the interval time, meaningful data is retained.

Note: Also see definition sheets 145-5 and 145-6

#149G ISOTOPE SOURCE, SELF CONTAINED

Purpose

For conducting Red Cell survival studies and for use in exposing organisms to radiation stress.

Requirements

May only require source in the form of a radiobiological which is experiment specific. For space life sciences investigations, an assortment of radiochemicals contained in a protective lead pig would be adequate.

Hardware Status

Many types and concentrations of radiochemicals and radiobiologicals are available for conducting isotope exposure studies and radiological work is available.

Technical Description

A typical assortment may consist of the following:

1 - 100 microcurie quantities of Nitrogen-15 labeled compounds (Nitrogen gas and amino acids). Radiolabeled subcellular products (ribosomes). Radiolabeled polynucleotides. Tritiated thymidine.

Cost

Commercial	$1-5 K each
Development	$150 K
Flight Unit	$50 K

Development Time

1-2 years

Isotopic Products

DEUTERATED SOLVENTS AND REAGENTS—Continued

CODE NO.	COMPOUND	STANDARD PACKAGING AMPOULES	PRICE PER PACKAGE* NUMBER OF PACKAGES PURCHASED 1	2-4	5-9	10 or more
54-935	Methanol-d_4	10 gram	$120	$108	$ 96	$ 84
54-936	CD_3OD	25 gram	240	216	192	168
54-938	>99 Atom % D	100 gram	720	650	575	505
54-958	Methyl-d_3 Amine Hydrochloride $CD_3NH_2 \cdot HCl$ >98 Atom % D	sealed	1 g: $25	5 g: $95		10 g: $170
54-940	Methyl-d_3 Iodide,	10 gram	50	45	40	35
54-941	CD_3I	25 gram	160	140	120	100
54-943	>99 Atom % D	100 gram	540	480	425	370
54-945	Phosphoric Acid-d_3	10 gram	15	13.50	12	10.50
54-946	D_3PO_4, 85% in D_2O	25 gram	35	32.50	28	24.50
54-948	>99 Atom % D	100 gram	105	95	84	73
54-950	Sodium Hydroxide-d	10 gram	15	13.50	12	10.50
54-951	30% in D_2O	25 gram	35	32.50	28	24.50
54-953	NaOD >99 Atom % D	100 gram	105	95	84	73

*A quantity discount, expressed as the reduced price per package as stated above when a given product is purchased in multiple units, is offered to users of Miles-Yeda deuterated solvents.

CARBON-13 LABELED COMPOUNDS

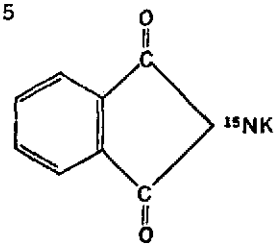
The products listed below represent only the initial offerings from Miles-Yeda's ^{13}C compound production program. It is planned to expand this list considerably in the expectation that the use of carbon-13 compounds will continue to increase in view of safety and technical limitations concerned with certain radiocarbon applications.

As with other Miles-Yeda stable isotopic products, the indicated isotopic purities of the compounds tabulated below are minimum values, warranted to be equalled or exceeded by the values for the actual compounds. Prices indicated are all per unit weight of compound, not in terms of isotope content.

CODE NO.	COMPOUND	FORMULA	ISOTOPIC PURITY ATOM % ^{13}C	STANDARD PACKAGING		
54-962	Barium Carbonate-^{13}C	$Ba^{13}CO_3$	55	1 g: $35	5 g: $140	
54-963	Carbon-^{13}C Dioxide	$^{13}CO_2$	55	100 ml: $90	500 ml: $360	1000 ml: $600
54-964	Carbon-^{13}C Monoxide	^{13}CO	55	100 ml: $155	500 ml: $620	1000 ml: $1050

NITROGEN-15 LABELED COMPOUNDS

Nitrogen-15 compounds are among the newest products of Miles-Yeda, Rehovot, Israel. Those listed below are now routinely available, but the list should be considered as only indicative of the proposed range of future ^{15}N compounds for research that are planned for manufacture. Inquiries for non-standard ^{15}N compounds are therefore particularly welcome.

CODE NO.	COMPOUND	FORMULA	ISOTOPIC PURITY ATOM % ^{15}N	STANDARD PACKAGING 100 mg	500 mg	1000 mg
56-981	Ammonium-N-15 Chloride	$^{15}NH_4Cl$	95	$ —	$ 95	$160
56-982	Ammonium-N-15 Nitrate	$^{15}NH_4NO_3$	95	—	60	100
56-980	Ammonia-N-15	$^{15}NH_3$	95	100ml: 150	500ml: 350	1000ml: 600
56-983	L-Alanine-N-15	$CH_3CH^{15}NH_2COOH$	80	105	415	750
56-985	L-Glutamic-N-15 Acid	$HO_2C{\cdot}CH_2{\cdot}CH_2{\cdot}CH^{15}NH_2CO_2H$	95	100	390	710
56-986	L-Glutamine (amide-N-15)	$H_2{}^{15}NCO{\cdot}CH_2CH_2CHNH_2CO_2H$	95	170	650	—
56-987	Glycine-N-15	$CH_2{}^{15}NH_2CO_2H$	95	55	195	350
56-988	Nitric-N-15 Acid, 10N	$H^{15}NO_3$	95	75	135	240
56-989	Nitrogen-N-15 Gas	$^{15}N_2$	95	100ml: 165	500ml: 525	1000ml: 935
56-990	Potassium Phthalimide-N-15		95	—	50	85
56-992	Urea-N-15	$(H_2{}^{15}N)_2CO$	95	85	335	600

NOTES:
1. Prices indicated above are all per unit weight of compound, not in terms of isotope content.
2. ^{15}N enrichments other than quoted above are available. Please inquire.

RADIOACTIVE ISOTOPIC COMPOUNDS (TRITIUM and CARBON-14 LABELED)

Miles' radiolabeled polyribonucleotides listed here are prepared and analyzed by procedures analogous to those employed for their normal counterparts, as described in the Synthetic Polynucleotides section, subject to the technical limitations of their micro-scale preparations.

SUPPLY: The products are provided as the specified salts, possessing average molecular weights in excess of 50,000 and are dispensed in 50% ethanol solution in hermetically sealed vials. Their specific activities are expressed in terms of microcuries per micromole of polynucleotide phosphorus.

ANALYTICAL INFORMATION: The Chemical Credentials accompanying each shipment include information on the product's molecular weight, specific activity, concentration in stated solvent, plus other appropriate data.

HOMOPOLYMERS, Radiolabeled

CODE NO.	COMPOUND	SPECIFIC ACTIVITY RANGE μCi/μmole P	STANDARD PACKAGE SIZES		
57-303	Polyadenylic Acid, Tritiated	10—30	10 μCi: $ 35	50 μCi: $150	100 μCi: $270
57-306	Polycytidylic Acid, Tritiated	10—30	10 μCi: 35	50 μCi: 150	100 μCi: 270
57-316	Polyguanylic Acid, Tritiated	10—30	10 μCi: 70	50 μCi: 300	100 μCi: 540
57-310	Polyuridylic Acid, Tritiated	10—30	10 μCi: 35	50 μCi: 150	100 μCi: 270
57-302	Poly[8-^{14}C]adenylic Acid	0.15—1.50	1 μCi: 50	5 μCi: 170	10 μCi: 300
57-305	Poly[2-^{14}C]cytidylic Acid	0.15—0.25	1 μCi: 80	5 μCi: 350	10 μCi: 600
57-315	Poly[8-^{14}C]guanylic Acid	0.15—0.25	1 μCi: 120	5 μCi: 525	10 μCi: 900
57-320	Poly[8-^{14}C]inosinic Acid	0.15—0.25	1 μCi: 80	5 μCi: 350	10 μCi: 600
57-309	Poly[2-^{14}C]uridylic Acid	0.15—1.50	1 μCi: 80	5 μCi: 350	10 μCi: 600

POLYNUCLEOTIDE DUPLEXES, Radiolabeled

The first members of a growing series of Miles radiolabeled polynucleotide duplexes are listed below. For details of supply and analytical information provided, see introductory paragraphs under *Radiolabeled Polynucleotides* (page 99).

CODE NO.	COMPOUND	SPECIFIC ACTIVITY RANGE μCi/μmole P	STANDARD PACKAGE SIZES		
	Poly d(A-T)				
57-323	Poly d (A*-T); [^{3}H] A	5—25	10 μCi: $ 50	50 μCi: $225	100 μCi: $ 400
57-324	Poly d (A-T*); [methyl-^{3}H] T	5—25	10 μCi: 50	50 μCi: 225	100 μCi: 400
	Poly dG•Poly dC				
57-325	Poly dG•Poly dC*; [^{3}H] dC	5—25	10 μCi: 50	50 μCi: 225	100 μCi: 400
	Poly I•Poly C				
57-326	Poly I•Poly C*; [^{3}H] C	4—14	10 μCi: 85	50 μCi: 370	100 μCi: 675
57-327	Poly I•Poly C*; [^{14}C] C	0.06—0.12	1 μCi: 205	5 μCi: 825	10 μCi: 1500
57-328	Poly I*•Poly C; [^{14}C] I	0.06—0.12	1 μCi: 125	5 μCi: 525	10 μCi: 950
57-329	Poly I*•Poly C*; [^{14}C] I, [^{14}C] C	0.12—0.20	1 μCi: 175	5 μCi: 675	10 μCi: 1250
	Poly A•Poly U				
57-330	Poly A*•Poly U; [^{3}H] A	10—70	10 μCi: 55	50 μCi: 270	100 μCi: 525
57-332	Poly A•Poly U*; [^{3}H] U	10—70	10 μCi: 55	50 μCi: 270	100 μCi: 525
57-331	Poly A*•Poly U*; [^{3}H] A, U	10—70	10 μCi: 60	50 μCi: 290	100 μCi: 550
57-333	Poly A*•Poly U; [^{14}C] A	0.10—1.0	1 μCi: 47	5 μCi: 210	10 μCi: 375
57-335	Poly A•Poly U*; [^{14}C] U	0.10—1.0	1 μCi: 63	5 μCi: 280	10 μCi: 500
57-334	Poly A*•Poly U*; [^{14}C] A, [^{14}C] U	0.15—1.5	1 μCi: 78	5 μCi: 350	10 μCi: 625

*Position of label

#150 RADIATION SOURCE STORAGE

Comments

For radioisotope storage.

150A RECORDER, MULTICHANNEL, BIOMEDICAL

Purpose

To provide a permanent visual record of up to 8 channels of biomedical data. This recorder is intended to supplement the data management system biological data acquisition capability during experiment setup and similar situations.

Requirements

Number of Channels	8
Frequency Response	DC to 150 HZ
Signal Conditioning Preamplifiers	Plug-in Modules

Typical Signal Sources

Strain gage transducers, thermistors, accelerometers, microphones and the output of the standardized signal conditioning couplers.

Hardware Status

Existing thermal writing systems offer a reasonable performance for this purpose. The Hewlett Packard Model 7708B is typical of these thermal oscillographic recorders.

Considerable modification of the basic unit to reduce the system weight and provide for 28 VDC power would have to be accomplished. There appears to be no zero-g limitations in the basic design except perhaps the recorder mechanism lubrication system.

Technical Description

Recorder and 8 Pre-Amplifiers:

Weight	300 lbs.
Size	25" H, 17" W, 25" D ($6.15\ ft^3$)
Power	600 Watt
Cost	$30,000 (COMMERCIAL)
DEVELOPMENT	$200K
UNIT	100K
Development Time	2 - 3 years

#150B CAGE MODULE RECEIVER, COMPACT, BIOTELEMETRY

Purpose

To provide acquisition of signals transmitted by microbackpacks on small vertebrates within the cage modules.

Requirements

Reception of signals from biotelemetry transmitters (microbackpacks) for electrocardiography (ECG), electroencephalography (EEG) and electromyography (EMG). Signals received by the 150B unit may then be relayed to the appropriate couplers to be interrogated by the data management system.

Hardware Status

Small versions of the Hewlett Packard Model 78101A Telemetry receiver are available or could easily be modified to suit space biology research requirements.

Technical Description

Estimated properties of a flight unit are:

Weight:	0.1 lb.
Power:	10 watts
Volume:	0.1 cu. ft.
Antenna:	Low profile monopole

Cost

Commercial	$ 0.8K
Development	$ 400K
Flight Unit	$ 20K

Development Time - 1 year

150D RECEIVER

Purpose

To provide reception of biotelemetry signals from deep body temperature and animal activity as well as for electromagnetic field monitoring.

Requirements

Frequency Range:	to 5 mHz
Sensitivity:	0.5 mv (microvolt) for 20 db quieting
Tuning:	Variable and Crystal controlled

Hardware Status

Many types of FM/AM telemetry receivers available. Many of these are flight rated for use in airborne systems. In the case of space biotelemetry and electromagnetic field monitoring, outputs from selected receivers can interface with on-board spacecraft signal analysis units (HP Model 3721A).

Technical Description

Estimated flight unit properties are:

Weight:	5.0 lbs
Power:	20 watts @ 28 VDC
Volume:	0.5 ft. cu.

Cost

Commercial:	$1 K
Development:	$200 K
Flight Unit	$10 K

Development Time: 3 Years

#153 RECORDER, VOICE

Purpose

To provide a means for an experimenter to make a voice record of experiment results, observations and other pertinent remarks that would be of concern in a biology lab. This recorder is intended to take the place of notebooks, scraps of paper, written reports, etc.

Requirements

Recording Time:	Up to 90 min.
Recording Media:	Monaural Cassettes, dual track
Recording Power:	Battery, rechargeable
Voice Input:	Microphone or auxillary input

Hardware Status

Existing model of Sony Corp., Model 110 Sound Recorder, will accomplish this task. Battery charging circuit would have to be modified to operate off of 28 VDC primary power.

If this recorder is required in a high O_2 concentration, the unit will have to be redesigned. A hermetically sealed enclosure is a possible means of sealing it. The recording tape and the plastic cassettes would also need redesign if they are combustible.

Technical Description

Weight	10 lbs.
Size	3" H, 6" W, 10" D (0.1 ft^3)
Power (battery, rechargeable)	10W - 20W

Cost

$35K Development
$5K Unit

DEVELOPMENT TIME

1 - 2 years

#153A ROTATING LITTER CHAIR

Comments

Articulated rotatable chair for tests on man. Volume shown is approximate envelope volume when in use. Skylab equipment.

#153B SENSORS, ASSORTED

Comments

Experiment specific.

#155A SENSOR, IMPLANTED

Comments

Deep Body Temperature Measurement.

156 SIGNAL CONDITIONER

Purpose

To provide the necessary electrical signal transformation between any of a number of transducers and the multiplexer/analog to digital converter of the data management computer, item 51. To provide the necessary electrical signal transformation between the computer digital to analog outputs and relay outputs to various experimental devices which need to be controlled by the computer.

Requirements.

Input to computer; ± 10 volts.

Transducer Power;

As required. For example, modulator/demodulator at 400 Hz . Precision D. C. Power Supply and Amplifier for strain gages, voltage dividers and isolation amplifiers.

Output from Computer:

As required. For example, relay closures for bells, alarms, lights, etc., High voltage source turned on by computer relay or digital to analog voltage outputs to be used in electric stimulus experiments.

Modular in Design.

All signal conditioners must fit into a standard signal conditioner module. All primary power, signal terminations and computer interfaces are standard. All signal conditioners are self-calibrating.

#156 SIGNAL CONDITIONER (Continued)

Requirements. (Continued)

Typical transducers or signals to be interfaced with the computer.

a. EEG

b. ECG

c. Blood flow and pressure transducers

d. Voltmeter outputs

e. Radiation counter outputs

f. PH meters

g. Psycho galvanometer

h. Temperature sensors

i. Mass spectrometer output

j. Mass spectrometer control

k. Signal Generator Control

l. Holding cage consumables control

m. Camera controls, TV and cine

n. Audiometer output

o. Spectrophotometer outputs and control

p. Biological analyzer outputs and control

q. EMG

r. Photocells

s. Accelerometers

t. Flow meters

u. Pressure

Hardware Status

Equipment similar to Statham Mueller patient monitoring system is unminiaturized version.

Technical Description

Mueller Units (estimates)

Size:	7" H, 2" W, 10" D (0.08 ft^3)
Power:	About 10 W/Card.
Cost:	~$3000/Module
Weight:	From 1 to 5 lbs.

Preliminary Estimates for Flight Units

Wt.	1.0 lb
Power	5 watts
Volume:	0.05

Cost

Preliminary Estimates for Flight Unit

$15K Development

$3K Unit

Commercial Unit

$3K Unit

Development Time: 1-2 Years

Comments

The unit cost includes a prorated modular enclosure cost and wiring costs. It is expected that from 14 to 15 of these would be fitted into one module. In case of unusual packaging requirements, a double-width signal conditioner card could replace 2 conventional plug-in cards.

SM Series Cabinets

The basic SM Series Cabinet will accommodate as many as seven SM Monitoring Modules, in addition to an SM1014 or SM1034 Power Supply Module. The cabinets are fully prewired, so that a module inserted into any one of the seven vacant positions is operational immediately. Interconnection of modules is automatic. Cabinet wiring permits routing of signals for oscilloscope display, strip-chart recording, either at bedside or central monitoring station, alarm excitation at bedside or remote location (including central monitor), and operation of such devices as pacemakers, cardiac synchronizers, and defibrillators. Cabinet wiring also provides for routing of input signals from bed or wall plate junction boxes.

In the standard SM Cabinet, SM1035 ECG Amplifier mounts in position 3, which allows it to accept lead-switching inputs from patient junction boxes. Other modules may be mounted in any vacant position, including those designed to accept the oscilloscope and ECG amplifier modules. Any combination of modules is possible within the seven-position potential. New modules may be inserted at any time, or the arrangement of existing modules may be altered. Blank panels are available for vacant positions.

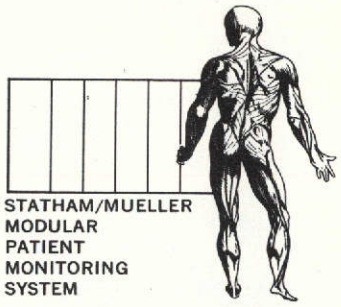
Specifications

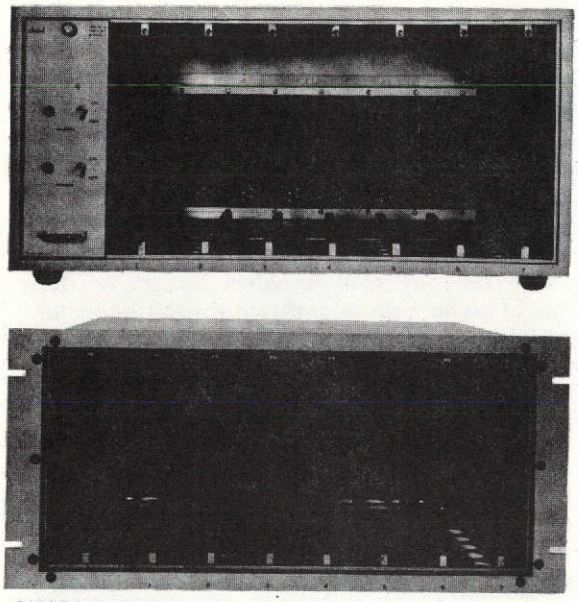
(Models SM1015, 1020, 1021, and 1037)

Capacity	Seven plug-in modules, 2-in W, plus power supply
Dimensions	17.5-in W; 15-in D; 8.75-in H (approx.)
Weight (without modules)	13 lb, 4 oz
Input connectors	One connector for input to all seven module positions
Output connectors	Eight channel pairs. Two output connectors for parallel connection of multiple cabinets; one connector may be used to route data to the central monitor, the other for therapeutic equipment or to monitor additional functions.
Ground connection	¼ stud, ⅝-in
Line cord	Three-wire power cord

SM Series Cabinets (Special Configurations)

SM1015-1	Specially wired to permit mounting of: one SM1001 Oscilloscope (positions 5-6-7) and one SM1012 or SM1024 Strip-chart Recorder (positions 3-4), OR two SM1001 Oscilloscopes (positions 5-6-7, and 2-3-4), OR two SM1012 or SM1024 Strip-chart Recorders (positions 6-7, and 3-4)
SM1015-2	Specially wired to permit mounting of: two SM1012 or SM1024 Strip-chart Recorders (positions 6-7, and 4-5)
SM1015-3	Specially wired to permit mounting of: three SM1012 and SM1024 Strip-chart Recorders (positions 2-3, 4-5, and 6-7)
SM1015-4	Specially wired to permit mounting of: one SM1001 Oscilloscope (positions 5-6-7) and two SM1012 or SM1024 Strip-chart Recorders (positions 1-2, and 3, 4)
SM1020-1, 2, 3, 4	Rack mount version
SM1021-1, 2, 3, 4	230V AC version of SM1015
SM1037-1, 2, 3, 4	230V AC version of SM1020





SM1015 Cabinet with SM1020 Rack Mount added. Comparable rack mount (SM1037) is available for 230V (SM1021) Cabinet.

Features

- Provide all necessary electrical connections and interconnections for SM Series Modules
- Standard Cabinet houses as many as seven SM Modules, plus power supply module
- Suitable for use at bedside or at central monitoring station
- Variety of mounting arrangements available for special applications

Specifications

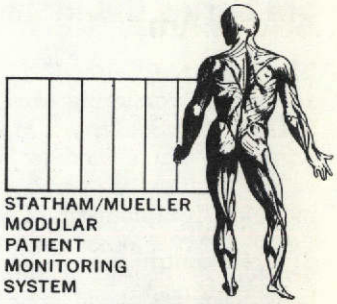
SM Series (Accessory Cabinet)

SM1022	Three-position accessory cabinet, for mounting either one SM1001 Oscilloscope, or one SM1012 or SM1024 Strip-chart Recorder

NOTE: When ordering SM1022 Cabinet for stacking on SM1015 Cabinet, please include order for one SM5009 Interconnect Cable

We strive constantly for product perfection, both in design and construction. As a consequence, detailed specifications are subject to change without notice.

Marketed Exclusively by
MUELLER & CO.
General Offices: 6600 West Touhy Avenue, Chicago, Illinois 60648, Telephone (312) 774-6800

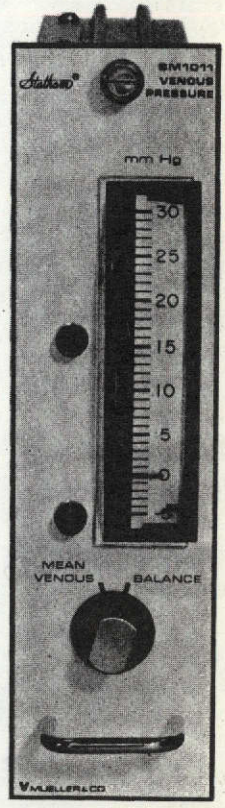


Venous Pressure Module, Model SM1011

The SM1011 Venous Pressure Module accepts venous pressure analog from either the SM1007 Blood Pressure Amplifier, or the SM1008 Bridge Amplifier, and from the input data computes and displays mean venous pressure.

A display meter on the front panel of the module indicates mean pressure over a range of −5 to +30 mm Hg. Two adjustable pointers on the face of the meter permit the physician to select acceptable minimum-maximum pressure limits. Should mean venous pressure exceed either of these limits, an alarm signal is generated by the SM1011 Module, triggering an audio/visual alarm at the central monitoring station. Minimum-pressure alarm function is feasible because the SM1011 removes the respiration component, largely responsible for negative venous blood pressure readings.

The Venous Pressure Module, Model SM1011, provides a standardized signal for display, strip-chart recording, magnetic tape recording, and/or computer analysis of the pressure reading.



Specifications

Dimensions	Standard SM Series 2-in Module
Meter scale	−5 - +30 mm Hg
Non-linearity	±1.0% FS from best straight line at constant line voltage and ambient temperature
Stability	±2.0% FS over temperature range of 50 - 140°F, and line voltage variations of 95 - 130V input to SM1014 or SM1034 Power Supply Modules
Output ripple	Negligible at full scale, 1.0% peak-to-peak at 10 breaths/min, and 50% modulation
Input impedance	100 kΩ minimum
Front-panel controls	Two-position selector switch/Mean venous/Balance NOTE: When set on "BAL," the selector switch also provides a balance indicator for the SM1007 or SM1008 Module, for purposes of setting atmospheric reference pressure.

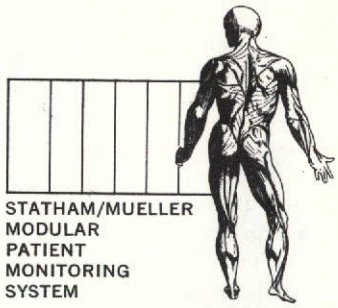
We strive constantly for product perfection, both in design and construction. As a consequence, detailed specifications are subject to change without notice.

Features

- Minimum-maximum pressure limits adjustable on meter face
- Alarm signal generated when either pressure limit is exceeded
- Standardized signal for display, strip-chart or magnetic tape recording, computer analysis
- Fits any free position in an SM Series Cabinet

Marketed Exclusively by
MUELLER & CO.
General Offices: 6600 West Touhy Avenue, Chicago, Illinois 60648, Telephone (312) 774-6800

Bridge Amplifier Module, Model SM1008

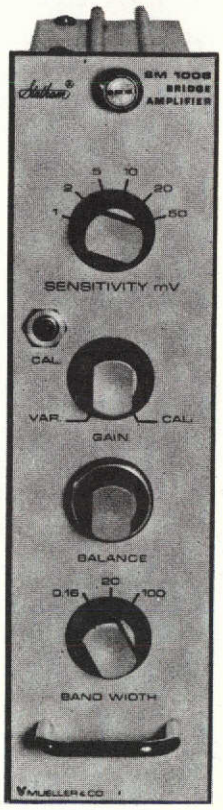


The SM1008 Bridge Amplifier module provides excitation voltage for strain gage devices such as blood pressure transducers, and amplifies the signals received from them, conditioning the signals for oscilloscope display, strip-chart recording, magnetic tape recording, and/or computerization. It has 6 sensitivity ranges: 0 to 1 millivolt, 0 to 2 millivolt, 0 to 5 millivolt, 0 to 10 millivolt, 0 to 20 millivolt, and 0 to 50 millivolt, all selected by a 6-position switch; and a fine adjustment set by a vernier control that allows continuous gain over the range from 1 to 125 millivolt. Frequency response is selected by a 3-position bandwidth switch: dc to 0.16 Hz, dc to 20 Hz, and dc to 100 Hz.

Amplifier SM1008 is used with non-standardized 4-leg Wheatstone bridge transducers for a variety of physiological measurements. Among the transducers with which it is used are Statham's blood pressure transducers P23AA, P23BB, P23De, P23Gb, P23H, SF1, and SF4. It is also used with Statham's universal transducing cells UC2, UC3, and UC4, which, with appropriate accessories, are suitable for such measurements as force, displacement, weight, TKD, apex cardiograph, muscle strength, and blood pressure.

In common with the other elements of the system, an outstanding level of performance is achieved without demanding the operator's constant attention, thus allowing concentration on the information that is being made available. The controls on the front panel are: a selector switch for frequency, selector switch for sensitivity, vernier gain control, a knob to adjust the balance and a calibrator pushbutton.

In keeping with the system's design, output is standardized. This offers several significant advantages to the user: greater flexibility; insurance against obsolescence; compatibility with computers and recorders; ease of installation and service; and initial cost is kept down.



Specifications

Signal input:	
Source	4-leg Wheatstone bridge transducers
Excitation voltage	7.5 V dc, ±5%
Transducer resistance	200 to 800Ω
Sensitivity: 6 calibrated positions	0 to 1 mV full scale 0 to 2 mV full scale 0 to 5 mV full scale 0 to 10 mV full scale 0 to 20 mV full scale 0 to 50 mV full scale (with 7.500 V excitation)
Vernier	Allows continuous gain from 1 to 125 mV full scale
Sensitivity stability	+1.5% of full scale, over specified environment
Sensitivity accuracy, including excitation and gain	±2% of full scale, 1 and 2 mV ranges ±1% of full scale, all other ranges
Frequency response:	dc to 0.16 Hz, −3 dB at 0.16 Hz dc to 20 Hz, −3 db at 20 Hz dc to 100 Hz, −3 dB at 100 Hz
Common mode rejection, 5 Vpp at 60 Hz	Better than −80 dB
Non-linearity	±1% of full scale
Zero drift, excluding transducer	±2% of full scale, from 65 to 85°F
Noise	1% of full scale, peak to peak, referred to input
Balance control	Ten-turn potentiometer with locking device
Calibration	100 kΩ ±1%, connected in parallel with legs 1 and 2 of Wheatstone bridge by means of pushbutton
Ambient temperature	60 to 100°F
Power	Derived from SM1014 Power Supply
Front-panel width	2″ nominal
Weight	Approximately 3 pounds 9 ounces
Mounting	Position 1—7 in SM1015 Cabinet

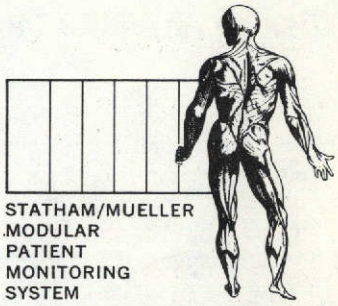
We strive constantly to improve the quality of all our products, both in their design and in their construction. Accordingly, detailed specifications are subject to change without prior notice.

Features

- For blood pressure transducers and other strain gage devices
- For use with non-standardized transducers
- Sensitivity range 1 to 125 millivolts
- 3 frequency response settings
- Outstanding performance without constant attention
- Standardized-level output
- All solid-state circuitry
- Triple isolation for safety

Marketed Exclusively by
MUELLER & CO.
General Offices: 6600 West Touhy Avenue, Chicago, Illinois 60648, Telephone (312) 774-6800

Electronic Thermometer Module, Model SM1006



The SM1006 Electronic Thermometer Module accepts signals only from Statham's patient temperature probes (Rectal/Esophageal Probe SM3605 and Skin Temperature Probe SM 3604) and conditions them to provide continuous meter readout in degrees Fahrenheit and degrees Celsius. It gives warning when a pre-selected maximum or minimum limit is exceeded. It also provides a signal for audio/visual alarm at the central monitor station and a standardized signal for display, strip-chart recording, magnetic tape recording, and/or computerization.

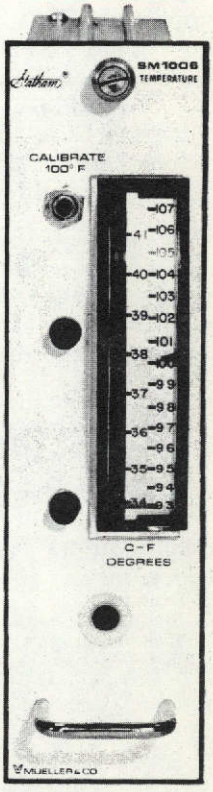
Temperature within the pre-selected limits is indicated by a green light. A red light indicates that either the maximum or the minimum has been exceeded. The limits are set by two pointers on the large, easy-to-read meter. They may be reset at any time, within the meter range of 93 to 107° F, or 34 to 41° C.

Statham's Rectal/Esophageal Temperature Probe, SM3605, and Skin Temperature Probe, SM3604, are standardized to ±0.2° F; no further standardization is needed to use either of the probes with the SM1006 Electronic Thermometer. A pushbutton on the front panel provides a calibration check at the 100° F point and an indication of the meter at 100° F (half-scale point). A screwdriver adjustment on the front panel is used to correct the calibration, if needed.

In common with the other elements of the system, an outstanding level of performance is achieved without demanding the operator's constant attention, thus allowing concentration on the information that is being made available. The only control on the front panel is the pushbutton to check calibration.

In keeping with the design of the system, output is standardized. This offers several significant advantages to the user: greater flexibility – insurance against obsolescence – compatibility with computers and recorders – ease of installation and servicing – initial cost can be kept down.

As is true for all elements of the system, all solid-state circuitry is employed, and is rated conservatively throughout. Careful attention is paid to every design detail; full advantage is taken of modern electronic and semiconductor technology. Thus, with Statham's tradition of using the finest materials, the most careful manufacturing, and the most rigid quality control, high reliability and long trouble-free life are assured, with resultant long-range economy.



Specifications

Meter Scales	93 to 107°F 34 to 41°C
Non-Linearity	±1% of full scale
Accuracy	±0.4°F, using Statham Probes SM3604 or SM3605
Calibration	At 100°F by front-panel pushbutton
Calibration Adjustment	Single-turn potentiometer, screwdriver adjustable
Ambient Temperature	60 to 100°F
Power	Derived from SM1014 Power Supply
Front-panel Width	2", nominal
Weight	Approximately 3½ lbs.

We strive constantly to improve the quality of all our products, both in their design and in their construction. Accordingly, detailed specifications are subject to change without prior notice.

Features

- Rectal, esophageal, or skin temperature
- Continuous meter readout in °F and °C
- Maximum/minimum alarm
- Standardized probes
- Pushbutton calibration check
- Outstanding performance without constant attention
- Standardized-level output
- All solid-state circuitry

Marketed Exclusively by
MUELLER & CO.
General Offices: 6600 West Touhy Avenue, Chicago, Illinois 60648, Telephone (312) 774-6800

#156B SQUIBS, FIXATIVE

Comments

Reactive device to stop plant growth.

#156C SQUIB FIRING APPARATUS

Comments

#156E SIGNAL CONDITIONER RACK

Comments

To be used in conjunction with metabolic mass balance equipment. Dev. cost in E.I. 103. Unit cost in holding units.

#157 SOUND LEVEL METER

Purpose

To be used for sound level surveys and a limited frequency analysis in real time. The instrument output will also be presented to a recording/monitoring system so as to function as an audio transducer for biological experiments.

Requirements

Simple operation, low power requirements, and self-calibration features of a reliable nature.

Frequency response:	125-8K Hz (est.)
Sound level range:	40-100 db (est.)

Hardware Status

Hardware is fully developed and should be readily used for space application. Minor modifications may be considered.

Technical Description

Bruel and Kjaer Instruments, Inc., Model 3501/S Portable Sound and Vibration Instrumentation System. Consists of a Model 2203 Sound Level Meter, Model 1613 Octave Band Filter, and Model 4220 Piston phone Calibrator. Accessory equipment includes various microphones, accelerometers, and cables.

System weight:	30 lbs
Carrying case:	17" high, 20" wide, 6" deep ($1.18\ ft^3$)

Cost

Model 3501/S Portable Sound and Vibration Instrumentation System - $2.5K.
Estimated flight item costs are $30K development and $5K unit.
Development Time - Available components.

#159 STAINING SYSTEM, BACTERIOLOGICAL

Purpose

Stain and fix biological specimens for microscopic examination.

Requirements

Provide automatic method for staining of biological specimens (Grams stain).

Hardware Status

Commercial units for blood analysis available (VWR Scientific Catalog 72), see page #159-2. Unit shown is for three step operation — Grams stain requires an additional step plus a change in stain material. Major redesign is required to provide positive staining solution flow control and pumping under zero gravity.

Technical Description

The following are estimates for a space unit:

Weight	7 kg (≈ 15 lbs)
Width	60 cm (24 in.)
Length	45 cm (18 in.)
Height	15 cm (6 in.)
Power	50 watts

Cost

Commercial Unit Cost: $1715.00

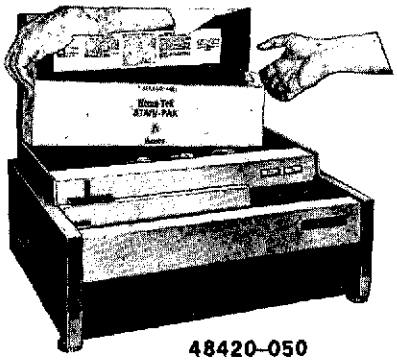
Estimated development and unit costs for space: $400K and $20K, respectively.

Development Time

4 years.

858 *Micro Slide Accessories*

SLIDE STAINER



48420-050

48420-050 SLIDE STAINER, Hema-Tek® — A self-contained, electrically operated, fully automated, bench-top precision instrument, designed specifically for use in hematology. It will accept, convey, stain, fix and deliver dry blood film preparations spread on standard 25 mm. x 75 mm. or 1" x 3" glass slides. Eliminates manual staining and results are consistent and uniform with reproducibility at a rate of one slide per minute.

The Hema-Tek Slide Stainer consists basically of 3 elements: Slide conveyer, staining platen, three solution pumps. The slide conveyer moves the slide from the loading platform, then horizontally over the stain platen: The staining platen maintains the volumes required for progressive introduction of stain, buffer, and rinse; also provides for precise mixing of stain and buffer. Three solution pumps operate peristaltically with cam drive. The pumps precisely control the flow of solutions from the three plastic containers of the Hema-Tek Stain-Pak, through three individual cannulas and tubes to the capillary space between the slides and the staining platen. The third peristaltic pump delivers the rinse solution. The slide is then blown dry by a stream of warm air, at the end of the cycle.

The feature of this instrument is the Hema-Tek Stain-Pak which consists of three bottles containing a special stain, buffer and rinse. One Stain-Pak provides enough solutions to stain and fix 1000 blood film preparations. The Stain-Pak is designed to facilitate installation and removal from the well at the rear interior of the slide stainer. Best results are obtained by using this special Hema-Tek Stain-Pack with the Hema-Tek Slide Stainer. Other stain solutions should never be used.

The mechanical operation of the slide stainer is simple and unique. Two conveyor spirals are utilized to convey 25 separate slides face down over an electro-formed precision platen, or platform.

The need for replacing the stain-pak is indicated when the stain pilot light goes "Off". To replace Hema-Tek Stain-Pak, remove the three cannulas and lift Stain-Pak out of the well and insert a new Stain-Pak.

Complete with Stain-Pak, pump tube set, cannula set, and instruction manual. For 115 VAC, 50 Hz.

Each 1715.00

#165 TOOL STERILIZER

Purpose

To sterilize miscellaneous small metal hand tools such as scalpels, by means of electrical induction heating.

Requirements

TBD.

Hardware Status

Existing induction heated sterilizers should be usable with minor modifications.

Technical Description

Estimated properties are:

Weight:	1 lb
Volume:	0.1 ft^3
Power:	500 watts

Cost

Estimated costs are:

Development:	$40K
Unit:	$10K

Development Time

Less than 1 year.

#167B STORAGE, GENL.

Comments

For general inert solid material.

#167C STORAGE, FILM

Comments

Film Cabinet, lead lined for protection from high energy particles.

#168A TAGS, I.D., ORGANISM

Comments

Identification Tags, package of 16. Experiment specific.

#172 SPACESUIT

Comments

For use in conjunction with MSI performance tests.

#174 TANK, VERTEBRATE WATER

Comments

Part of organism EC/LSS.

#175 TANK, PLANT/INVERT. WATER

Comments

For plant watering/fertilization. Part of EC/LSS.

#176 TAPE, VIDEO

Comments

Part of DMS.

#176H TASKBOARD, FORCE/TORQUE

Purpose:

A device that measures man's capability to apply forces and torques in a variety of directions from various hand/body orientations and restraint conditions.

Requirements:

1. Capable of measuring one and two-handed force applications within $\pm$ 0.5 pounds.
2. Capable of restraining the test subject in the desired position.

Hardware Status:

A Force/Torque Module and Cueing Module have been developed for NASA by General Electric (NAS 9-8640) for ground-based simulations, which could be adaptable for this purpose.

Technical Description:

Weight: 50 pounds

Volume: 2 cubic feet

Power: 5 watts

Cost:

Development cost: $50K

Unit cost: $5K

Development Time:

Approximately 1 year

#177 TEMP. SENSOR, BODY

Comments

For vertebrate body temperature measurements.

#179 TEMPERATURE BLOCK

PURPOSE:

Heating block to maintain constant vial or test tube temperature.

REQUIREMENTS:

Four units should be available for simultaneous operation at 4 temperatures in the maxi lab. (ambient to 120°C ± 0.5)

12 tubes per unit

Gravity independent tube retention

Housing to prevent personnel burns

HARDWARE STATUS:

Slight modification of commercial items

TECHNICAL DESCRIPTION:

Ref. DOW DIAGNOTEST Heating Block Form No. 340-033-67

Temperature range	ambient to 140°C
Control	$\pm$ 0.5°C
Dimensions ea.	$4\frac{1}{4}$ x $5\frac{1}{2}$ x 4-5/8 in.(0.06 ft^3) 12 holes: 17/32 in. dia. 2-5/8 in. deep
Weight ea.	10 lb.
Power ea.	200 W

COST: $100 (commercial unit)

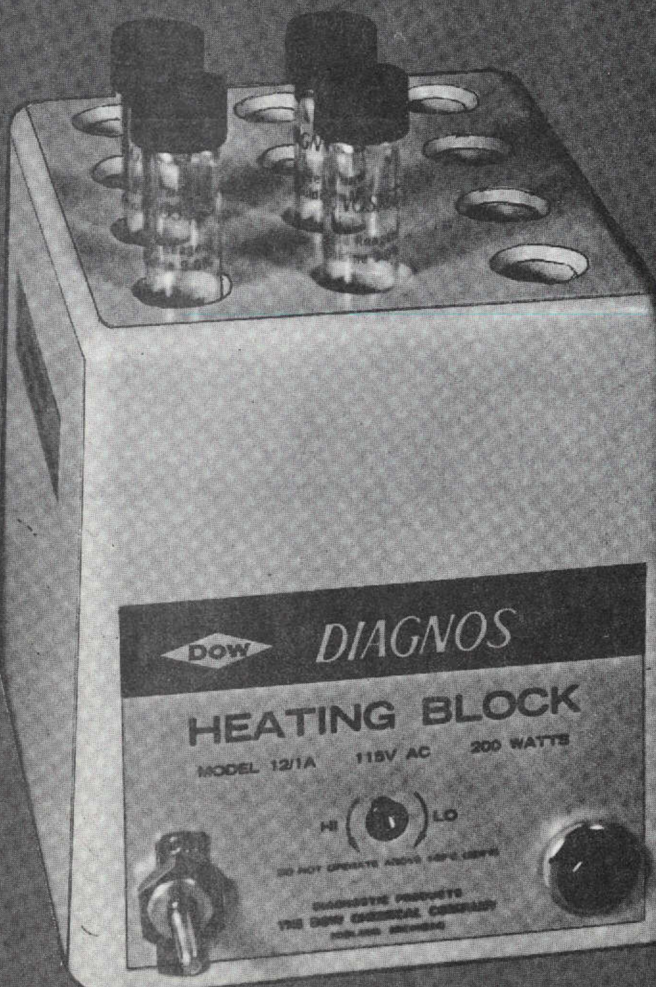
DEVELOPMENT $5K, UNIT $1K

DEVELOPMENT TIME: 1 year

DIAGNOSTEST Heating Block

DOW

The DIAGNOSTEST™ Heating Block is a constant temperature dry bath engineered for precise temperature control from ambient to 140°C. This constant temperature block eliminates the need for a water bath with its consequent annoyances of steam, maintenance of water level, control of algal growth and mineral deposition.



FAST HEAT-UP TIME

When set at 37°C. or 100°C. the DIAGNOSTEST Heating Block reaches temperature equilibrium within 6 to 30 minutes, respectively.

ACCURATE

The high quality, low-differential thermoregulator maintains temperature control of ±0.5°C from hole to hole throughout the operating range. Holes precisely dimensioned for the DIAGNOSTEST reagent vials assure rapid and uniform heat transfer.

VERSATILE

The heating block can be set to any temperature up to 140°C. The pilot light will go out when the block has reached the temperature preset with the screw on the front of the unit.

RUGGED CONSTRUCTION

The solid, cast-aluminum heat sink block has an insulated bottom cover, dual heater and adjustable thermoregulator. The special epoxy finish is chemical and heat resistant.

SPECIFICATIONS

ELECTRICAL SYSTEM:	115 volts A.C. 50–60 cycles per second 200 watts 6 ft. 3-wire cord with adapter plug
HEATING RANGE:	Ambient to 140°C. Temperature control maintained to ± 0.5°C.
BLOCK:	Solid aluminum block with gray epoxy finish Shipped with a ½" thick vulcanized fiber insulating pad
DIMENSIONS:	Overall: 4½" x 5½" x [illegible] 12 Holes: 17/32" diameter 2¼" depth
WEIGHT:	10 lbs.

Warranty

The DIAGNOSTEST Heating Block is warranted against defects in material and workmanship for one year from date of delivery, and any such defects not resulting from abuse or carelessness by user will be repaired free of charge.

Form No. 346-033-67

DOW DIAGNOSTIC PRODUCTS · THE DOW CHEMICAL COMPANY · MIDLAND, MICHIGAN 48640

#179A THERMOCOUPLES

Comments

Package of 20.

#180 TIMER, EVENT

Comments

General purpose elapsed time device, portable, used for various psychomotor performance tests, biochemical analysis procedures, etc.

#180A TRACE GAS CONCENTRATOR

Purpose

This device is used to concentrate trace quantities of gaseous contaminants (mainly ethylene) in air so that they can be quantitatively measured. It is essentially a freeze trap.

Requirements

Assuming that ethylene is the primary constituent to be concentrated, the freeze trap temperature would have to be below -272° F (melting point) for freezing, or below -155° F (boiling point) for liquification. This would require a cryogen for cooling or the use of a cryostat. The flow of gases through the trap would have to be measured. The capacity of such a device is yet to be determined. Current estimates on the concentration of ethylene to be measured is 20 ppb.

Hardware Status

This is a new system which may be able to use existing components such as cryostats.

Technical Description

Flight unit estimate based on using a cryogenic N_2 freeze trap:

Weight - 20 lbs (dry weight for 7-day unit)

Volume - 1 ft^3

Power - 0

Liquid N_2 - 3 lb/day, 21 lb/7 days

Cost

Estimated cost based on using an LN_2 freeze trap:

$200 K - development of 0-g unit

$ 10 K - unit

Development Time

One to two years

#181B TRANSDUCER, PLETHYSMOGRAPH

Comments

Part of E.I. 139.

#181C TRANSDUCER, BLOOD PRESSURE

Comments

#181D TRANSDUCER, PRESSURE

Comments

For various pressure measurements.

#181E VIDEO ID DATE-TIME SYSTEM

Comments

Identification and time recording system for visual records. Conceptual design item. Included in E.I. 32A, E.U. 1.

#181G TRASH CAN

Comments

For inert waste material (paper, plastic, etc.)

#182J COUPLER, VECTORCARDIOGRAM

Comments

Coupler. See E.I. 156 , E.U. 2 definition sheet.

#182K VISION TESTER

Purpose:

An optical device augmented by a viewing hood and response keyboard that measures a variety of visual functions.

Requirements:

1. Capable of measuring the following parameters:

   Visual field

   Depth perception

   Critical flicker fusion frequency

   Phorias

   Acuity

   Dark adaptation

   Brightness threshold

   Photo stress

   Color perception

2. Capable of both monocular (either eye) and binocular presentations.
3. Capable of both near and far vision measurements.
4. Capable of both static and dynamic visual measurements.
5. Provides a controllable stimulus intensity and duration.
6. Provides an adjustable face-frame/bite-board for precision subject alignment.

Hardware Status:

The IMBIMS provides a visual measurement device that fulfills most if not all of the requirements.

Technical Description:

See IMBIMS reports. Estimated values:

Weight: 50 pounds

Volume: 4 cubic feet

Power: 100 watts

Cost:

Development Cost: $20K

Unit Cost: $25K

The development cost represents the cost of integrating the IMBIMS visual measurement device into the payload.

Development Time:

Approximately 1 year.

#185 VOLTMETER (VOM)

Purpose

To provide a portable, reliable multi-function meter for general purpose experimental work and for primary troubleshooting.

Specifications

AC-DC Measurements:

DC Volts	100 mV to 10 KV
DC Current	1 ma to 10 amp
AC Volts	10 mV to 300 volts
AC Current	1 ma to 1 amp
Ohmmeter	10 ohms to 10 M ohms center scale

Battery operated, rechargeable

Hardware Status

The basic DC and AC measurements can be made with the Hewlett Packard Model 427A Multi-Function Meter. The high DC measurements can be made with a new design DC probe, the DC current range can be made with an adaptation of the Hewlett-Packard Model 428B milliammeter and the AC current measured with the Hewlett-Packard Model 456A AC current probe.

Technical Description

Hewlett-Packard Model 427A
Multi-Function Meter

DC Volts	100 mV to 1000 V
AC Volts	10 mV to 300 V
Ohmmeter	10 ohm to 10 M ohm
Center scale	
Cost	$250

DC Clip-on Milliammeter,
Hewlett-Packard Model 428B

Current Range 1 mA to 1 A

Cost $650

AC Current Probe,
Hewlett-Packard Model 456A

Current Range 1 mA to 1A RMS

Cost $250

Development $12K, Unit $2K

Comments

By the time this capability would be needed, a single instrument combining the capabilities of all three of the previously described instruments should be available. In any case, it would seem to be no more than a repackaging effort to get this capability.

#186 VOLUMETRIC MEAS., LIQUID

Comments

Liquid Volume Measuring System. Conceptual design item.

#186A VOMITUS BAGS & HOLDERS

Comments

Emergency bags for human test subjects.

#187A WASTE STORAGE SYSTEM

Purpose

This system provides for the handling, storage, and disposal of solid and liquid waste matter from the experiments.

Requirements

1. Wastes to be handled include chemicals, cadavers, cleaning solutions, tissue, plastic containers, paper, foil, disposable tools and instruments, media, feces, etc.
2. Minimum venting of gases overboard.

Hardware Status - Conceptual Design Item.

Technical Description

This system might include a number of components such as a vacuum drier, storage container, heat exchangers, filters, valves, etc. Wastes with special properties such as acids or radiobiological chemicals may require special treatment or storage containers for return to earth.

Details of this system are not yet determined.

Estimated Costs

Development	$100K
Unit	$20 K