Aviation Week & Space Technology

75 cents

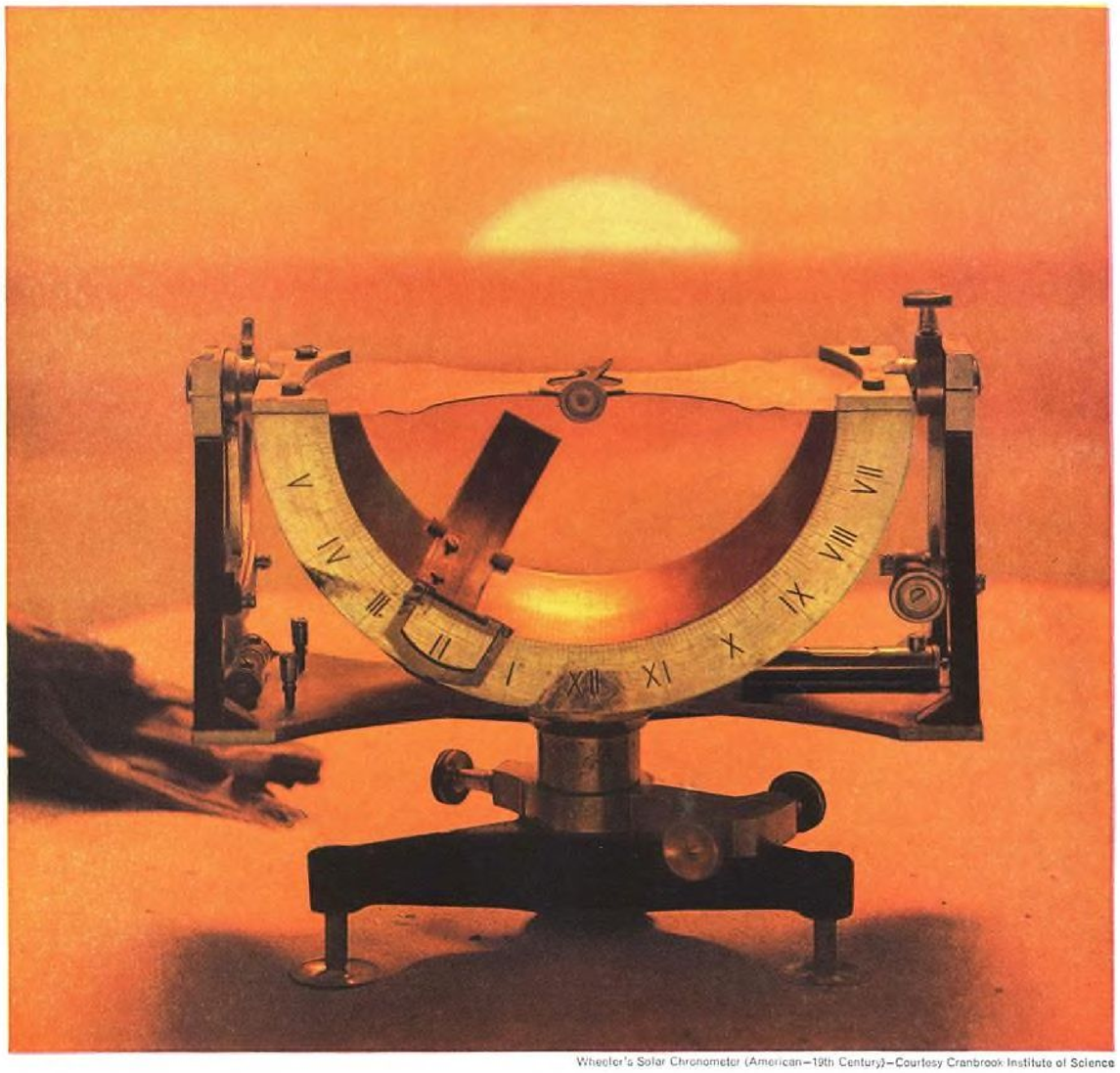
A McGraw-Hill Publication

Mid-December, 1963

Buyers Guide Issue

Titan 2 Silo Launch





Wheeler's Solar Chronometer (American—19th Century)—Courtesy Cranbrook Institute of Science

from solar chronometer to space booster guidance

The Wheeler Solar Chronometer was designed to indicate true sun time and longitude, with corrections for the seasons and the earth's position. Highly accurate though it was, the instrument had the basic fault of all sun dials: it was utterly worthless when the sun went down.

To avoid the possibility of being in the earth's shadow, space launch vehicles require guidance systems capable of determining positional fixes without solar observation. This requires advanced navigational systems of unparalleled accuracy—AC accuracy.

AC is presently modifying its Titan II inertial guidance system for application in the Titan III. And AC has recently been selected to produce the navigation guidance system for NASA's Apollo command module. Added to these current programs, AC's outstanding performance on the Thor, Mace, Regulus and Polaris missile programs and its work in providing navigation equipment for manned aircraft have established AC as a leader in the field of navigation and guidance.

AC's ability to design, develop and produce highly accurate guidance and navigation systems at low cost is unique. Put it to work for you. Contact Director of Sales, AC Spark Plug Division, General Motors, Milwaukee 1, Wisconsin.

MASTER NAVIGATORS THROUGH TIME AND SPACE

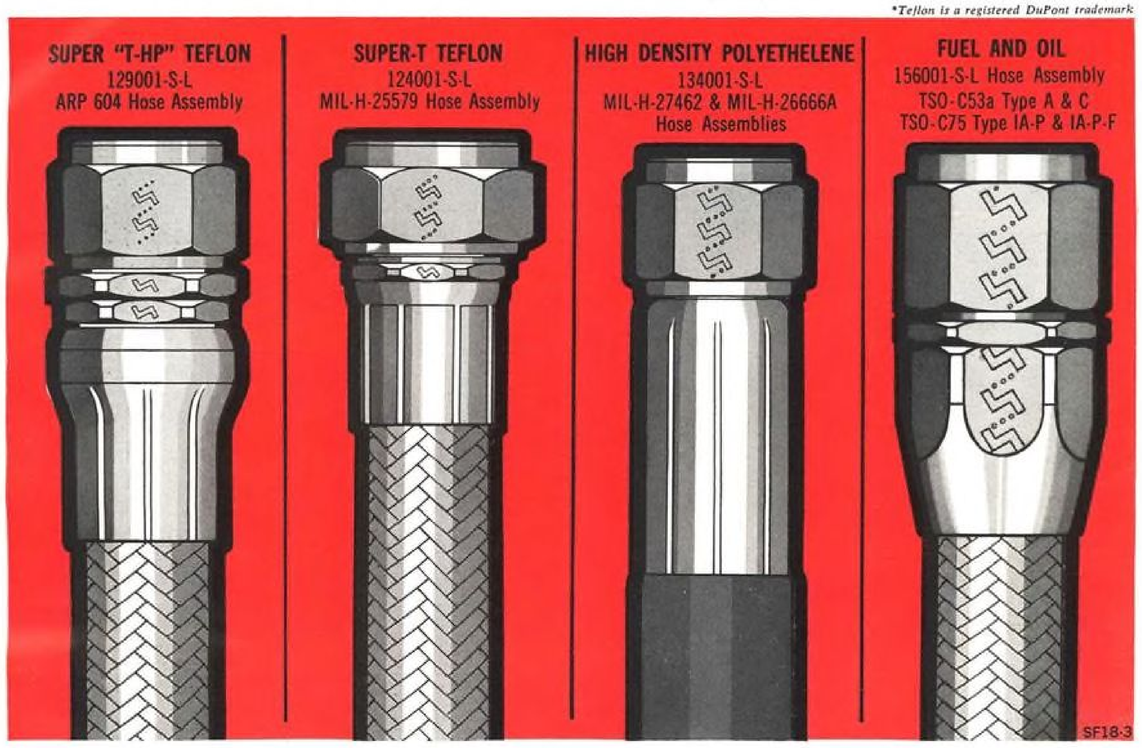
GUIDANCE AND NAVIGATION FOR BALLISTIC MISSILES • AVIONICS • SPACE BOOSTERS • SPACECRAFT • DELIVERED ON TIME AT LOW COST WITH OUTSTANDING ACCURACY AND RELIABILITY

Circle Number 293 on Reader-Service Card

SPECIFY STRATOFLEX FOR EVERY HYDRAULIC & PNEUMATIC LINE REQUIREMENT

Stratoflex offers hose, fittings and hose assemblies in a wide range of sizes and types, allowing engineers exceptional freedom in equipment design for aircraft, missiles and ground support systems. Stratoflex flexible hose and fittings are available for hydraulic and pneumatic applications in a wide pressure range. High pressure Super "T-HP" Teflon* and medium pressure Super-T Teflon* hose assemblies are designed for extreme temperature applications. High Density Polyethelene hose assemblies are designed for pneumatic applications on ground support systems to operate up to 8,500 psi. SF 156 Hose assemblies are designed for special hydraulic and engine fuel and oil systems. Hose assemblies shown below conform in every detail to specifications listed.

*Teflon is a registered DuPont trademark





113026-S-L
("113" Hose up to 40% lighter than conventional MIL-H-8794)



112-313-313-S-L
MS 28759 Hose Assembly
MIL-H-8788 Hose



112-342-342-S-L
MS 28762 Hose Assembly
MIL-H-8788 Hose



SPECIAL CONFIGURATIONS
Shown here are a few of the many different configurations Stratoflex has supplied to industry.



111-312-312-S-L
MS 28741, MS 24587
(MIL-H-8795) Hose Assembly
MIL-H-8794 Hose



193-311-311-S-L
AN-6270 Hose Assembly
MIL-H-5593 Hose

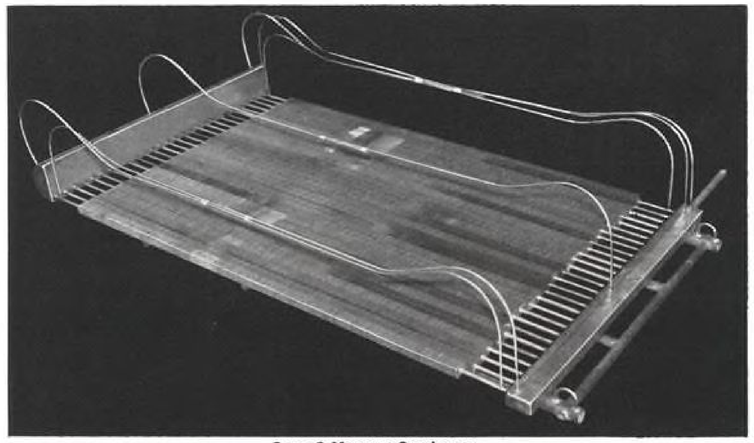


Write for Stratoflex Aircraft & Missile Catalog, Super "T-HP" Teflon Bulletin S-7 or Super-T Teflon Bulletin S-3.

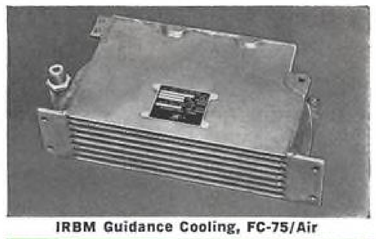
STRATOFLEX

Stratoflex, Inc. — P. O. Box 10398, Fort Worth, Texas

Circle Number 294 on Reader-Service Card



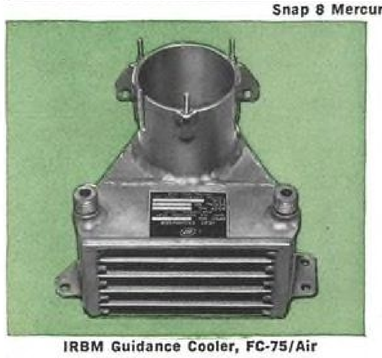
Snap 8 Mercury Condenser



IRBM Guidance Cooling, FC-75/Air



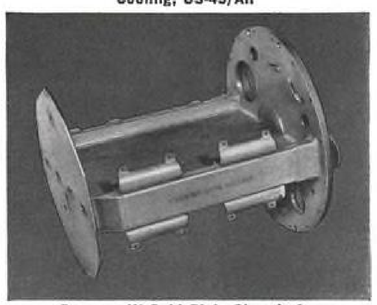
Sparrow III Electronic Guidance Cooling, OS-45/Air



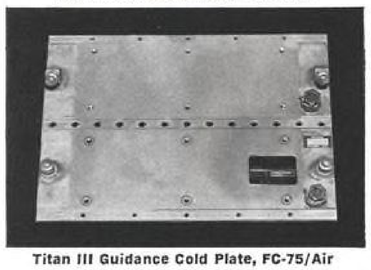
IRBM Guidance Cooler, FC-75/Air



Missile Guidance Cooler, FC-75/Air



Sparrow III Cold Plate Chassis for Electronic Cooling-Air



Titan III Guidance Cold Plate, FC-75/Air



Missile Launch Vehicle Hydraulic Cooling, Air/Oil

IN FIN ITY

Fins, fins, fins. Plain fins, slotted fins, ruffled fins, lanced fins, stripped fins. Cold and hot fluid circuit fins of different heights, thicknesses, densities and materials. UAP can design and build *secondary surface heat exchangers* of the plate-and-fin type to meet your precise requirements. We make all types of fins in our own plant, and employ our own outstanding dip-braze facilities. This shortens lead time, gives you better delivery. And to speed design time, UAP has programmed a digital computer for an infinite amount of heat exchanger information derived from experience and testing, plus engineering performance data. The computer can quickly indicate what type of fin is best for your application in terms of pressure drop, heat rejection, weight, size and other factors. For details, write . . . or phone 224-3841 today. UAP means United Aircraft Products. *Since 1929 a dynamic, independent company in Dayton, Ohio. A name to remember when it comes to plate-and-fin heat exchangers.*

Outstanding opportunities for qualified engineers.

UAP

Circle Number 295 on Reader-Service Card

Volume 79

Number 28

Aviation Week & Space Technology

Mid-December, 1963

PUBLISHER.....Robert W. Martin, Jr.
EDITOR.....Robert B. Hotz

MANAGING EDITOR.....William Gregory

SENIOR EDITORS
Cecil Brownlow, L. L. Doty, Philip Klass, Irving Stone

EUROPEAN EDITOR.....Cecil Brownlow

BUREAU CHIEFS
WASHINGTON.....Edward H. Kolcum
LOS ANGELES.....Irving Stone
DALLAS.....Erwin J. Bulban
LONDON.....Herbert J. Coleman
CAPE CANAVERAL.....George Alexander

NEWS EDITOR.....James D. Hendricks
DESK EDITORS.....Richard G. O'Lone, Kenneth J. Stein, William J. Normyle
AVIONICS EDITOR.....Philip J. Klass
ASSISTANT.....Barry Miller
TRANSPORT EDITOR.....L. L. Doty
ASSISTANTS.....Robert H. Cook, James R. Ashlock, Edith Walford
ENGINEERING.....Michael L. Yaffee, C. M. Plattner, Warren C. Wetmore, Roderick D. Hibben
SPACE TECHNOLOGY.....Alfred P. Alibrando, Donald E. Fink
MILITARY EDITOR.....Larry Booda
MANAGEMENT EDITOR.....Harold D. Watkins
BUSINESS FLYING.....Erwin J. Bulban, David A. Brown
CONGRESS.....George C. Wilson, Katherine Johnsen
EQUIPMENT.....Ward Wright
ART EDITOR.....Lawrence J. Herb
ASSISTANT.....Mary Wilkins
EDITORIAL PRODUCTION.....Frank Miazga
ASSISTANT EDITOR.....Ann Dunphy
EDITORIAL ASSISTANTS.....Marjorie Todd, Maureen Whittaker, Susan Thorn
LIBRARIAN.....Wana Wu

FOREIGN NEWS SERVICE
EDITOR.....John Wilhelm
PARIS.....Robert E. Farrell
MOSCOW.....Stewart Ramsey

Published weekly with an additional issue in December by McGraw-Hill Publishing Company, James H. McGraw (1860-1948), Founder. See panel below for directions regarding subscription or change of address. **Executive, Editorial, Circulation and Advertising Offices: McGraw-Hill Building, 330 West 42nd Street, New York, N. Y., 10036.** Printed at Albany, N. Y. OFFICERS OF THE PUBLICATIONS DIVISION: Shelton Fisher, President; Vice Presidents: George H. Reppert, Jr., Operations; John R. Callaham, Editorial; Ervin E. DeGraff, Circulation; Donald C. McGraw, Jr., Advertising Sales; Angelo R. Venezian, Marketing. OFFICERS OF THE CORPORATION: Donald C. McGraw, President; Hugh J. Kelly, Harry L. Waddell, Executive Vice Presidents; L. Keith Goodrich, Executive Vice President and Treasurer; John J. Cooke, Vice President and Secretary.

Available only by paid subscription. Publisher reserves the right to refuse non-qualified subscriptions. Subscriptions to Aviation Week solicited only from persons who have a commercial or professional interest in aviation, including missiles and space technology. Position and company connection must be indicated on subscription orders forwarded to address shown in box below.

Available to Government officials and military officers professionally concerned with aerospace, via the Federal Supply Schedule. Send requisitions (showing subscriber's title or rank) direct to Circulation Manager, Aviation Week, 330 West 42nd Street, New York, New York, 10036. Specify FSS Stock Requisition Number 7030-527-3125, Index No. 255, FSC Group 76, Part III.

Single copies 75¢. Subscription rates—United States and possessions, $7 one year. Canada, $8 one year. All other countries, $20 one year.

Our primary aim is to provide subscribers with a useful and valuable publication. Your comments and suggestions for improvement are encouraged and will be most welcome. The publisher, upon written request, agrees to refund the part of the subscription price applying to the remaining unfilled portion of the subscription—if service is unsatisfactory.

Second class postage paid at Albany, N. Y. Printed in U. S. A. Title registered in U. S. Patent Office

©Copyright 1963 by McGraw-Hill Publishing Co., Inc. All rights reserved. Cable Address: "McGraw-Hill New York." Publications combined with AVIATION WEEK & SPACE TECHNOLOGY are AVIATION, AVIATION NEWS, AIR TRANSPORT, AERONAUTICAL ENGINEERING and AIRCRAFT JOURNAL. All rights to these names are reserved by McGraw-Hill Publishing Co.

Subscribers: Send correspondence and change of address to Fulfillment Manager, Aviation Week, P. O. Box 430, Hightstown, N. J., 08520. Subscribers should notify Fulfillment Manager promptly of any change of address, giving old as well as new address, including postal zone number. Enclose recent address label if possible. Allow one month for change to become effective.

Postmaster: Please send form 3579 to Fulfillment Manager, Aviation Week & Space Technology, P. O. Box 430, Hightstown, N. J., 08520.

CONTENTS

MILITARY PROCUREMENT

DOD MAPS CONTRACT MANAGEMENT CHANGES..... 40
Defense Supply Agency Grows..... 44
USAF Meets New Environment..... 45
Navy Creates Single Material Office..... 48
Army Studies Procedure Standardization..... 51

SPACE TECHNOLOGY

NASA INCREASING INCENTIVE CONTRACT USE..... 54

MANAGEMENT

SMALL BUSINESS DEFENSE ROLE STRESSED..... 58

AIR TRANSPORT

AIRLINES CONSOLIDATE, AUTOMATE SUPPLY..... 60

AVIONICS

EMPHASIS RENEWED ON TECHNOLOGY'S ROLE..... 62

BUSINESS FLYING

MANUFACTURERS REVIEW COMPONENT BUYING..... 64

BUYERS' GUIDE SECTION

Products and Services..... 89
Index of Products and Services..... 272
Corporate Index..... 67
Distributors Index..... 86
Classified Section..... 284
Advertisers Index..... 290
Index of Products Advertised..... 289

MESSAGE FROM THE PUBLISHER..... 39

COVER: Titan 2 intercontinental ballistic missile launched from a silo at Vandenberg AFB by a combined crew from Strategic Air Command's 395th Missile Squadron and Martin, prime systems contractor for the missile.

PICTURE CREDITS

Cover—The Martin Co.; 41—Cessna; 46, 47—USAF; 50—General Electric; 51—(top) Sikorsky, (bot.) Wide World; 61—Boeing; 64—Erwin J. Bulban.

WRIGHT SERVO MOTORS AND ROTATING COMPONENTS

A. C. SERVO MOTORS

PART NUMBER	SIZE	VOLTS FIXED	VOLTS CONTROL	STALL TORQUE	NO LOAD SPEED	STALL POWER/ϕ	ACCEL. RAD./SEC.^{2}
20D633-4	8	26	36CT	.19	6200	2.1	96,100
20D624-4	8L	115	36CT	.36	9800	3.2	137,000
20D929-2	11	115	50	.80	6200	3.9	57,600
20D591-4	15	115	36CT	1.49	4800	6.5	33,700
20D930-2	18	115	40	2.9	4800	14.4	32,800

A. C. MOTOR TACHOMETERS

PART NUMBER	SIZE	VOLTS FIXED	VOLTS CONTROL	STALL TORQUE	NO LOAD SPEED	TACH. VOLTS	V/1000 RPM	TOTAL NULL	ACCEL. RAD./SEC.^{2}
20D628-2	8L	115	115/57	.30	6200	26	.20	.015	73,800
20D956-2	8L	26	36CT	.36	9000	26	.20	.015	105,000
20D668-4	11	115	36CT	.60	6200	115	.50	.019	42,400
20D915-2	15/11	115	36CT	1.24	6000	115	3.4	.019	42,000
20D916-2	18/11	115	36CT	2.3	4500	115	3.4	.019	32,800
20D756-2	8-TC	26	36CT	.29	6200	26	.50	.020	9,750
20D673-2	11-TC	115	40/20	.55	5800	115	2.75	.020	6,420
20D698-2	15-TC	115	40/20	1.45	4500	115	2.75	.015	12,100

INERTIA DAMPED A. C. MOTORS

PART NUMBER	SIZE	VOLTS FIXED	VOLTS CONTROL	STALL TORQUE	NO LOAD SPEED	STALL POWER/ϕ	DAMPING DYNE-CM.	ACCEL. RAD./SEC.^{2}
20D618-2	8	115	40/20	.33	6200	3.4	40	49,400
20D605-6	11	115	40/20	.60	6200	3.5	100	32,100
20D594-2	15	115	115/57	1.24	6200	6.0	750	24,700
20D613-4	18	115	36CT	2.25	4800	9.6	750	26,800

A. C. & D. C. TACHOMETERS

PART NUMBER	SIZE	TYPE	INPUT VOLTS	V/1000 RPM	IN-PHASE NULL	TOTAL NULL	LINEARITY	TEMP. COMP. RANGE
20D846-2	11	A.C.	115	3.4	.010	.019	1.0%	—
20D773-2	11-TC	A.C.	115	2.75	—	.015	.05%	−55°to+175°C
20D981-2	11	D.C.	—	5.0	(Ripple 5%)		.01%	0-50°C
20D238-3	20	D.C.	—	16.4	(Ripple 5%)		.01%	0-50°C

D. C. SERVO MOTORS

PART NUMBER	SIZE	TYPE	CONTROL POWER	STALL TORQUE	NO LOAD SPEED	THEOR. ACCEL.	TACH TYPE	V/1000 RPM
659740	24	Shunt	58	41	7000	24,000	None	—
659741	25	Shunt	94	80	7100	19,000	None	—
20D530-2	24	Shunt	0.4	7.0	6600	4,000	D.C.	16.5
2586866	24	Series	88	42.5	8000	22,000	A.C.	.33

GYRO MOTORS

PART NUMBER	SIZE	TYPE	INPUT VOLTS	CURRENT/ϕ (RUN)	INPUT POWER	SPEED	STALL TORQUE
20D793-2	9	Hysteresis	115	.049	5.5	24,000	.11
20D972-2	14	Induction	115	.066	5.5	22,000	.37
20D261-2	17	Induction	115	.052	6	22,200	.74
20D44-2	35	Induction	115	.19	18	23,500	3.23

GYRO SYNCHROS

PART NUMBER	SIZE	TYPE	ROTOR VOLTS	ROTOR CURRENT	STATOR MAX. VOLTS	STATOR VOLTS/DEG.	ERROR MINUTES
20D755-2	20	Transmitter	115	.016	13.2	—	±30
20D906-2	23	Transmitter	115	.055	12.1	—	3 total
20D107-2	23	Linear Trans.	57.5	.063	16.5	.20	—
20D812-3	30	Transmitter	115	.025	11.8	—	±12

GYRO TORQUERS

PART NUMBER	SIZE	VOLTS FIXED	VOLTS CONTROL	POWER FIXED	POWER CONTROL	STALL TORQUE
20D759-2	20	115	50	17	1.95	.54
20D676-4	32	115	9	7	.015	.08
20D675-2	32	115	115	25	25	8.7

FLAT MOTORS

PART NUMBER	SIZE	VOLTS FIXED	VOLTS CONTROL	STALL TORQUE	STALL POWER	NO LOAD SPEED	SPECIAL FEATURES
20D432-2	50	200	100/50	62	14.7	3600	2ϕ PM Alternator
20D461-2	70	200	100/50	520	75	5200	2ϕ PM Alternator
20D895-2	100	200	(3-ϕ)	250/300	180/220	1040/510	2 speed motor

STEP MOTORS

PART NUMBER	SIZE	TYPE	VOLTS/ϕ	STALL TORQUE	WDG. RES. OHMS	STEPS/SEC. MAX.
20D949-2	8	PM	52CT	.40	576	250 @ 45°

NOTE:
All data are nominal values at 25°C with unit temperature stabilized, except speed and torque (minimums), and current (maximum). Torque is given in inch-ounces. Power is in watts, current in amperes, voltage and tach nulls in volts (either r.m.s. or d.c. as applicable). Size is maximum case diameter in tenths of inches. This information is for reference only; obtain official drawings for specification purposes. This is not a complete listing of available designs. Electrical characteristics can be readily modified to fit a specific application.

WRIGHT
DIVISION OF
SPERRY RAND
DURHAM, NORTH CAROLINA

Circle Number 296 on Reader-Service Card

MATERIALS IN SMALL-DIAMETER TUBING

Design Guide to Superior Tubing



Your basic reference on Superior tubing. Covers all principal analyses in carbon and alloy steel, stainless, nickel and nickel-base alloys, nickel-iron alloys, copper-base alloys, glass sealing alloys, reactives and refractories. Gives size limits for each analysis; spells out tolerances, tempers, straightness, lengths. Thumbnails applications for each materials group. Request Bulletin No. 43.

Major Materials Groups



Superior Stainless Steel Tubing: Comprehensive catalog covering some 30 analyses, including 300 and 400 Series. Highlights Superior specialties such as large-OD thin wall tubing, aircraft hydraulic tubing. Exhaustive technical data, plus practicalities of selection, application, fabrication. Catalog No. 22.



Superior Carbon and Alloy Steel Tubing: Gives analyses, sizes offered in low- and medium-carbon steels, alloy steels, tool steels, diesel fuel-injection-quality steels. Complete data on temper, mechanical properties, tolerances. Selection guide; tips on working and joining; review of Superior specialties, including shaped tubing. Ask for Catalog 31.



Superior Nickel and Nickel Alloy Tubing: Treats standard and special analyses—200 Series, Monels[1] and Inconels, Incoloy,[1] Duranickel,[1] Ni-O-Nel.[1] Covers tolerances, sizes; chemical, mechanical and physical properties; temper, finish, testing. Major sections on selection and application and Superior tubing specialties — Bourdon, thermocouple, cryogenic, heat exchanger, thrust chamber, chromatographic. Catalog 13.



Superior Super Alloy Tubing (a Super Alloy is defined as a metal having 1000-hr. stress rupture strength at 1200°F at 25,000 psi min. stress, combined with resistance to oxidation and other corrosion): Includes Type 316, Hastelloy C[2] and X,[2] Haynes 25,[2] Inconel Alloys 702[1] and X-750,[1] A-286,[1] Waspaloy. Bulletin 71 gives short-time tensile properties at elevated temperatures; also stress rupture data.

Other Aids for Materials Engineers

Superior will gladly furnish you separate technical literature on any of these tubing materials and products:



Tubing Materials
Beryllium copper
Tool steel
Ingot iron
Ni-Span C[1]
Carbon hydraulic
Leaded C-1020
Titanium, titanium alloys
Zirconium, Zircalloy
A-286
PH 15-7 MO[4]
Columbium
Tantalum
Vanadium

Products
Needle tubing
Capillary tubing
Diesel fuel-injection tubing
Super pressure tubing
Stainless waveguide tubing
Tapered tubing

New Literature on Small Tubing

Long Length Tubing—Data Memorandum No. 31: Covers Superior capabilities in lengths up to 1500 ft. Specifies length limits for various ODs in carbon and alloy steel, stainless, nickel and nickel alloys, others.

Superconductive Wire—Data Memorandum No. 3: Latest information on Superior Cb_3Sn-core superconductive wire[3] now available in 10,000-ft. minimum lengths and longer —and ductile enough to wind around a ¼-in. core without breaking.

Molybdenum and Molybdenum Alloy Tubing—Development Preview 301: Report on state of the art in small-OD, high-quality seamless moly tubing as drawn by Superior. Properties, availability, fabrication techniques.

Inconel Alloy 718 Tubing—Data Memorandum No. 33: Latest addition to Superior Super Alloy family. Unique in that it can be age-hardened immediately after welding—without intermediate anneal.

AM 350 (WELDRAWN[5]) Tubing—Data Memorandum No. 32: This chromium-nickel-molybdenum stainless tubing combines the corrosion resistance and formability of the austenitics with the strength and hardness of straight chromium martensitics.

Maraging Steel—Development Preview 302: 18% Nickel (300) maraging steel. Maraging gets its name from martensite and age-hardening. Principal advantage of this material is yield strength up to 300,000 psi.

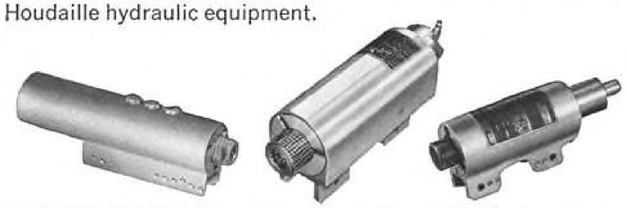
[1]TM Reg., International Nickel Co.
[2]TM Reg., Haynes Stellite Co.
[3]Produced under Western Electric license
[4]TM Reg., Armco Steel Corp.
[5]TM Reg., Superior Tube Co.

Tomorrow's tubing technology—today

Superior Tube
The big name in small tubing
NORRISTOWN, PA. 19404
West Coast: Pacific Tube Company, Los Angeles, California

Circle Number 297 on Reader-Service Card

TOTAL PERFORMANCE of military aircraft and missile systems depends on **component** performance and reliability. For rotary power functions, hydraulic damping and vibration control, leading airframe and missile contractors specify Houdaille hydraulic equipment.



FLUTTER DAMPERS — An original Houdaille design, these compact rotary vane-type dampers offer the best solution to high-frequency vibration problems on aircraft control surfaces. Applications include the Republic F-105 and McDonnell's F-4H and F-101.



VISCOUS SHIMMY DAMPERS — The shearing action of highly viscous fluid provides effective shimmy damping, with 360° rotation, on all types of castering landing gear. The Sikorsky S-64 "Flying Crane" and Vertol V-107 II and HRB-1 utilize Houdaille viscous dampers.



CONTROLS DAMPERS — For a variety of control system applications, these specially engineered units provide positive hydraulic damping for such functions as elimination of stick vibration and feedback, and limiting of pilot control input. Shown are the stick damper for the Kaman HU2-K and other typical designs.



HYDRAULIC ROTARY ACTUATORS—Designed for direct rotary torque output, without linkages or backlash, Houdaille actuators perform such functions as powering airborne radar scanners and raising and lowering radar antennae on mobile missile launchers.

WHETHER YOUR PROBLEMS involve airborne hydraulic applications or ground handling systems, look to Houdaille for the answers. Write for our descriptive booklet showing Houdaille's complete facilities and products, or send details of a special problem to . . .



HOUDAILLE HYDRAULICS
...PROVEN BY PERFORMANCE IN AIRCRAFT AND MISSILE APPLICATIONS

Houdaille Industries, Inc.
BUFFALO HYDRAULICS DIVISION
500 EAST DELAVAN AVENUE • BUFFALO 11, NEW YORK
Specialists in hydraulic damping and vibration contro

Circle Number 298 on Reader-Service Card

BRAEBURN announces new facilities for vacuum arc melted alloys

BRAEVAC

Braeburn's new vacuum consumable electrode melting furnaces are opening new vistas for the super critical metal user. Braeburn's long recognized capabilities as a producer of the foremost quality high speed and hot work tool steels are now extended to users of high temperature metals, super strength steels, special stainless and heat resisting grades. The most modern furnaces for the production of these special alloys are now in operation at the Braeburn plant.

Write or call your nearest Braeburn sales offices for your Braevac bulletin on vacuum melted alloys.

Ultra-Clean Metals for High Temperature or High Strength Applications

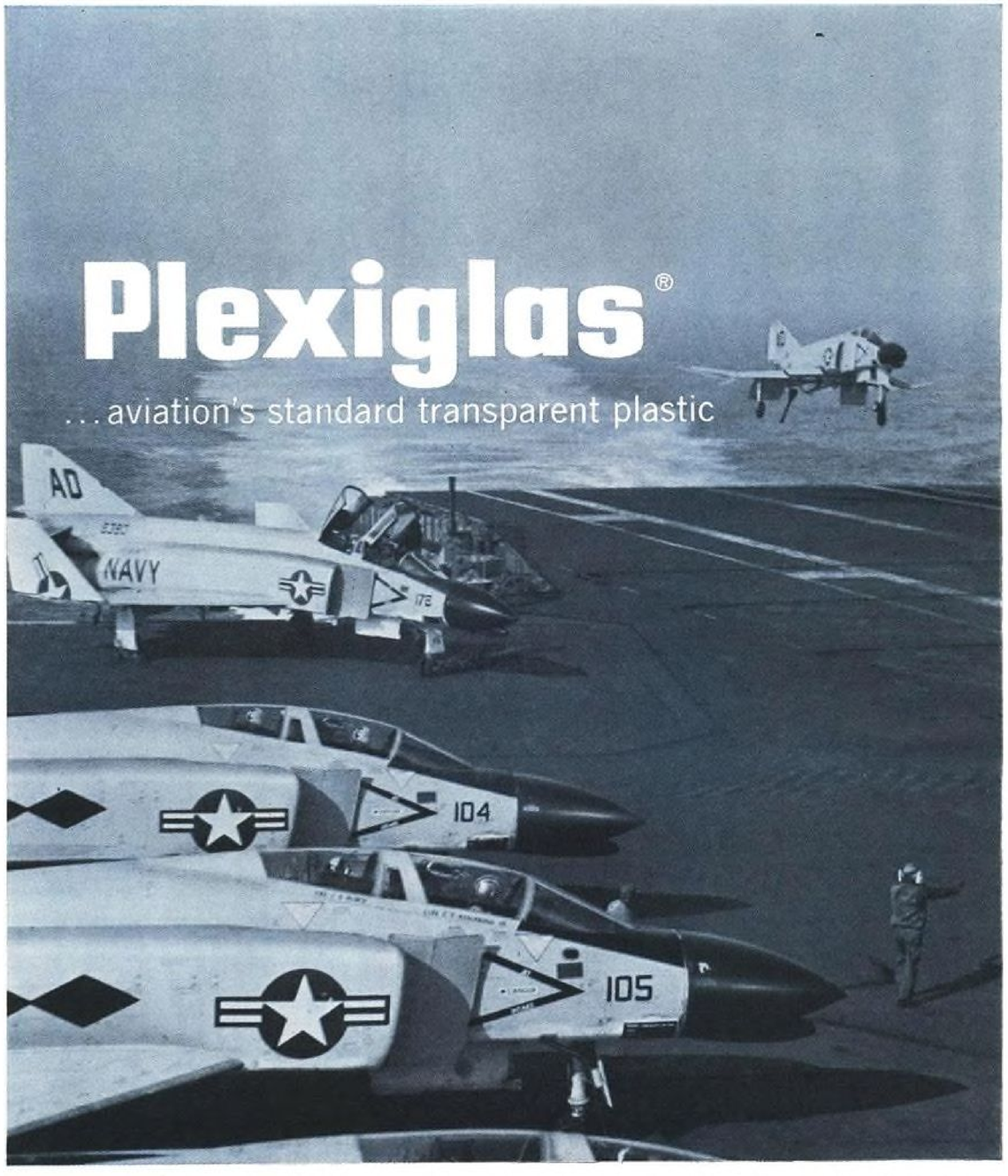
CCS CONTINENTAL COPPER & STEEL INDUSTRIES, INC.
BRAEBURN ALLOY STEEL DIVISION, Braeburn, Pa.
SALES OFFICES: CHICAGO • CINCINNATI • CLEVELAND • DETROIT
INDIANAPOLIS • LOS ANGELES • MILWAUKEE • NEW YORK
NORTH MIAMI • PITTSBURGH • WORCESTER • YOUNGSTOWN

Steel

Circle Number 299 on Reader-Service Card

Plexiglas®

...aviation's standard transparent plastic



Crew enclosure and side windshield panels on the McDonnell Phantom II are made of stretched PLEXIGLAS 55 *acrylic plastic. The Phantom II is the world's fastest all-weather jet fighter, now being built for Navy, Marine Corps and Air Force use.*

® Trademark Reg. U.S. Pat. Off., Canada and principal Western Hemisphere countries. Sold as OROGLAS® *in other countries.*

ROHM & HAAS
PHILADELPHIA 5, PA.

WHERE THERE'S PROGRESS, THERE'S PLEXIGLAS

Circle Number 300 on Reader-Service Card



Blade turns PAYMOVER® into effective snow fighter

With only a minimum investment for this straight snow dozing blade, you can convert your present PAYMOVER tractor into a dual purpose machine that will serve as one of the basic tools you need for winter maintenance.

Existing Models T-225SL and T-300SL PAYMOVER towing tractors can be turned into effective snow fighters in 15 minutes time, simply by adding the special snow dozer attachment. These units can travel at speeds up to 20 mph. to help keep ramp and loading areas open and avoid costly delays of disrupted flight schedules.

This blade is 50" high, has vertical hydraulic control and clears a 20' path over apron and ramp areas in one sweep. It is specially designed to retain its snow load through a unique tumbling action that keeps side spillage to a minimum and eliminates the need for additional passes. A special tripping mechanism permits the bottom of each side plate to follow ground contours. This allows working over uneven surfaces without reducing travel speed.

The complete line of PAYMOVER towing tractors includes sizes up to 35,000 lb. drawbar class and smaller units (as low as 3,000 lb. drawbar) for all types of towing, pushing and other prime mover work at terminals. Call or write for complete information.

HOUGH, PAYLOADER, PAYDOZER, PAYMOVER, PAYLOGGER, PAYLOMATIC and PAY are registered trademark names of The Frank G. Hough Co.



The new 4-wheel drive T-180F PAYMOVER is built to push or tow largest passenger planes. Develops 18,000 lb. drawbar pull; 6 speeds forward up to 20 mph.; automatic transmission, front wheel steer. Sells for considerably less than any previous 4-wheel drive PAYMOVER.

HOUGH®

THE FRANK G. HOUGH CO.
LIBERTYVILLE, ILLINOIS
SUBSIDIARY - INTERNATIONAL HARVESTER COMPANY
IN CANADA - HOUGHCO PRODUCTS LTD., CANDIAC, QUE.

THE FRANK G. HOUGH CO. 12-E-3
976 Sunnyside Ave., Libertyville, Ill.
☐ **Send data on snow dozer attachment**
☐ **Send data on complete PAYMOVER line**

Name
Title
Company
Street
City State

Circle Number 301 on Reader-Service Card

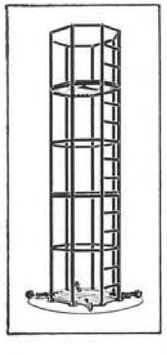
Two ways to get aerospace workstands and scaffolding:

1

First find someone locally who can recommend and design custom-made equipment that fills your needs. Someone with plenty of aerospace experience, who can really understand your problem. This may take a few weeks and cost plenty. Then find an outfit who can fabricate the scaffolding, or hire the people yourself and buy them all the equipment they'll need. This may take another few months, and it could cost a fortune. Then, after a few tries and some backing and filling, you'll get some workstands or scaffolding you can depend on. Maybe.

2

Call Patent Scaffolding's Aerospace Division.







Call us and you'll get *exactly* what's needed, *fast*—at lowest possible cost. Send for a copy of our booklet showing a dozen typical aerospace jobs we've done lately, from missile access platforms to special submarine and radome erection scaffolding; from aircraft workstands to microwave towers. Bulletin G216 is yours for the asking.

PSC AEROSPACE DIVISION

THE PATENT SCAFFOLDING CO., INC.

Dept. AW, 38-21 12th St., Long Island City, N.Y. 11101, Phone 212 EX 2-3660

Circle Number 302 on Reader-Service Card

THREE MORE FOR SPACE FROM DI/AN*

available now — from production



MILLIWATT CLOCK:

- Serial Binary, Real or Elapsed Time Output, repetitive or on command
- 2^{20} max count before reset — also resets on command
- Standard resolutions ½ to 8 seconds
- Accuracy .1% and .01%
- Various codes and bit rates for telemetering and magnetic tape
- −50°C to +100°C Operating
- Qual-tested by DI/AN



MILLIWATT MEMORY:

- 210 to 82,368 bits asynchronous to 50 Kc word rate
- No loss of address or data with power failure
- 1 — 5 milliwatt standby power
- As small as 12 cubic inches
- Read/Restore (non-destructive read-out) Clear/Write or Read/Write Modes, Split or Complete cycle
- −55°C to +100°C Operating
- Qual-tested by DI/AN



MILLIWATT INTERVALOMETER:

- 12 successive events — each can latch or unlatch 5 relays.
  Relay cycles can overlap. 12 relays built in
- Events separated by intervals of 1 to 16,384 time units. Time units 50 milliseconds to 2 sec. 12 independent intervals prewired.
- Two Intervalometers give complex cycle of 1600 years with variety of sub-routines
- .1% accuracy
- −55°C to +95°C operating
- Qual-tested by DI/AN

***HISTORY:** NO ONE (repeat, no one) comes close to matching DI/AN's history of reliability in magnetic logic equipment for space. Proof: The operating history of these devices (and their predecessors) approaches a million hours in over 30 different aerospace programs with no known failure.

RELIABILITY: This, mind you, is a record of actual use of our clocks, timers, counters, miniature memories, etc. The record is supported by two life tests of the individual magnetic Core-Transistor Logic modules (CTL's), with which these equipments are made. The Tests have logged 3½ million module hours over 5 years — no failures, and 1½ million module hours over 2 years — no failures. These numbers are for complete logic elements — but compare them with numbers for single components!

THE KEY to this history and reliability: The unique advantages inherent in CTL magnetic logic design: low power, few components, non-critical semiconductor parameters, no incremental flux states, resistance to radiation and to extreme temperatures. Plus, extraordinarily high, fully cabled circuit density. (Over 10,000 high-logic-power CTL's per cubic foot.) 1000 CTL's make a parallel GP computer.

SHORT DELIVERY: One type of magnetic logic element is used for all functions — function determined by interconnections. New equipments are built with almost no electrical engineering time required. Product line units illustrated above are available on short delivery from current production.

WRITE FOR DATA SHEETS and special report on "MAGNETIC LOGIC IN SPACE — A REPORT ON HISTORY AND RELIABILITY".

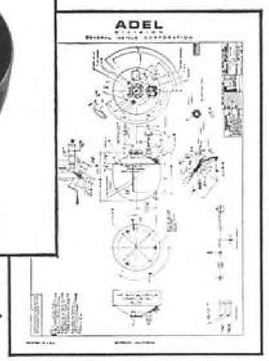
ALSO AVAILABLE: Literature covering three other DI/AN product areas ■ Magnetic Logic and Register Modules and cards ■ Standard Core Memories ■ Data Systems.

Di/An Controls, Inc. di/an 945 DORCHESTER AVE., BOSTON 25, MASS. 617-AV 8-7700 — TWX: 617-288-5963

Circle Number 13 on Reader-Service Card



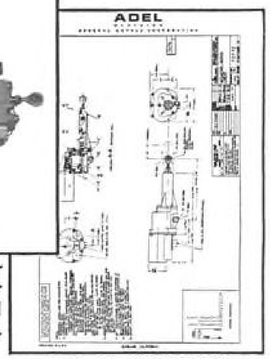
POWER PACKAGES



Electro- and Hydromechanical for missile, aircraft and ground support applications.



ACTUATORS

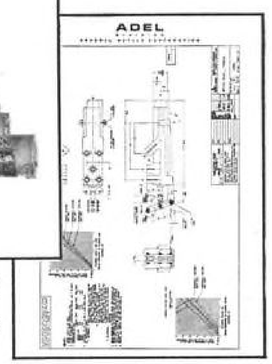


Electromechanical—linear and rotary types. Modular designs to meet special application requirements.

ASK FOR . . . . . DATA SHEETS



VALVES

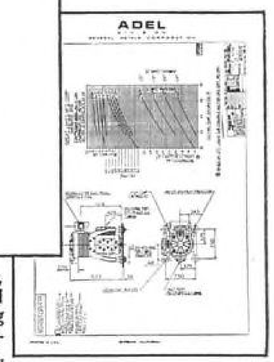


Many types—many applications for hydraulic, pneumatic, fuel and exotic fluids.

ASK FOR . . . . . DATA SHEETS

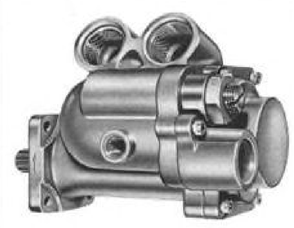


REFRIGERANT COMPRESSORS

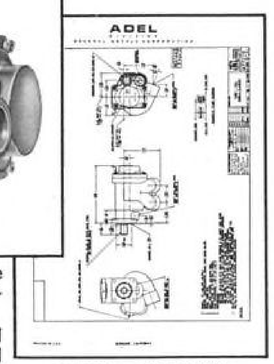


Minimum weight and size, for airborne or ground check out electronic cooling heating requirement. Multi-cylinder designs available.

ASK FOR . . . . . DATA SHEETS



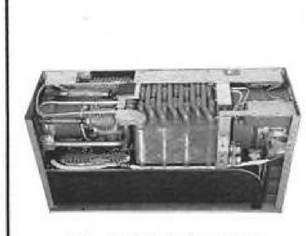
PUMPS



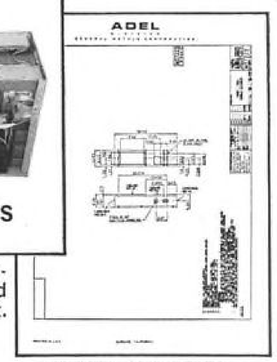
Positive displacement—wide range of uses, speeds, pressures.

Dynamic—submerged and line mounted—AC, DC and other drives.

ASK FOR . . . . . DATA SHEETS



AIR CONDITIONERS



Cooling and heating systems for aerospace and ground support equipment.

ASK FOR . . . . . DATA SHEETS

DIVERSIFIED CAPABILITIES

ADEL FLIGHT SUPPORT DIVISION
10777 VANOWEN ST., BURBANK, CALIF.

GREAT LAKES MANUFACTURING CORP.
4223 MONTICELLO BLVD., CLEVELAND 21, OHIO

16-15

ADEL
DIVISION
GENERAL METALS
CORPORATION
BURBANK, CALIF. / HUNTINGTON, W. VIRGINIA.

A SUBSIDIARY OF TRANSAMERICA CORPORATION

Circle Number 14 on Reader-Service Card



APEX Military Universal Joints are built to conform with and exceed all requirements stipulated in Spec. MIL-J-6193A, Class 2, Standard Drawing MS-20271 (Heavy Duty) and Class 1, Standard Drawing MS-20270 (Light Duty), as indicated in Qualified Products List QPL-6193-2. SPECIAL UNIVERSAL JOINTS, IN ALL CORRESPONDING SIZES, MANUFACTURED TO SAME SPECIFICATIONS.

APEX Military Universal Joints Offer:

BALANCED DESIGN

High axial and torsional strengths.
High strength-weight ratio per size.
Minimum maintenance attention.
No replacement during anticipated service life of airplane on most applications.
High mechanical efficiency, low wear.
Low torsional deflection.
Not adversely affected by Brinelling or fret corrosion under shock loads or vibration, or by operating overloads.
NOMINAL SIZES: 3/8" THROUGH 1½"

PERMANENT LUBRICATION

Working parts enclosed in covers especially adapted for service in heat, cold, ozone, oil, etc.
SEALED, LUBRICANT-RETAINING COVERS provide a supply of lubricant in excess of actual requirements, for long service periods.
Exclude dirt; sustain lubricating film in bearings.
Provide high resistance to vibration, offer vibration dampening.
Increase heat dissipation; eliminate corrosion.

WRITE FOR CATALOG 38

APEX
The Apex Machine & Tool Company
1025 So. Patterson Blvd.
Dayton 2, Ohio

UNIVERSAL JOINTS and ASSEMBLIES

Circle Number 15 on Reader-Service Card

Filament Winding...

Capability Unlimited



What do these have in common?

They are all products of the world's leading filament winding facility. A pre-programmed hydraulic servo mechanism is the basis of the BS&B developed filament winding machines which maintain exacting tolerances and insure repeatability and reliability. Assembly areas are dust free. Temperatures and humidity are rigidly controlled. Extreme versatility eliminates size limitations previously imposed on filament-wound structures.

BS&B filament winding production facilities include 120,000 square feet of security controlled manufacturing area. Additional space with unlimited primary utilities is available for continued expansion. The plant is completely accessible by air, rail and interstate motor freight.

FILAMENT STRUCTURES DIVISION
BLACK, SIVALLS & BRYSON
Industrial Air Park, Ardmore, Oklahoma

B·S&B

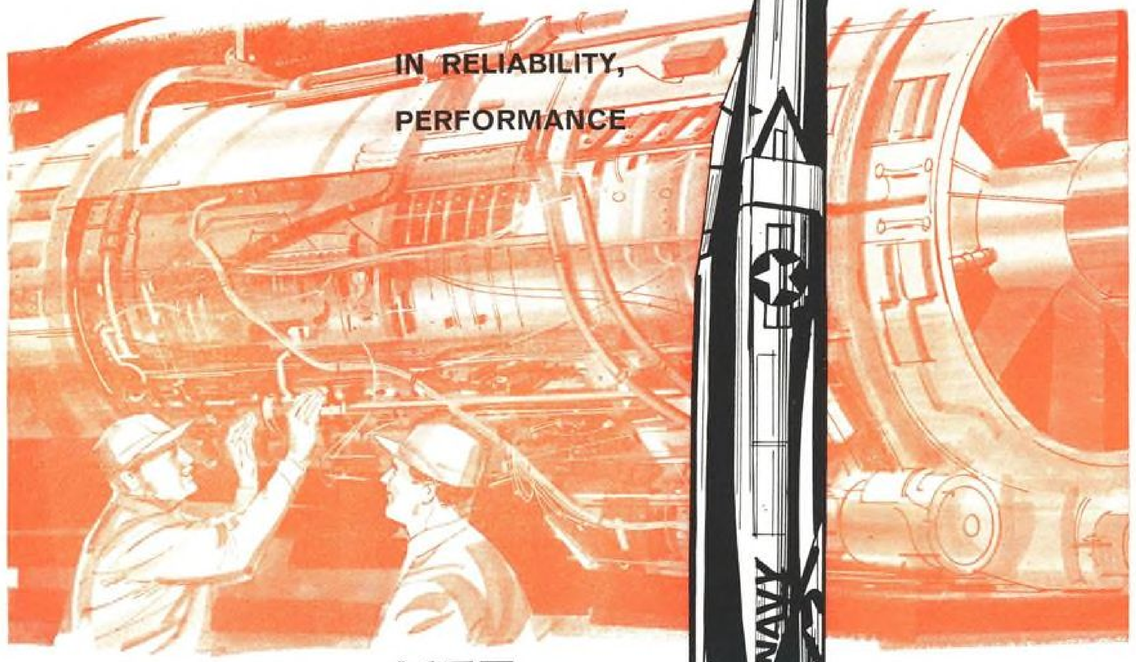
Circle Number 16 on Reader-Service Card

TYPE 1307 FUEL CONTROL IS

HIGH

IN RELIABILITY,

PERFORMANCE





YET–

LOW IN WEIGHT AND COST

As aircraft speeds range into the supersonic and beyond Mach 2, engine control needs become more and more critical and exacting. The J-79 engines on the record-setting F4H aircraft have Woodward controls which quickly and accurately sense and act upon the slightest input variation.

Type 1307 Fuel Control on the F4H is a striking example of the capability of a compact precision control to meter fuel precisely under swiftly changing conditions. Write to Woodward for your aircraft governor needs.

World's oldest and largest manufacturer of prime mover controls exclusively

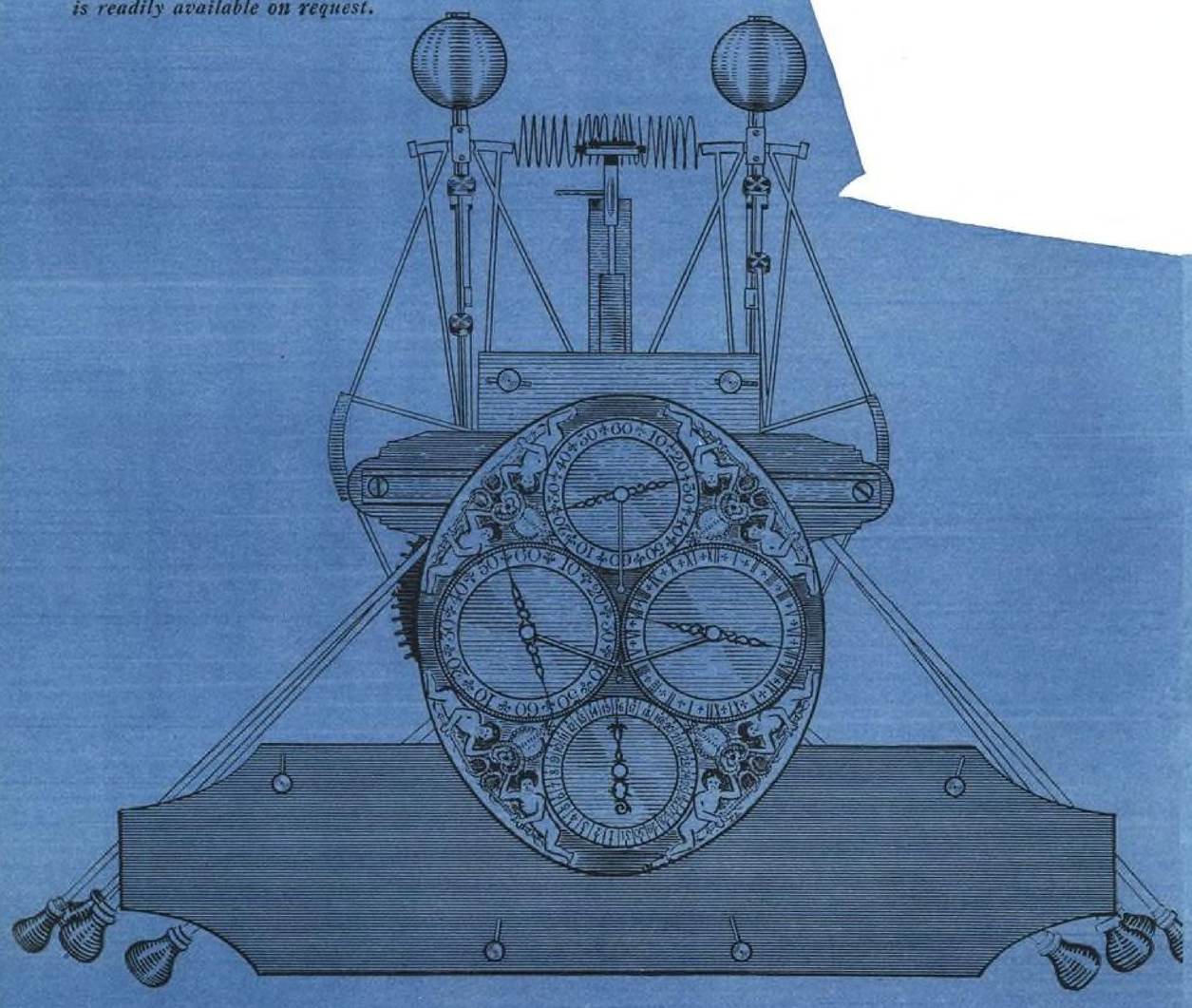
WOODWARD GOVERNOR COMPANY
ROCKFORD, ILLINOIS • Phone 815 877-7441

WOODWARD GOVERNOR G.m.b.H.
LUCERNE, SWITZERLAND
Fort Collins, Colorado • Slough, England
Schiphol, The Netherlands • Tokyo, Japan

S-135

Circle Number 17 on Reader-Service Card

HARRISON'S CHRONOMETER *Marine Timekeeper No. 1, invented 1735 for determining longitude, functioned within an error of three seconds per day. This is one of a series commissioned by the Canadian Marconi Company. A printed reproduction of this historic navigating instrument, size 11 x 14 inches is readily available on request.*

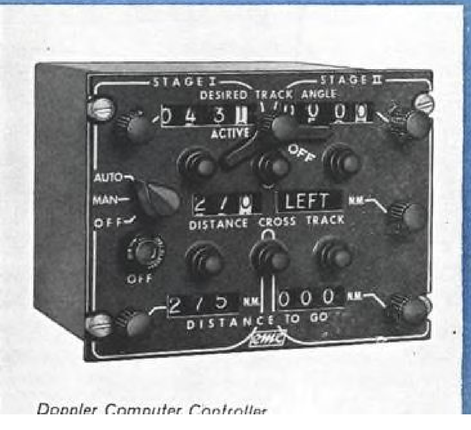


228 years before DOPPLER

Between the chronometer and Doppler lie 228 years of man's attempt to mark an accurate track of his coming and going over the earth, and of his immediate position on its surface. Canadian Marconi Doppler provides a new measure to the navigator's art preceded by the astrolabe for latitude, compass for direction, sextant for position and chronometer for time. With the compass, CMC Doppler gives the art all these simultaneously, without human error, in the most accurate and reliable system used today. CMC designs and manufactures Doppler for "I" and "J" bands, Lat/Long and Along and Cross Track Computers, as well as Indicators. CMC Doppler is applied to commercial transport, aerial survey, military transport, anti-submarine warfare, helicopters, V/STOL aircraft and supersonic aircraft.

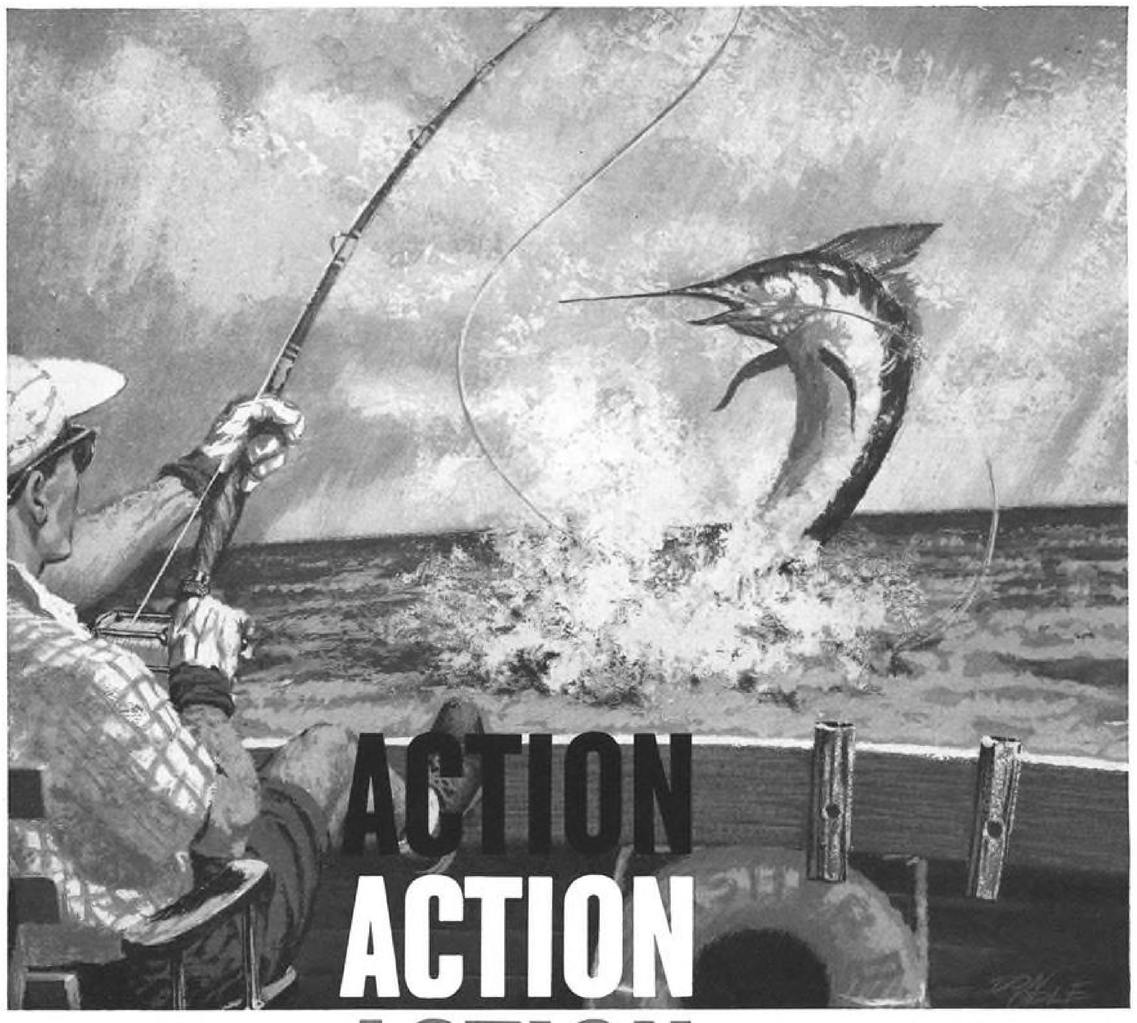


CANADIAN MARCONI COMPANY
Commercial Products Division
2442 TRENTON AVE.,
MONTREAL 16, CANADA



Doppler Computer Controller

Circle Number 18 on Reader-Service Card



"You get ACTION at brooks & perkins"

It wasn't by chance that B&P was selected to produce the *first* Vanguard satellites (payload structures). It was due to our thorough knowledge of the space age metals. Our capabilities in design, fabrication and assembly of all space age metals are the reasons you can be sure of action at B&P. We are the number *1* supplier of the Aerial Delivery Systems used by the U.S. Air Force and U.S. Army.



View of the B&P Aerial Delivery System installed in the C-130.

•

Send for your copy of our new booklet entitled "Count-down."



Investigate the potential of a career with Brooks & Perkins—An equal opportunity employer

b+p **BROOKS & PERKINS, INC.**

64-DP—2

1902 W. FORT ST. • DETROIT 16, MICHIGAN

Circle Number 20 on Reader-Service Card

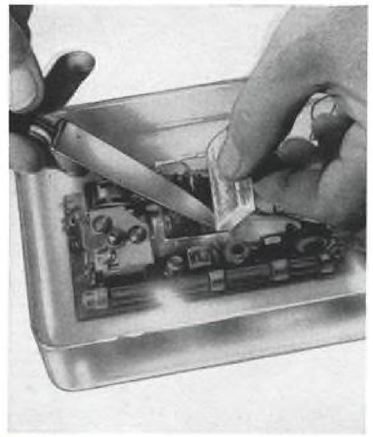
SILICONES

What you can do with General Electric's versatile RTV silicone compounds

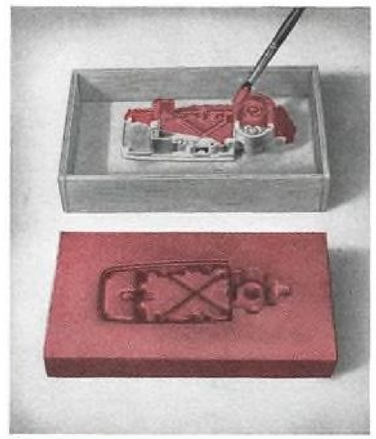
to insulate, seal and mold from –150°F to 500°F



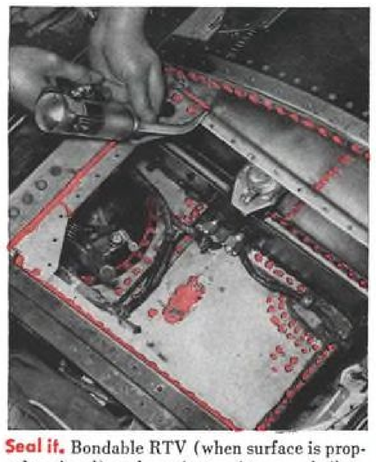
Encapsulate it. Fluid RTV silicone rubber penetrates deep into transformer coils. RTV has excellent dielectric strength and practically no shrinkage. Cure time at room temperature can be varied from minutes to hours.



Pot it. Transparent or opaque, G-E silicones provide a resilient protection against moisture, ozone, thermal and mechanical shock. Flows freely around complicated parts, can be cut away to replace internal components.



Duplicate it. Flexible RTV is often used to make molds for prototypes and short run production. This part requires deep undercutting, but duplicate parts flex free easily. RTV's tensile strength is as high as 850 psi.



Seal it. Bondable RTV (when surface is properly primed) seals against moisture and vibration, ozone and chemicals. Can be used for sheet metal fabrication, shock mounts, gasketing. Viscosities range from pourable to paste.



Insulate it. Adhesive/sealant RTV-102 requires no mixing of catalyst, can be used to insulate open wiring, for on-the-spot caulking, gluing and soldering. RTVs are virtually ageless, will not stress-crack or weather.



Manufacture it. RTV adhesive/sealants are fast working assembly tools, eliminate prefabricated parts or more costly, time consuming techniques. Here an RTV adhesive laminates flexible mica strips to form cylindrical ducts.

If you would like a free sample of one of the nine General Electric RTV silicones for evaluation, write on your letterhead, describing your application. For additional information, check reader service card. Section J1295, Silicone Products Dept., General Electric Company, Waterford, New York.

GENERAL ELECTRIC

Circle Number 21 on Reader-Service Card



How to squeeze more horsepower into every inch of engine displacement

...another example of Caterpillar capabilities at work

When Caterpillar Research Engineers talk about this project, they call it VHO.

Officially, it's a research project to design a family of four Very High Output engines for the U. S. Army Tank Automotive Command. The family goal: delivery of more working horsepower per inch of displacement than any compression-ignition engine now available. Horsepower-to-weight ratios will be in the gas turbine range.

Current design indicates a realistic initial target of 80 HP from each cylinder at 2800 RPM. This is without revolutionizing engine structure or creating highly sophisticated aspiration methods.

Even in the design stage, family likeness is certain. Of the 194 major parts needed for the entire family, only 30 parts have single usage and 164 are used in at least two models.

Because of this high interchangeability, vehicle designers won't be hampered by a single engine configuration. They will be able to arrange external accessories on these 4.5 x 5.5 bore and stroke engines to suit the vehicle ... without adding parts to the logistics system.

The VHO research program demonstrates another of Caterpillar's capabilities in the area of military vehicles and engines to power them.

If anyone knows how to squeeze a thundering herd of horsepower into a military compression-ignition engine—or create a highly specialized piece of ground support equipment—Caterpillar does. To find out just how far Caterpillar's abilities range, contact Defense Products Department, Peoria, Illinois.

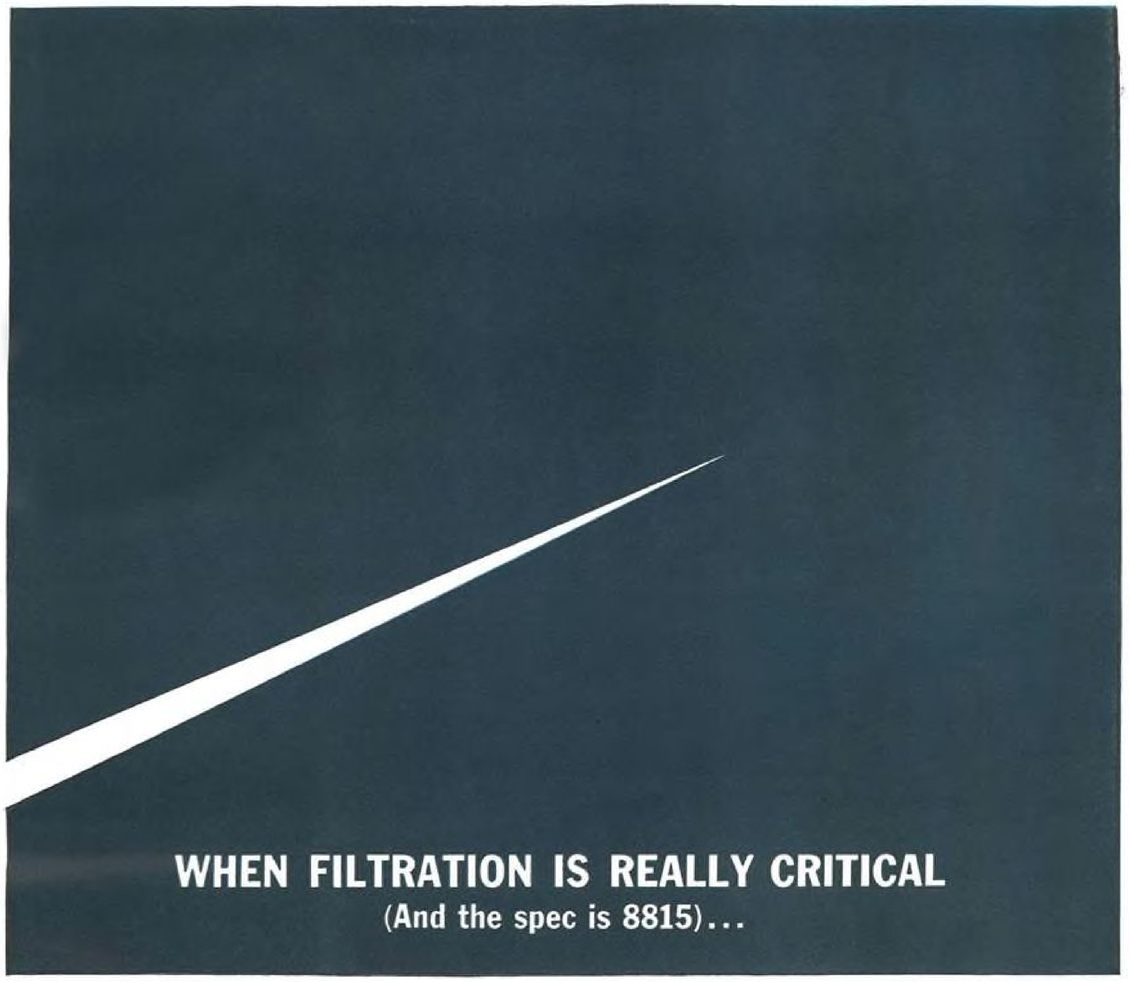
CATERPILLAR

Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

Caterpillar Tractor Co., General Offices, Peoria, Ill. • Caterpillar Americas Co., Peoria, Ill. Caterpillar Overseas S.A., Geneva • Caterpillar of Australia Pty. Ltd., Melbourne • Caterpillar Brasil S.A., São Paulo • Caterpillar Tractor Co. Ltd., Glasgow • Caterpillar of Canada Ltd., Toronto • Caterpillar France S.A., Grenoble • Caterpillar (Africa) (Pty.) Ltd., Johannesburg

Career opportunities are available at Caterpillar for qualified Engineers, Researchers and Designers. An equal opportunity employer.

Circle Number 22 on Reader-Service Card



WHEN FILTRATION IS REALLY CRITICAL
(And the spec is 8815)...

THE ANSWER IS SCREEN PRODUCTS SP-2105 HYDRAULIC FILTERS

Sometimes a filter element doesn't get changed when it should, and no harm is done when dirty oil bypasses the filter and circulates through the hydraulic system.

But, some applications are critical ... especially in the aerospace field.

If you've been working to the MIL-F-8815 spec, you've had little choice, until now. NOW there's Screen Products Division's SP-2105 hydraulic filter series, featuring a THERMO-MESH*™ throw-away filter element (more economical in time, dollars and performance than cleaning a dirty element). THERMO-MESH provides absolute filtration down to 15 microns, with greater dirt-holding capacity and higher working temperature than other wire mesh units with the same micron rating. And the SP-2105 is **available without bypass**; the rugged filter element is designed to withstand full proof pressure (4500 psi) without collapse.



Further filtration insurance for critical applications is Screen Products PRESSUR-GARD*® differential pressure indicator which reports a dirty filter element through a visual signal when differential pressure build-up reaches a predetermined level.

A variety of sizes, styles, and seals are available in the new SP-2105 series, and many sizes use the same THERMO-MESH element, reducing replacement inventory.

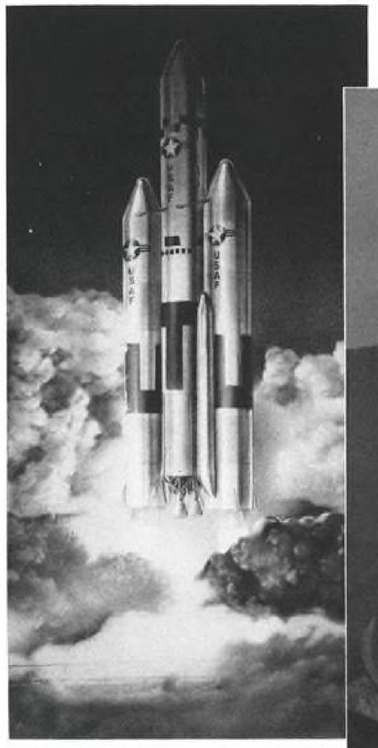
If you're dealing with **really critical** filtration problems, you'll want to know more about the SP-2105 series. Ask for Technical Bulletin FA-300

*Patent pending

SCREEN PRODUCTS DIVISION • CONTINENTAL COPPER & STEEL INDUSTRIES, INC.
P.O. Box 430 • Caldwell, New Jersey 07006

West Coast Representation By: Permanent Filter Corporation • A subsidiary of CCS, Compton, California

Circle Number 23 on Reader-Service Card



Drawing of Titan III-C Standard Space Launch Vehicle



Seven foot diameter nozzle

CAMERON PRODUCES WORLD'S LARGEST CLOSED-DIE FORGING FOR TITAN III-C STANDARD SPACE LAUNCH VEHICLE

Forged for Thompson Ramo Woolridge, Inc. to meet design specifications of United Technology Center. These SEVEN FOOT diameter nozzles are forged with one heat and one stroke on Cameron's 20,000 ton closed-die forging press.



20,000 Ton Forging Press

Cameron produces forgings of unmatched quality and configuration by using the most advanced techniques available in the forging industry. Cameron's completely integrated facilities include steel melting, vacuum degassing, vacuum arc melting, forging, heat treating, and rough machining, giving customers the benefit of an undivided responsibility for quality and delivery.

You too may have a requirement for a "ONE RESPONSIBILITY" forging. Call, write or come by.

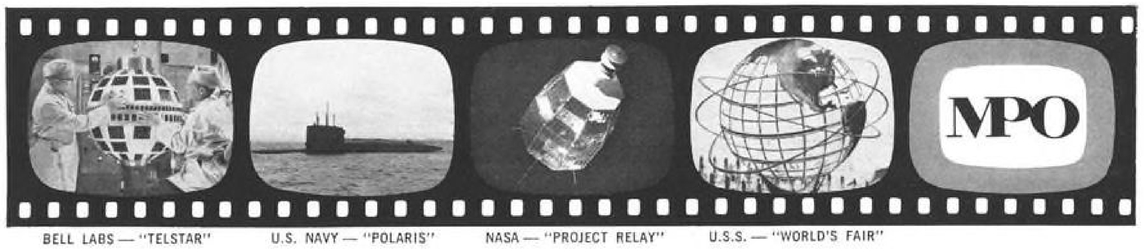
Cameron

CAMERON IRON WORKS, INC. SPECIAL PRODUCTS DIVISION
P. O. BOX 1212 HOUSTON, TEXAS

Circle Number 24 on Reader-Service Card

Q: Why do more government agencies come to MPO for their films than anywhere else?

A: Simple. MPO has a staff of production and camera crews that already have security clearance. MPO has the experience that makes the film crew part of the project team. MPO has the world's most modern motion picture studio center. MPO is ready to shoot anywhere in the world. MPO makes films for the U.S. Army, Navy, Air Force, NASA, FAA, Bell Labs, Ford, GM, Eastman Kodak, U.S.S. and many others. Want an estimate? Want to talk about films? Want a brochure describing our new studios? Write or call Andy Gold. He's in charge.



BELL LABS — "TELSTAR" U.S. NAVY — "POLARIS" NASA — "PROJECT RELAY" U.S.S. — "WORLD'S FAIR"

Special Projects Division, MPO Productions, Inc./222 E. 44 St., N.Y. 17, N.Y./Area code (212) TN 7-8200/also in Detroit, Chicago and Hollywood

Circle Number 25 on Reader-Service Card



INLAND D-C Torque Motors

Inland provides a complete line of compact d-c torque motors for direct drive servo positioning. High-torque output, low-power input and high angular resolution are offered in distinctive, space-saving pancake shape.

Exclusive commutator and brush rigging design.
Complete range from 0.1 to 3,000 pound-feet.
No gear backlash or other gear train problems.

Inland Amplifiers, rotary and solid state, are available for systems use with Inland torquers. The 100-watt solid state d-c amplifier, shown here, is the first of its type packing high power output in a hermetically sealed can only 2½" x 3 3/16" x 2½".



Model 579.35
100-watt d-c amplifier

For complete data write Inland. Dept. 9-4.

REPRESENTATIVE RANGE OF INLAND D-C TORQUE MOTORS

TYPE	PEAK TORQUE AT STALL	POWER INPUT FOR PEAK TORQUE WATTS @ 25°C	DIMENSIONS INCHES	O.D. THICKNESS
T-1321	20 oz.-in.	57	1.94	.50
T-2136	35 oz.-in.	42	2.81	.63
T-2108	60 oz.-in.	32	2.81	1.00
T-2907	.85 lb.-ft.	79	3.73	1.09
T-4006	1.8 lb.-ft.	100	5.13	1.25
T-5106	2.7 lb.-ft.	86	6.25	1.31
T-5703	7.0 lb.-ft.	246	7.20	1.63
T-7202	11.0 lb.-ft.	327	9.00	1.63
T-8001	25 lb.-ft.	925	10.50	2.63
T-10001	35 lb.-ft.	620	13.69	4.30
T-10004	100 lb.-ft.	1020	12.75	5.75
T-18002	300 lb.-ft.	1300	26.63	5.82
T-18004	900 lb.-ft.	4330	26.50	10.56
T-36001	3000 lb.-ft.	7400	45.0	10.25

For complete data on these or other Inland d-c pancake torquers, address Dept. WE, Inland Motor Corporation of Virginia, Northampton, Massachusetts.

INLAND MOTOR CORPORATION OF VIRGINIA
A SUBSIDIARY OF KOLLMORGEN CORP.
NORTHAMPTON, MASS.

Circle Number 26 on Reader-Service Card



UNCOVERING THE UNKNOWNS IN TEMPERATURE CONTROL!

ON THE JOB WITH A GM HARRISON RESEARCH ENGINEER

Six months' work may be riding on the results of the dial. The machine—a mass spectrometer—detects and measures inconceivably small leaks by helium emission. The man—a GM Harrison research engineer—charts the course of new heat exchanger design.

At GM Harrison, there's plenty of room for his curiosity to operate. But he's a practical engineer, too. His "way-out" explorations are down-to-earth evaluations! He proves his ideas in practice as well as on paper, in costs as well as theory. His research emphasis is on the development of ideas to improve the efficiency and reliability of *today's* temperature control equipment *as well as tomorrow's*.

In addition to product development and improvement, he and his associates are always a rich source of technical information and assistance in the fields of *marine, industrial, nuclear, automotive* and *aero/space* heat transfer. Good reason to look to GM Harrison for your next temperature control solution.

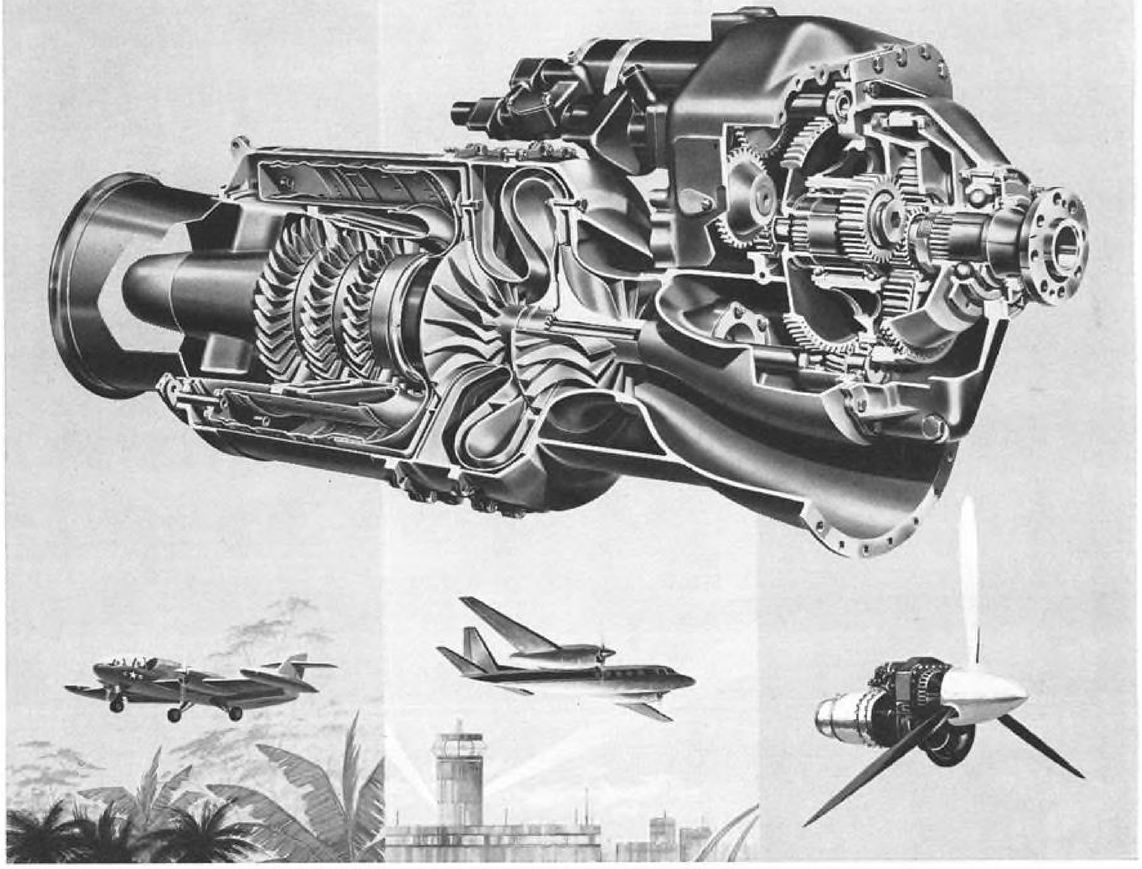
Free For an informative 48-page brochure on the complete Harrison line . . . write to Department 902.

GM HARRISON TEMPERATURES MADE TO ORDER
AERO/SPACE, AUTOMOTIVE, MARINE AND INDUSTRIAL HEAT EXCHANGERS

HARRISON RADIATOR DIVISION, GENERAL MOTORS CORPORATION, LOCKPORT, NEW YORK

Circle Number 27 on Reader-Service Card

TURBOPROP ENGINE FOR LIGHT AIRCRAFT
AIRESEARCH MODEL 331



This 600 horsepower turboprop engine is designed to power the new generation of light, fixed wing aircraft for both civil and military applications. • The Garrett-AiResearch TPE-331 has a specific fuel consumption of .62 pound per shaft horsepower-hour, and a weight to power ratio of .45 pound per horsepower. The engine has a response rate from flight idle to full power of approximately 1/3 of a second. A military version has been designated the T76 by the U.S. Navy. • Designed specifically as a prime power plant, the model 331 is backed by the company's experience in producing over 10,000 gas turbine engines. A unique offset gearbox permits flexibility of application while a straight forward induction system minimizes installation costs. Opposite output rotation can be made available, and controls are adaptable for a prop governing, beta, or combination system. • The Model 331 engine is programmed for additional performance growth. The turboshaft version (TSE-331) has been flight tested as a power plant in rotary wing and vertical lift vehicles. Please direct inquiries to the Phoenix Division.

GARRETT

AIRESEARCH MANUFACTURING DIVISIONS

LOS ANGELES 9, CALIFORNIA • PHOENIX, ARIZONA

SYSTEMS AND COMPONENTS FOR: AIRCRAFT, MISSILE, SPACECRAFT, ELECTRONIC, NUCLEAR AND INDUSTRIAL APPLICATIONS

Circle Number 28 on Reader-Service Card



GD700 SERIES
GAS-O-DOME REGULATORS

Models in bronze or stainless steel
Pilot operated type
Max. inlet: 3600 to 10,000
Outlet range: 25-200 to 500-8000 psig
Flows to 600 scfm
Low Torque: 50 inch-lb. at 8000 psig
Panel mounting
Bulletin R43



BPR SERIES
BACK PRESSURE REGULATORS

Models in bronze, stainless steel, or aluminum
Adjustable relief ranges:
From 25-500 psig
to 2000-10,000 psig
Bulletin R42



LR SERIES LOADER REGULATORS

Models in bronze, stainless steel, or aluminum
Max. inlet: 7000 to 10,000 psig
Outlet range: 25-200 to 500-10,000 psig
Flow: 15 scfm
Low Torque: 40 inch-lb. at 7,000 psig
60 inch-lb. at 10,000 psig
Panel mounting
Bulletin R30



GD90B, GD100B, AND GD200A
SERIES GAS-O-DOME REGULATORS

Models in bronze or stainless steel
Compensated, high-flow type
Max. inlet and outlet: 6000 psig
Flows to 80,000 scfm
Remote control and/or
panel mounting provisions
Bulletins R33 to R40 incl.



LV LOADER VALVE

Models in bronze, stainless steel, or aluminum
Inlet and outlet: 7000 psig
Flow: 10 scfm
Fast finger-tip control:
30° clockwise, loads;
30° counter-clockwise, bleeds
Panel mounting
Bulletin R31



GD61C AND GD80A
SERIES GAS-O-DOME REGULATORS

Models in bronze
Inlet and outlet range:
2500 to 10,000 psig
Flows to 1500 scfm
Remote control and/or
panel mounting provisions
Bulletins R46, R48, R53

VICTOR

High pressure gas controls

Victor high pressure gas regulators are cleaned, assembled, tested and packaged under carefully controlled conditions to insure maximum product reliability.

Regulators shown here are typical of the available models covering a range of pressures to 10,000 psig and capacities to 80,000 scfm at −67° F to +160° F. Other types, sizes and modifications for special applications available upon request. Write for Regulator Inquiry Form 361-B.



Victor "clean" room insures maximum cleanliness to meet military and missile industry requirements.

VICTOR for regulators

VICTOR EQUIPMENT COMPANY

844 Folsom Street, San Francisco 7
3821 Santa Fe Ave., Los Angeles 58 • 1145 E. 76th St., Chicago 19

Manufacturers of high pressure gas regulators; welding & cutting equipment; hardfacing rods; blasting nozzles; cobalt & tungsten castings; straight-line and shape cutting machines; rebuilding machines for tractor tracks, rollers, and idlers.

Circle Number 29 on Reader-Service Card

MORE OF THE NEWEST AIRCRAFT FLY WITH CHATHAM TRANSFORMER-RECTIFIERS THAN WITH ANY OTHER POWER SUPPLY



BOEING C-135 TRANSPORT
28VS100Y Silicon T-R



BOEING B-52H STRATO-FORTRESS
28VS100C Silicon T-R



LOCKHEED F-104G STARFIGHTER
28VS120Y Silicon T-R



BOEING IM-99B BOMARC MISSILE
28VCP-C Silicon T-R



CANADAIR ARGUS MK-11
28VS22C Silicon T-R



CONVAIR F-106A/B DELTA DART
28V30BPA Selenium T-R and Battery



CONVAIR 880 JET LINER
28VS50-1 Silicon T-R



CONVAIR F-102 DELTA DAGGER
28V20CV Selenium T-R



DOUGLAS A-4C/E SKYHAWK
28VS20C Silicon T-R



CANADAIR CL-44 TRANSPORT
LOCKHEED P3V-1 ORION
LOCKHEED QF-104 DRONE
28VS200Y Silicon T-R



BOEING 707/720 STRATOLINER
28V50C Selenium T-R and
28VS50C-3 Silicon T-R



McDONNELL F4B PHANTOM II
28VS60 Silicon T-R



NORTH AMERICAN A-5C VIGILANTE
28VS200BL Silicon T-R

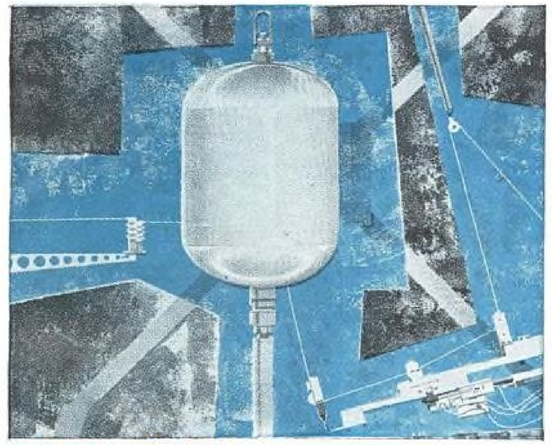
FOR AIRCRAFT AND MISSILE TRANSFORMER-RECTIFIERS (SELENIUM, OR SILICON) AND INDUSTRIAL REGULATED POWER SUPPLIES, SPECIFY CHATHAM

CHATHAM ELECTRONICS
LIVINGSTON, N. J. TWX: 201-992-7350
DIVISION OF TUNG-SOL ELECTRIC INC.

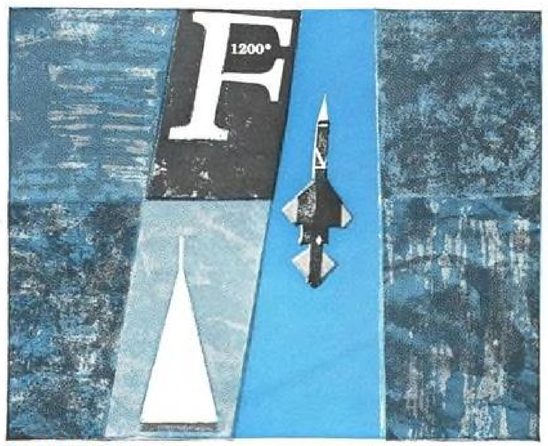
SEE OUR SPECIFICATIONS IN V·S·M·F USE MICROFILM CATALOG FILE

Circle Number 30 on Reader-Service Card

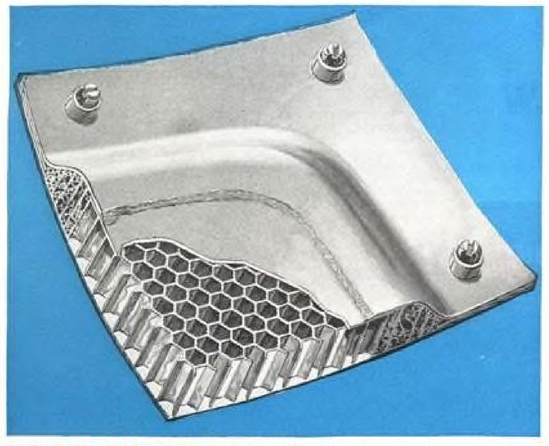
Researched, developed, manufactured and tested... in house by Brunswick



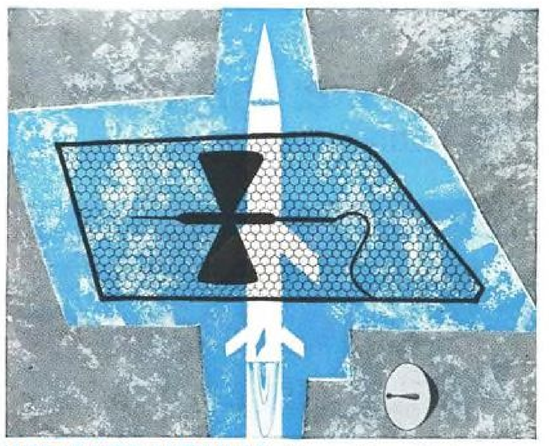
ROCKET MOTOR CASE – Brunswick is a leading designer and fabricator of fiberglass filament wound rocket motor cases. Experience on Polaris A-3 and other programs has resulted in an unexcelled capability for design, fabrication, and test. From the fabrication of the insulator to the final hydrostatic testing of the completed unit, Brunswick can offer a product of utmost reliability.



RADOMES – for supersonic aircraft and missiles. Brunswick's biaxial filament winding process guarantees maximum transmission properties by precise resin control, precision ground wall thickness tolerance of ±.001. Brunswick's electronic test facilities include ten test ranges for pattern studies on all types of antennae with directional pattern characteristics.



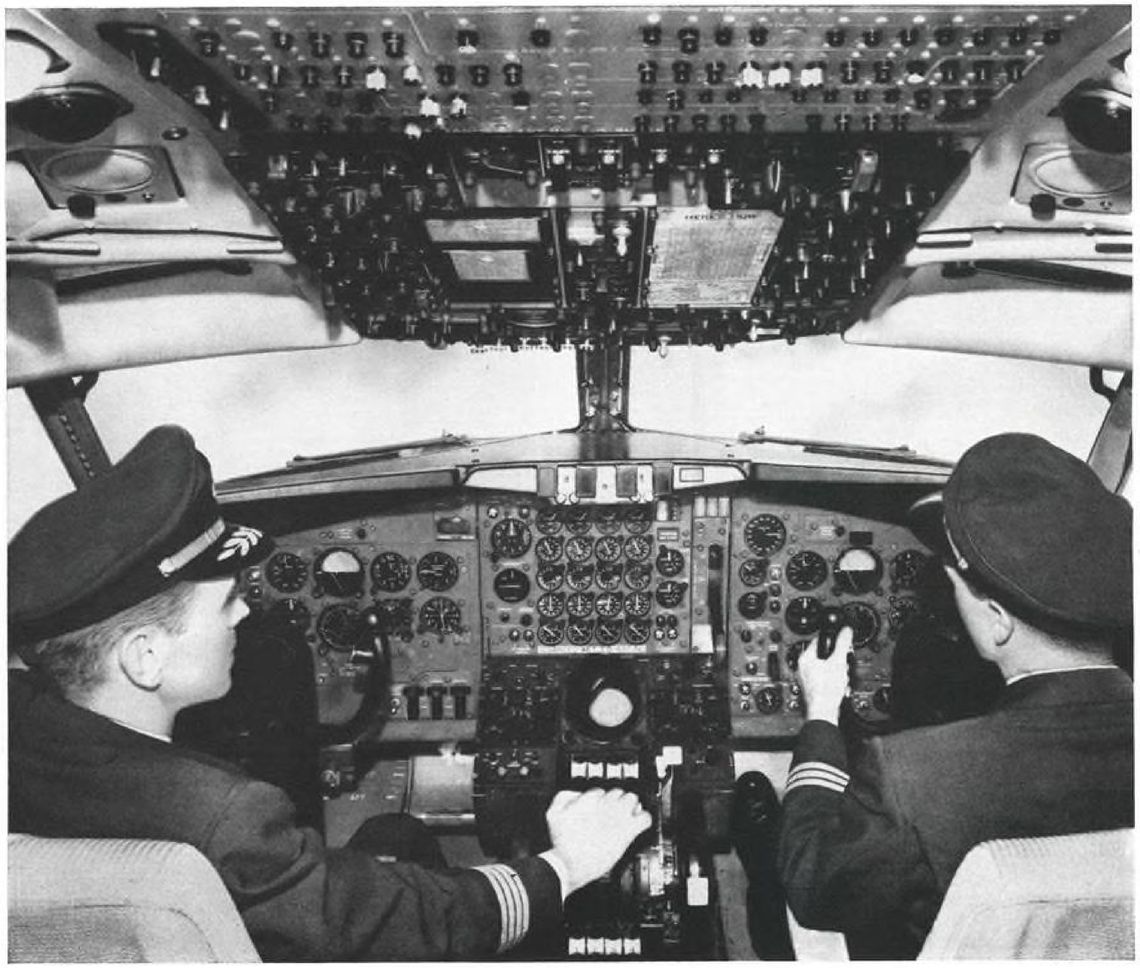
HONEYCOMB ASSEMBLIES – Brunswick has complete facilities for the design and fabrication of aluminum sandwich and reinforced plastic components. Large parabolic reflector panels are fabricated to ± .010 contour tolerance. Other sandwich assemblies can be fabricated using a wide variety of adhesives and materials. Brunswick's decade of experience has made it an acknowledged leader in this field.



INTEGRATED ANTENNAS – Brunswick totally integrates all communications, telemetry and navigational antennas and reflectors within primary structures. No sending or receiving interference. All-plastic aircraft and missile assemblies give high weight-strength ratio, while providing aerodynamically clean lines. Can Brunswick Corporation help you in any way? Write or call today!

MAKES YOUR IDEAS *WORK*
Brunswick
BRUNSWICK CORPORATION • DEFENSE PRODUCTS DIVISION
1700 MESSLER STREET • MUSKEGON, MICHIGAN

Circle Number 31 on Reader-Service Card



Sinclair keeps ahead— to keep aviation ahead

Keeping up with aviation's progress is a pretty hard job these days. Keeping **ahead** is even harder... but Sinclair Research takes pride in doing it.

From this research-for-progress have come many products of great help to aviation—Sinclair higher-octane fuels which gave piston engines greater power—Sinclair jet fuels which jets used to break the sound barrier—special Sinclair lubricants which helped to put man into space.

Sinclair Turbo-S Oils are among these fine products. Major airlines rely on Turbo-S Oils by Sinclair, a leading supplier of quality aviation products.

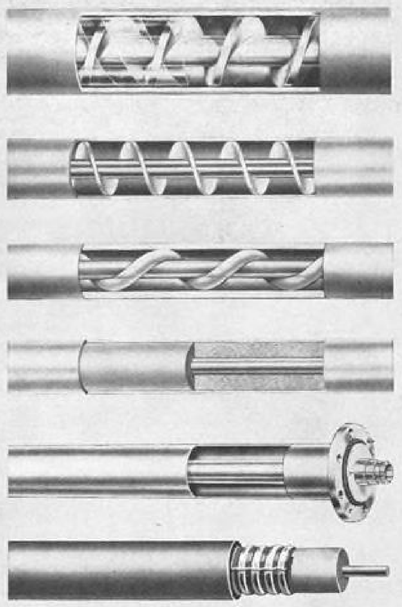
Sinclair

SINCLAIR AVIATION OILS

SINCLAIR REFINING COMPANY • 600 FIFTH AVENUE, NEW YORK 20, NEW YORK

Circle Number 32 on Reader-Service Card

PDE SYSTEMS COMMUNICATIONS COMPONENTS AND CAPABILITY



STYROFLEX® COAXIAL CABLE Leads the line of PDE semi-flexible air dielectric cables. Available in 50, 70, 75, 100 ohm impedances; 1/2", 3/4", 7/8", 1-1/8", 1-5/8", 3-1/8", 4-1/8", 6-1/8" diameters. **Bulletin PS 4.**

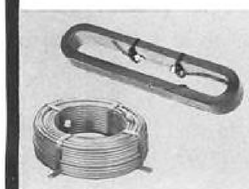
HELICAL MEMBRANE COAXIAL CABLE New lighter weight advanced design for GSE and missiles. Choice of polyethylene or Teflon® helix. 50, 75, 100 ohms; 1/2", 3/4", 7/8", 1", 1-5/8". **Bulletin HM 1.**

SPIRAFIL COAXIAL CABLE Specified throughout electronic industry, with heavy usage in broadcast and community antenna systems. 50 and 70 ohms; 3/8" and 1/2" diameters. **Bulletin CT 3.**

FOAMFLEX COAXIAL CABLE Lightweight, low-loss cable created to aviation Mil specs. Many proven microwave and RF applications. 50, 70, 75, 100, 125 ohms; 0.18", 1/4", 3/8", 1/2", 3/4", 7/8", 1-5/8". **Bulletin FF 3.**

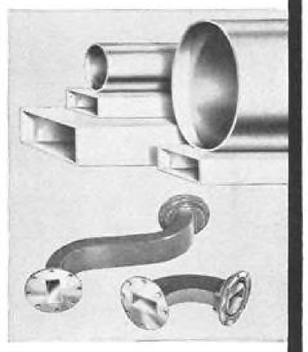
PDE RIGID LINE Latest PDE development provides extremely low loss, high power capability and excellent VSWR. 50 and 75 ohms; 7/8", 1-5/8", 3-1/8", 4-1/8". **Bulletin RL 1.**

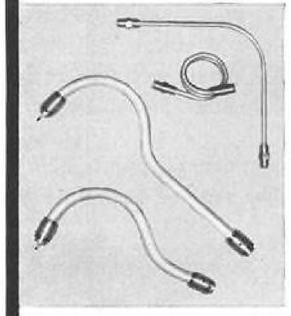
CORR-O-FOAM COAXIAL CABLE Economically priced for applications in radio, community antenna, educational TV and broadcast communications. 50 and 75 ohms; 3/8", 1/2", 3/4", 7/8". **Bulletin CF 1.**



COAXIAL CABLE DELAY LINES PDE coaxial cables shaped into custom configurations have outstanding performance. Tolerance of delay accuracy is within ±.02 nanoseconds. Frequencies from 60 C to 12 KMC, impedances of 50, 70, 75, 100, 125 are parameters. **Bulletin DL 1.**

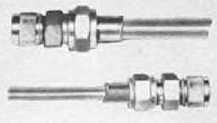
RIGID WAVEGUIDES Seamless rectangular and circular waveguides for top performance at high frequencies possess precise tolerances. Certified oxygen-free copper and commercial bronze, 90%, with a mirror-smooth finish assures maximum signal fidelity. Available in 12-foot lengths in 16 JAN and EIA sizes. Custom shapes: twists, bends, coils, offsets, transitions, fabrications and complete assemblies can be engineered to meet your selected frequencies. **Bulletin WG 1.**





CABLE CONFIGURATIONS In addition to furnishing PDE coaxial cables in 1000-foot lengths or cut to length, bending cables into sophisticated configurations to allow termination-to-termination use is an exclusive capability. A radius as tight as 3 diameters and no minimum straight length between bends offers a custom shape to fit the tightest confines. **Bulletin C 1.**

CONNECTORS Splices, adapters (UHF, N, HN, TNC, BNC, C, LC, LT, GR, EIA; QDL and QDS), transitions, short circuit terminations, end seals, waveguide transitions and panel mounts are off-the-shelf PDE connectors. **Bulletin WH 3.**



ACCESSORIES Pressure gages, valves, locating caps, plugs, tees, hangers and tools are performance-matched to PDE coaxial cables. **Bulletin AC1.**

SYSTEMS CAPABILITY *Throughout the microwave spectrum, PDE subsystems and systems are operating with an unusually high degree of reliability. Missile check-out and guidance, radar, telemetry, a legion of diverse applications have demonstrated PDE capability and proven PDE purebred components.*

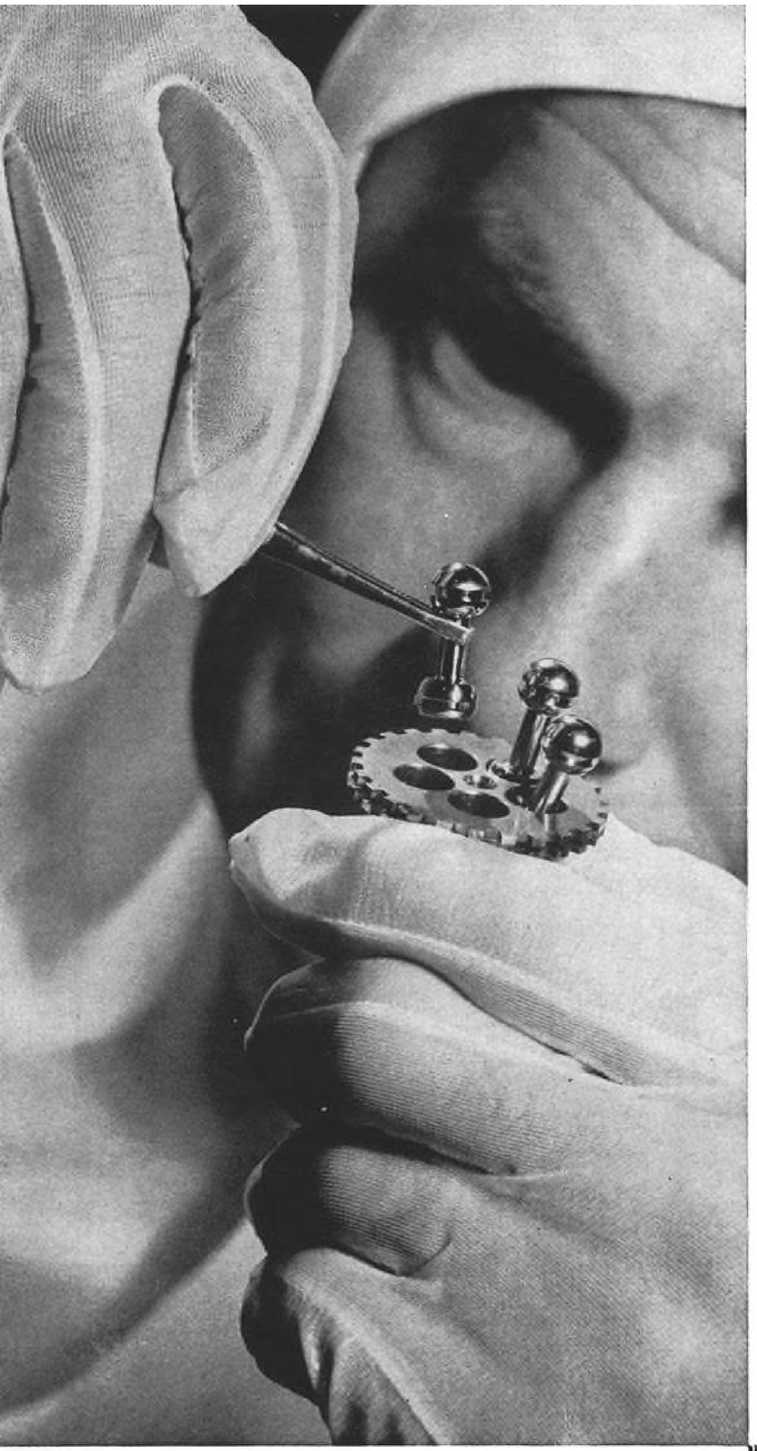
When systems communications is the key to your project . . . see PDE.

PHELPS DODGE ELECTRONIC PRODUCTS

CORPORATION • NORTH HAVEN, CONNECTICUT

Regional Sales Offices in New York, Washington, Dallas, Chicago, Los Angeles. Technical Representatives in all areas.

Circle Number 33 on Reader-Service Card



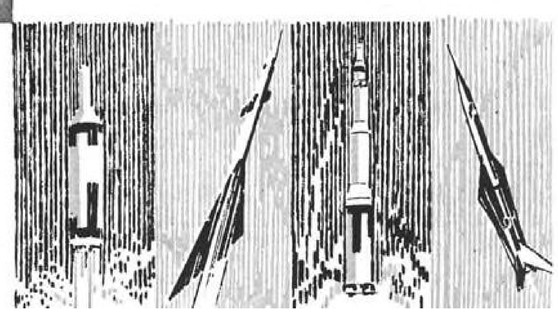
in aerospace
hydraulic pumps...

the PISTON makes the difference



There's no room for failure on aerospace flights . . . that's why PESCO's piston pumps are built to run at high speeds for long hours at extreme temperatures. PESCO's spherical pistons, with line contact rings, maintain zero bore clearance for the life of the pump . . . keep efficiencies high at fluid temperatures from –65° to 700° F . . . make pumps relatively insensitive to contaminated fluids. No PESCO pump has ever seized during more than 25,000 hours of operation on aircraft and missiles. For your piston pump requirements, using either fuel or hydraulic oil, look first to PESCO.

THIS IS WHY PESCO VARIABLE AND FIXED DISPLACEMENT PISTON PUMPS ARE SPECIFIED ON AMERICA'S ADVANCED AIRCRAFT AND MISSILES



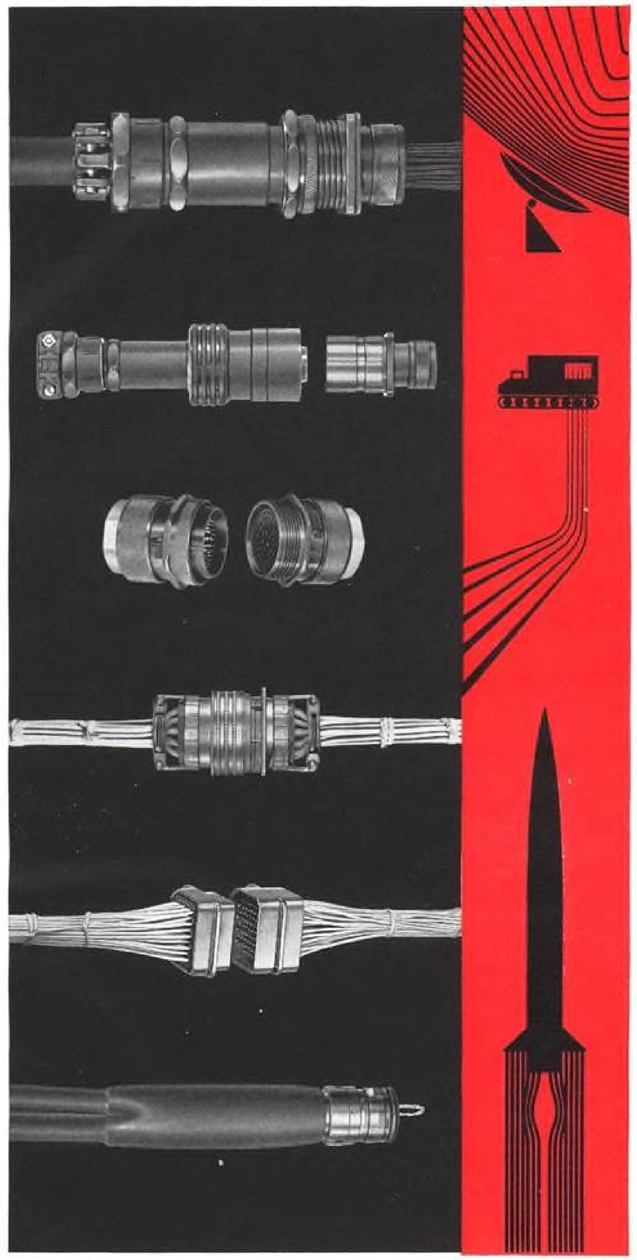
PESCO PRODUCTS DIVISION
Borg-Warner Corporation
24700 North Miles Road, Bedford, Ohio

BORG-WARNER

Export Sales:
Borg-Warner International Corp. • 36 South Wabash Avenue, Chicago 3, Illinois

B1099-PC

Circle Number 34 on Reader-Service Card



PYLE-NATIONAL EXCELS IN MEETING EXTRAORDINARY "SPECS" FOR CONNECTORS. The challenging state of sophisticated circuit connection problems spurs the State of the Art at Pyle-National. Many rely on our imaginative engineering to help them solve such tricky application requirements as: rough environments, compact size, reduced weight, rugged construction, RFI, and uncanny configurations.

Here's demonstrated proof of our capabilities in imaginative engineering. . . .

Pyle-Star-Line® Neptune Series, heavy-duty environmental connectors. Resist moisture, shock, chemicals, corrosion, pressure, temperature extremes. Offered with inserts having: I, captive solder contacts; II, push-in crimp removable contacts; III, collet retained, rear entry and release crimp contacts. Five shell sizes, 150 insert configurations.

Pyle-Star-Line, Class Q, quick connect and disconnect connectors. Speed-up coupling and uncoupling of cable networks with straight push and pull. Field indexable with same insert configuration to 16 key positions. High reliability and durability proven under worst field conditions.

Pyle-Star-Line Test Connectors. Prevent physical and electrical damage to connector contacts while monitoring circuits. Test Probe connector couples to connector under test; Test Cable connector is potted, molded and terminated to testing cable. Easy multiple indexing.

Pyle-Star-Line, Mercury-Series, Miniature Connectors. Eliminate corrosion possibilities, extend wear-life with stainless steel shells. Qualified and exceeds rigorous MIL-C-26500B specs. Accessories meet almost every extreme operating condition, including RFI.

Ractanglar™ Rack and Panel Connectors. Permit collet-retained contacts to be snapped in and removed from terminating side of rigid inserts. Features: high-density contact configurations . . . chamfered closed-entry socket block . . . rugged aluminum alloy shells . . . plastic tool.

Harness Connectors. Facilitate connector terminating, potting and molding to cables. Eminently-qualified by special equipment and experience to work with cable assemblies of varying wire sizes, insulations, and jackets.

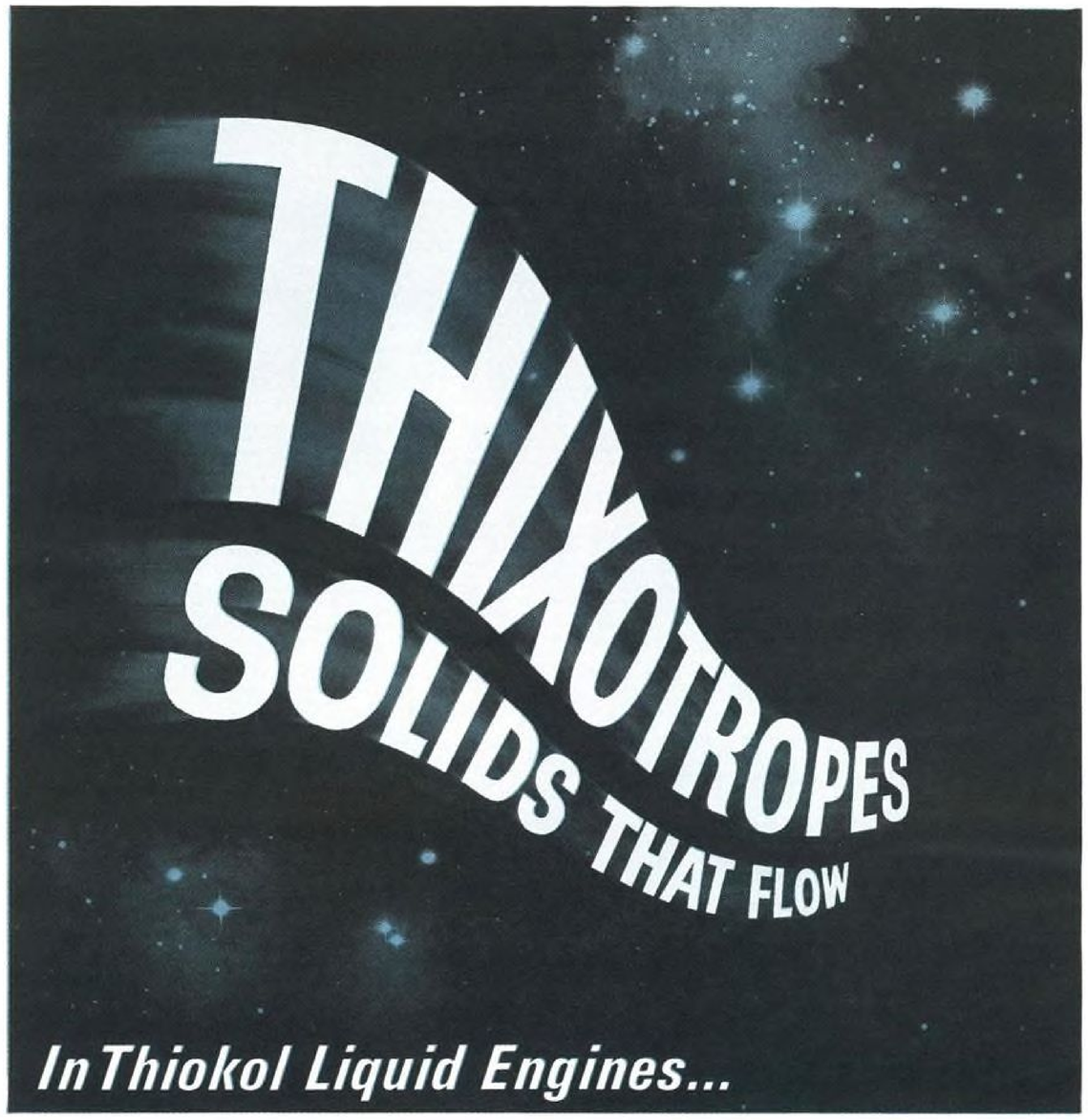
State your interest—we'll send appropriate literature. State your unsolved circuit connection problem—we'll try to provide a solution—idea.

CONNECTOR DIVISION, THE PYLE-NATIONAL COMPANY, 1334 NORTH KOSTNER AVENUE, CHICAGO 51, ILLINOIS

ALSO MFG. IN CANADA BY: PYLE-NATIONAL (CANADA) LTD., CLARKSON, ONTARIO

Pyle-National

ELECTRICAL CONNECTORS LIGHTING EQUIPMENT CONDUIT FITTINGS



A new propellant concept for high performance

"Thixotropes"—in rocketry, gelled propellants that flow like liquids when pumped or pressurized. Why thixotropic propellants? Improved safety, design simplicity, but most important, increased rocket engine performance. Gelling is one practical way to suspend high energy metallic particles in moderately energetic liquid propellants, particles which substantially boost propellant bulk density and specific impulse for many current and planned applications.

Thiokol's Reaction Motors Division is spearheading progress in all phases of thixotropic engine technology. Under Air Force and other hardware-oriented programs, key rocket system components are being designed for, and evaluated with, gelled propellants containing metal additives. Parallel research and engineering studies are exploring advanced Thiokol concepts in simple, ultra-high performance propulsion based upon a unique family of gelled "heterogeneous" propellants.

Thiokol
CHEMICAL CORPORATION
Bristol, Pennsylvania
Rocket Operations Center: Ogden, Utah
An equal opportunity employer

Circle Number 36 on Reader-Service Card



Joy Axivane Fans for Electronics • Aircraft • Armored Vehicles

Joy Axivane fans are today's standard of reliability and versatility in aviation, electronics and armored vehicle applications. Because of lightweight compactness, high capacity performance and shock resistance, Joy Axivane fans are ideal for wing and tail de-icing, cabin and cockpit heating and ventilating, cabin and compartment air recirculation, cooling electronic equipment and pressurizing. Operating dependability of Joy Axivane fans has been proven at altitudes of 50,000 feet and in temperatures as low as 100°F. For further information, write Joy Manufacturing Company, 900 Woodland Avenue, Michigan City, Indiana. 301

Circle Number 37 on Reader-Service Card

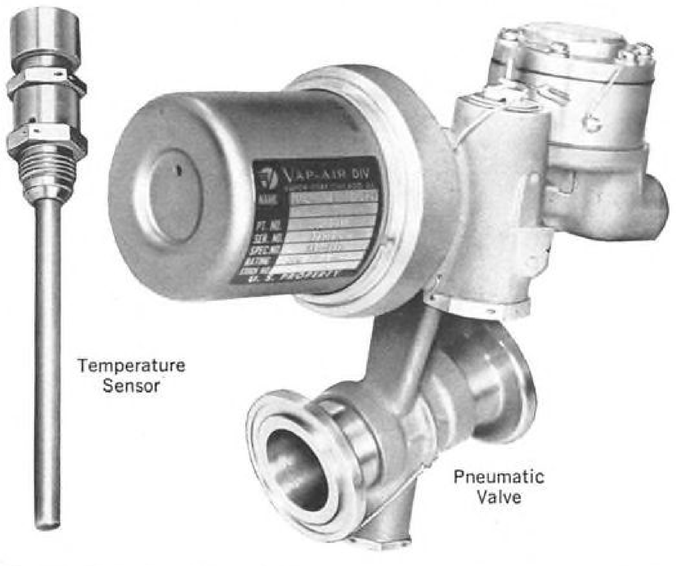
VAP-AIR PNEUMATIC TEMPERATURE CONTROL SYSTEM

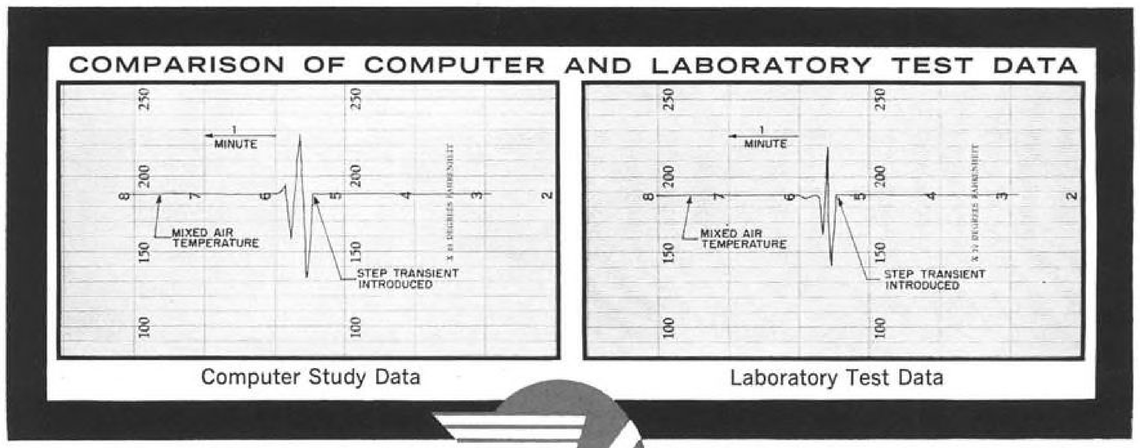
for high performance aircraft

Vap-Air's completely pneumatic temperature control system for high performance aircraft offers many advantages over electro-mechanical systems for controlling air flow in such applications as primary heat exchangers, windshield de-fogging, canopy de-fogging, rain removal, anti-icing and others.

Advantages include:

- Increased reliability
- Faster response (less than 2 seconds)
- Lower cost
- Lighter weight
- Minimum packaging requires less space
- Eliminates electrical connections
- Wider ambient temperature range (−80° to 450° F.)
- Higher resistance to shock and vibration





COMPLETE ENVIRONMENTAL FACILITIES

Vap-Air has complete facilities for the design, development, engineering and manufacturing of every type of thermal control system. In addition complete facilities are available for high pressure flow and temperature* testing of pneumatic systems under the most extreme environmental conditions required under MIL Specifications. We invite your control problems for thorough engineering analysis.

*(500 PSIG and 1200 F°)

Write to:

VĀP-AIR®

Division

VAPOR CORPORATION

80 East Jackson Blvd.

Chicago 4, Illinois

Circle Number 38 on Reader-Service Card

Message From the Publisher

Industry's Endless Challenge

The aerospace industry is facing another year of technical and economic transition that will offer a substantial challenge to management. It has been a tradition of the aerospace industry, from the original Wright brothers factory in Dayton to the space age, that technology has forced changes almost faster than organizations—both industrial and political—have been able to absorb them. The penalties for those who have failed to perceive these changes have been severe. The rewards for those who have ridden the crest of expanding technology have been substantial.

The Buyers Guide issue this year should provide the aerospace industry with some significant clues on what changes in procurement and technology portend for 1964 and beyond. The Fiscal 1965 budgets for the Defense Dept. and the National Aeronautics and Space Administration are now being hammered into their final form for presentation to the Congress next month. It is already clear that they will continue an extremely high level of activity across the entire spectrum of the aerospace technology. The peaks of the major ICBM programs such as Titan, Minuteman and Polaris, particularly the acquisition of costly hardened land bases and nuclear-powered submarines, have passed. But there will continue to be strong activity in developing improved propulsion, guidance, re-entry vehicles and command systems for advanced models of new ballistic missiles that can be accommodated in the vast complex of concrete silos and submarines already established. The biggest military procurement item will continue to be aircraft and their related equipment. It is significant that even when missile spending reached its peak in the years just past, it never equalled the steady level of aircraft procurement, and never even came close to splitting the market evenly as so many false prophets predicted.

Resurgence of Aircraft

The aircraft portion of the aerospace industry is headed for a period of lively technical development, stimulated by accumulated technical neglect during the past several years and the development of a wide range of new military requirements for flying vehicles of all types. Those who abandoned aviation prematurely in the first flush of missileering are now due for an agonizing reappraisal.

Space technology will continue to expand in both its NASA and military phases, with additional impact from the growing international realization that no nation can play a significant role in the world tomorrow without a sound capability of its own in the science and industry of space.

The greatly expanded Products and Services section of the Buyers Guide issue now lists more than 4,000 manufacturers in this country, Canada and Europe, and covers some 2,000 specific types of products they make. Here are the clues to the new materials, production techniques and sources of supply to meet the new technical challenges of the 1960s in aerospace.

Performance of the difficult task of keeping track of the significant facets of a changing industry, and tabulating its size and scope in detail, has been substantially improved for this Buyers Guide issue by the use of modern data reduction techniques that will increase its already wide readership acceptance as a basic management tool. The acceptance of the Buyers Guide issue as a long-term management aid was documented by a study conducted on the previous edition six months after its publication. A total of 66% of the respondents in this survey still retained their copy and 55% said they referred to it at least once a month.

Service to Readers

The Buyers Guide is an essential ingredient in the year-round editorial service that Aviation Week & Space Technology provides its engineering-management readership in the aerospace industry, in forecasting significant technical and economic trends, spotting their initial emergence into hard policy, and interpreting their long-range effects. In addition to the regular weekly issues, special editions are devoted to major forecasts across the entire technical spectrum in the "Inventory of Aerospace Power" each spring; a special report in depth on the most important phase of research and development in mid-year, and the survey of international air transport in the fall.

In addition to its problems with changing technology, management in the aerospace industry will find next year a critical test of whether the incentive-type contract will really provide significant rewards for better cost performance and tighter program management. As the procurement picture is now planned, industry profits should improve where performance merits. But, as with so many government policies, the difference between promise and delivery is often substantial. The scope and character of these potential variants should become apparent to industry next year as the application of the new type contract spreads.

Next year will be the sixty-first year of the aircraft, the twentieth year of the liquid-fueled ballistic missile and the seventh year of the space age. The challenge to aerospace managements to handle the combination of technical ferment, political problems and economic pressures that will be generated by these three facets of a common technology will never be greater.

—Robert W. Martin, Jr.
Publisher

DOD Maps Contract Management Changes

By William H. Gregory

Washington—Defense Dept.'s extensive modification of military procurement policies and procedures was completed for the most part this year, and next year will be one of consolidation and refinement.

Industry's day to day operation, however, may be strongly influenced by what will probably be DOD's only major new item on the 1964 procurement agenda. This is a field evaluation in the Philadelphia area of combining the contract management functions of the services, under study in DOD's Project 60.

Involved here are reporting requirements, regarded by contractors as a chronic headache. Industry feels reporting requirements are generally excessive, but for contractors with multiple government contracts—with the military and with the National Aeronautics and Space Administration—they can be faced with as many as five different types of reporting systems, each with essentially the same information goals but asking for varying data.

Contract management, which covers diverse phases of primarily post-award relations with contractors that include facility surveys, quality assurance, production expediting, plant cognizance, plant security, etc. has grown over the last decade with little procedural guidance at the beginning from DOD.

Lacking such guidance, the services followed their own inclinations to develop systems that DOD feels are not necessarily weak, but do increase government and contractor overhead because of the differences.

Organization and procedures for the pilot test are being recommended by the management consulting firm of Booz, Allen and Hamilton as a subcontractor to the Logistics Management Institute, an advisory body to DOD.

The test, and Project 60, are under the supervision of the office of the Assistant Secretary of Defense for Installations and Logistics, and the test operation itself is under command of Brig. Gen. A. T. Stanwix-Hay of the Army, formerly commanding general of the Army's Electronic Materiel Agency in Philadelphia.

Included in the operation of the pilot model Contract Administration Services Region are 2,105 persons in 14 offices of the USAF Philadelphia Contract Management District; the Philadelphia Army Procurement District; four Inspector of Naval Material Offices at Baltimore, Philadelphia, Pittsburgh, and Reading, Pa., and the Defense Supply Agency Support Office at Philadelphia.

Coordination between the test operation and DOD will be through the recently created Directorate of Contract Administration Services in the office of the Assistant Secretary of Defense for Installations and Logistics, which is headed by USAF Col. Donald E. Sowle. Responsibility of the directorate is to formulate common procedures and policies in the contract management field.

The Project 60 task force, comprising 84 specialists in management and procurement from defense agencies and the National Aeronautics and Space Administration, recommended establishment of the directorate.

Plans for the test program call for it to begin in February, continue for three months, and lead to coverage under the Armed Services Procurement Regulations by July 1. The final system may be a combination of the best procedures of the services—or at least bring about elimination of the less effective ones.

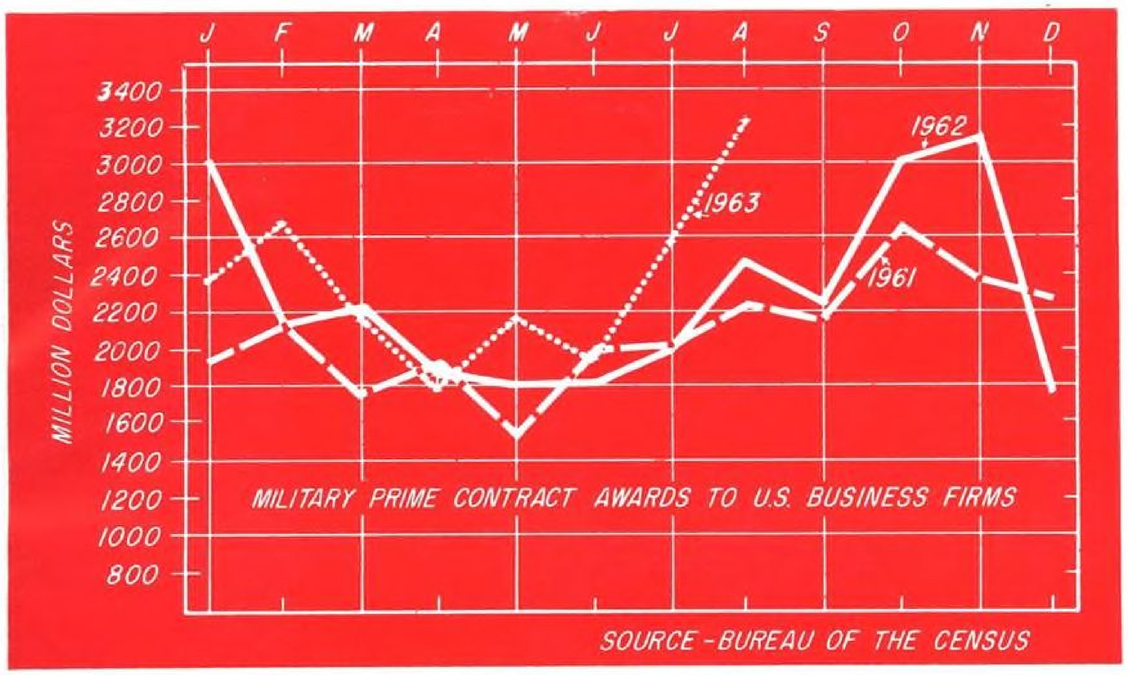
DOD and the services are proceeding cautiously in the program because of the possible impact on local communities through personnel transfers and changes in installations. Almost 43,000 people in 444 field organizations are involved in contract administration and supporting services. Another reason is that Project 60 has stirred fears in the field that the entire procurement structure of the services will be combined.

Top defense officials deny this, and say that no more consolidation of military buying is contemplated other than that in existence now with the Defense Supply Agency.

Increased emphasis on incentive contracting and the reduction of cost plus fixed fee contracts—well under-way over the past year—is considered by defense officials as the most significant phase of the current DOD procurement program.

But there are three other important elements, two of which became policy relatively late this year and which will not be fully felt by industry until 1964:

• **Program definition phase** as a mandatory procedure prior to undertaking development of any major weapons system. USAF's Titan 3 space booster system was the pioneer in this procedure two years ago.



PATTERN OF MILITARY prime contract awards to U. S. industry is charted according to figures compiled by the Bureau of the Census, Department of Commerce. July and August of this year, the initial months of Fiscal 1964, show increases over previous years.

• **Contractor performance evaluation.** Initial reports are now in preparation under this procedure, but little application of its results is expected before June, 1964, at the earliest.

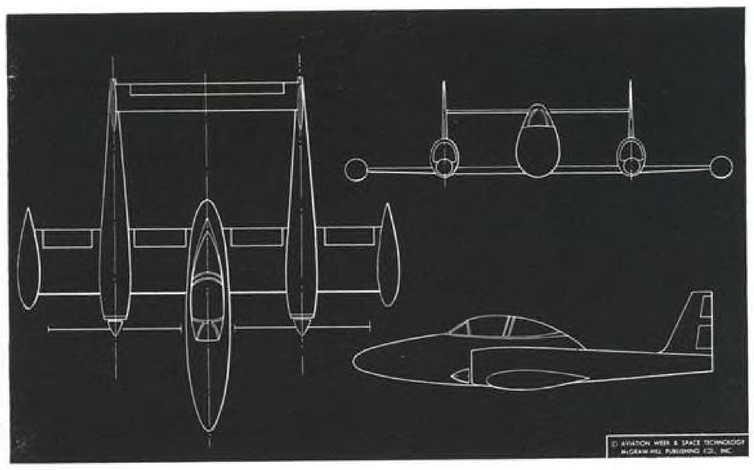
• **Weighted guidelines system.** Use of this system for setting target profits in all contracts that require cost analysis, i.e., advanced weapons system development, becomes mandatory Jan. 1, but has been used on an optional basis in 1963.

How these elements tie together is described by Graeme C. Bannerman, deputy assistant secretary of defense for procurement:

• **Program definition** makes widened application of incentive contracts possible. Cost plus fixed fee contracting stemmed from the assumption that specifications for complex, advanced weapons systems could not be defined adequately enough for firm pricing. Program definition forces the government buyer to decide what he wants in enough explicitness so that a meaningful work statement can be written. Without clearly defined goals, incentive contracts cannot be written.

• **Incentive contracting** and program definition make it easier to get into contractor performance evaluation. By having clear program goals and incentive values to indicate relative importance of goals, an objective statement can be written as to whether goals were met.

• **All these elements** make the weighted guidelines system possible. This system, incorporated into ASPR, provides the contracting officer with percentage weights to assign the cost, risk, past performance and incentive elements of a



New Designs for COIN Aircraft

Defense Dept. emphasis on limited war capability has produced new concepts for counter insurgency aircraft, like the configuration (left), and the Cessna T-37 (right) modified under USAF contract. The YAT-37D carries two weapons and one fuel pod under each wing, has armor plate under the seat, and wide track wheels for rough field operation. New powerplants for this aircraft are General Electric J85-J2 turbojets of 2,400 lb. thrust each. The artist's concept illustrates concepts followed by several companies (AW Nov. 25, p. 26).



program to meet DOD's basic objective: to utilize fully the profit motive as a tool to reduce costs of defense hardware.

"The guidelines and the incentive give a good target and variable earnings," Bannerman said, in discussing the desirability from the government's standpoint in reintroducing the element of risk into defense contracting. "But it takes all these to induce a real change in the pattern."

Basically the pattern DOD seeks to change is the level of effort mentality, the system that pays off for man-hours performed, regardless of the results achieved.

Emphasizing of incentive contracting over the last two years was not accomplished without strong administrative pressures from DOD, and skepticism or resistance from the services or contractors.

Military procurement officers questioned not merely the practicability but the possibility of defining complex, sophisticated systems sufficiently to estimate costs adequately. And Bannerman commented: "Contractors would love to get high profits without taking any risks."

Not enough contracts have been completed to indicate whether the prospective benefits of incentive contracts actually are being routinely realized. But there are some favorable signs:

• **Shift away** from cost plus fixed fee contracts is proceeding faster than DOD projected. Cost plus fixed fee contracts hit a high point of 38% of total contracts. DOD's goal was to reduce them to 12.3% of the total at the close of Fiscal 1965, and the total now is within a percentage point of that.

• **Military skepticism** appears to be fading, and support of the incentive contract as a workable and useful tool is growing at the working level.

• **One early incentive contract**—that for the Vela Hotel nuclear detection satellite (AW Oct. 28, p. 28) has gotten off to a good start from both industry and government points of view.

A complex scale of performance targets and fees was involved for the program, which called for manufacture of five pairs of spacecraft. Maximum fee was based on successful launch and operation of the first pair, falling to par if objectives were not met until the third set, and minimum fee if all five were required.

Bannerman said the first launch, which had no contractor-controllable errors, produced an example of good incentive contracting, although costs were slightly overrun and the government might have four sets of surplus spacecraft.

Increase in Net

Bannerman referred to one contractor whose percentage of cost plus fixed fee backlog dropped from 90% to 45% in the last year. At the same time, its net profits rose 42% while its sales were increasing only 17%.

None of these indications as yet is conclusive evidence of permanent improvement of low aerospace industry profit margins. If incentive contracting performs as advertised, there will be some examples of the opposite effect—lower profits, or even losses. Impact on company profit and loss statements may be slow to appear, and the effect is likely to be subtle since results of various programs in a company's over-all business can normally be expected to vary.

Writing of good incentive contracts requires considerable skill, for a badly drawn document can provide the contractor with increased profits for providing something the government doesn't really want.

Lack of discernment in matching and weighting incentives on a missile contract could result in an absurdity like paying for a weapon that underran costs, was delivered ahead of schedule, but failed to have enough range or payload.

Contract Pattern

In general, multi-incentive contracts —which will come more and more into use—will stress performance incentives in research and development and cost and schedule incentives in production.

Incentive contracts vary, but usually consist of a maximum target price, over which the contractor must pay some or all excess costs. Below the target, to a minimum cost target, contractor and government share dollar for dollar in cost plus types or the contractor may earn all in a fixed price type.

Aerospace Industry Backlog

VALUE OF BACKLOG REPORTED BY MANUFACTURERS OF COMPLETE AIRCRAFT, SPACE VEHICLES, MISSILES, AND SELECTED PARTS: FOURTH QUARTER 1962—FIRST AND SECOND QUARTERS 1963

(Millions of dollars)

Type of product or service	Quarter ending— Dec. 31, 1962[1]	March 31, 1963*	June 30, 1963
TOTAL	12,521	13,324	13,336
United States Government	9,981	10,898	10,878
Other customers	2,540	2,426	2,458
Complete aircraft and parts, total	4,988	5,239	5,438
United States Government	3,687	3,986	4,158
Other customers	1,301	1,253	1,280
Aircraft engines and parts, total	1,527	1,405	1,388
United States Government	1,164	1,053	1,043
Other customers	363	352	345
Missile and space vehicle systems, engines, propulsion units and parts, total	3,659	4,376	4,207
Missile systems and parts (excluding propulsion units):			
United States Government	2,047	1,827	1,757
Other customers[2]	[3]154	[3]111	[3]106
Space vehicle systems and parts (excluding propulsion units):			
United States Government:			
Military	551	918	807
Nonmilitary	299	771	755
Other customers[2]	(2)	(2)	(2)
Engines and/or propulsion units for missiles and space vehicles (including parts):			
Military:			
United States Government	336	427	482
Other customers	158	160	152
Nonmilitary:			
United States Government	81	122	122
Other customers	33	40	26
Other aircraft, space vehicle and missile activities, total[3]	1,323	1,263	1,237
United States Government	930	906	864
Other customers	393	357	373
All other products and services, total[4]	1,024	1,041	1,066
United States Government	886	888	890
Other customers	138	153	176

* Revised. Source—U.S. Commerce Dept.

[1] Represents revised totals reflecting both usual year-end adjustments and revisions resulting from changes in accounting practice involving the concept of backlog.

[2] Figures for "Space vehicle systems and parts" for "Other customers" are included with those for "Missile systems and parts" for "Other customers."

[3] Includes all conversions; modifications; site activation; other aerospace products (including drones) and services; and receipts for applied research and development on items such as drones, etc. Receipts for other applied research are included with figures for the respective reporting categories.

[4] Includes all nonaircraft, nonspace vehicle, and nonmissile products and services; and all basic research.

Heart of incentive contracting is in accurate estimates of the minimum and maximum costs likely, since this determines the swing available for incentives. Error can be costly to government or contractor.

Contract details are usually complicated. Titan 3 has 330 milestones the contractor must meet in the time phase alone. Total swing in the contract is pro rated into rewards or penalties for meeting or missing key milestones in such time phases, and for other targets in cost and performance areas.

Program definition and incentive contracting unquestionably result in delays in initiating weapon system development, which might be viewed as a drawback. Bannerman feels this delay is offset by the time gained in development because objectives are clearly drawn.

"There is no question it reduces change orders," he said. "The government doesn't get into the details of design as much as before because the contract is written around performance."

Less experience is available on use of the weighted guidelines (AW Sept. 2, p. 60), though much of its content has been government policy for years.

Bannerman said the ASPR directive on weighted guidelines, whose firm statement on profits attracted considerable industry comment, was in fact a restatement of existing ASPR profit policy. As such, it had been honored more in the breach than in observance.

Profit Pressure

Some fear has arisen that the contracting officer may find himself in a difficult position if he negotiates a contract calling for significantly higher profits than have become customary. Bannerman said the newness of the system and its hurdles were recognized in DOD and that support would be provided for the contracting officer. And he added: "They can expect to find themselves in more of a hot spot if they don't follow the guidelines."

Of all the new procedures, the contractor performance evaluation has stirred the most disquiet in industry, especially qualms of the danger of future haunting by ghosts of the past. The pitfalls of lack of objectivity are recognized in DOD. Besides requiring that reports confine themselves to factual statements of results as against contract goals—with allowance for circumstances beyond control of the contractor—review groups are provided in the services charged specifically to ensure that such procedure is followed. Comment by contractors on evaluations also is required.

First evaluations by contracting officers under the system are now in progress and are due by Dec. 31. Sixty days are allowed after that date for military and contractor review before delivery to DOD.

Col. Herbert J. O'Connor, director of the program in DOD, said it was the goal to confine the DOD staff to a specialist in engineering, procurement, and accounting, and to limit review there for consistency and adherence to policy. Eventual goal is a program run by the services, without much interference from DOD.

First year reports will be limited to about 100 contractors, since contracts more than two years from date of original award and with 50% or more of total funds spent were exempted.

No data at all is likely to be available until June 1, 1964, at the earliest, and no significant volume of data is expected for about two years.

Existing equipment and facilities will be used for data storage, but no site has been chosen yet for the data bank. One possible site will be the Defense Documentation Center, the former Armed Services Technical Information Agency that is now part of the Defense Supply Agency Headquarters at Cameron Station, Alexandria, Va.

Initially, data retrieval will provide the entire record of a contractor, since it necessarily will be small. Eventually, the data bank will provide records specifically sought by contract award boards covering only specific contracts, or areas of capability.

Reports will be provided in their original factual form, with no coding or symbol system, or any type of grading.

Aerospace Industry Sales

VALUE OF BACKLOG OF ORDERS, NET NEW ORDERS, AND NET SALES REPORTED BY MANUFACTURERS OF COMPLETE AIRCRAFT, SPACE VEHICLES, MISSILES, AND SELECTED PARTS: SECOND QUARTER 1963

(Millions of dollars)

Type of product or service	Backlog March 31, 1963*	Second quarter 1963: Net new orders[1] Prime contract	Net new orders[1] Subcontract	Net Sales, receipts or billings	Backlog June 30, 1963
TOTAL	13,324	3,572	359	3,919	13,336
United States Government	10,898	3,124	xxx	3,144	10,878
Other customers	2,426	448	359	775	2,458
Complete aircraft and parts, total	5,239	1,102	18	921	5,438
United States Government	3,986	852	xxx	680	4,158
Other customers	1,253	250	18	241	1,280
Aircraft engines and parts, total	1,405	334	7	358	1,388
United States Government	1,053	259	xxx	269	1,043
Other customers	352	75	7	89	345
Missile and space vehicle systems, engines, propulsion units and parts, total	4,376	1,407	101	1,677	4,207
Missile systems and parts (excluding propulsion units):					
United States Government	1,827	727	xxx	797	1,757
Other customers[2]	[3]111	xxx	[3]35	[3]40	[3]106
Space vehicle systems and parts (excluding propulsion units):					
United States Government:					
Military	918	130	xxx	241	807
Nonmilitary	771	165	xxx	181	755
Other customers[2]	(2)	xxx	(2)	(2)	(2)
Engines and/or propulsion units for missiles and space vehicles (including parts):					
Military:					
United States Government	427	286	xxx	231	482
Other customers	160	xxx	54	62	152
Nonmilitary:					
United States Government	122	99	xxx	99	122
Other customers	40	xxx	12	26	26
Other aircraft, space vehicle and missile activities, total[3]	1,263	379	155	560	1,237
United States Government	906	338	xxx	380	864
Other customers	357	41	155	180	373
All other products and services, total[4]	1,041	350	78	403	1,066
United States Government	888	268	xxx	266	890
Other customers	153	82	78	137	176

* Revised. Source—U.S. Commerce Dept.

[1] New orders received during the quarter less terminations during the quarter.

[2] Figures for "Space vehicle systems and parts" for "Other customers" are included with those for "Missile systems and parts" for "Other customers."

[3] Includes all conversions; modifications; site activation; other aerospace products (including drones) and services; and receipts for applied research and development on items such as drones, etc. Receipts for other applied research are included with figures for the respective reporting categories.

[4] Includes all nonaircraft, nonspace vehicle, and nonmissile products and services; and all basic research.

DSA Aerospace Procurement May Grow

Cameron Station, Va.—Aerospace industry contractors may find the Defense Supply Agency becoming a larger factor in their business next year as a result of a study of combined management of aircraft turbine and piston engine spare parts, and aircraft tires.

Following a pilot study of the over-all $10-12 billion, 750,000 item military aeronautical spares inventory in 1962, a more detailed evaluation began early in 1963 of 11 federal supply classes covering 150,000 items with a $5-billion value, all but the one tire category relating to aircraft engines.

The study, by an Army-Navy-USAF team headed by USAF Col. Robert L. Thornton of the Defense Supply Agency, is now in the report preparation stage, following visits to USAF Air Materiel Area centers, Air Force Logistics Command, the Army's Aviation Center at Ft. Rucker, Ala., and the Navy's Aviation Supply Office in Philadelphia.

The report is due to go to Defense Secretary Robert McNamara at the end of January. It will then be submitted to the services and to the Defense Supply Council, making a decision unlikely before spring.

No other area is now under study for consolidated management, but avionics contractors are doing an increasing amount of business through the Defense Supply Agency's Defense Electronics Supply Center at Dayton. This center next April will take over the last classes of an 800,000 item military electronic inventory.

Procurement this year by the Electronic Center—covering such products as resistors, capacitors, transistors, tubes, switches, connectors, relays, antennas, waveguides, solenoids, headsets and handsets—will rise about 20% to an estimated $157 million.

In Fiscal 1963, procurement at the Electronics Center was 85% price competitive, much of it formally advertised, and that figure rose to 88.9% for the first four months of Fiscal 1964.

Procurement is continually under way at the center, though individual buys are often consolidated into packages that can be supplied by companies with multiple product lines.

The Defense Electronics Center buys and manages one of the three basic categories of military hardware:

- **Code A** items are those of unstabilized design or of extreme critical nature, or peculiar to a particular weapon system. These the services buy themselves.
- **Code B** items are repetitively procured stock items, what would amount to catalogue items. These fall into the Defense Supply Agency category.
- **Code C** items are common items, available in most communities, and usually bought locally.

The Defense Electronics Center absorbed the Dayton Air Force Depot, which had managed USAF avionics component buying, at its initial activation, and is now absorbing Navy and Army electronic inventories.

Experience at the Electronics Center in responding to service requisitions has been satisfactory, according to Defense Supply Agency officials. For example, the center, which is tied in to the Air Force automatic data processing system, has been able to meet Strategic Air Command's four-hour requisition response requirement.

Air Force and Army bases requisition directly to the Electronics Center, and items are supplied from Dayton or from a depot at Ogden, Utah. Only Dayton manages procurement, however.

Navy ships and bases generally requisition on Navy Supply centers at Norfolk, Va., or Oakland, Calif., and these in turn order from the Defense Electronics Supply Center. Marine Corps requisition is handled through depots at Barstow, Calif., and Albany, Ga.

The Center uses the Military Standard Requisitioning and Issue Procedure (Milstrip) for distribution and inventory management.

Besides procurement, stocking, and issue, the Electronics Center also has the mission of item reduction and standardization. Net annual growth of 20% in electronic items makes inventory control a costly and proliferating adjunct to the technologically booming avionics field.

The Defense Logistics Services Center, a Defense Supply Agency command at Battle Creek, Mich., maintains the Federal Supply catalogue, and is responsible for screening and locating matches in part numbers.

The Electronics Center has been running its own item control program, with the University of Michigan as subcontractor.

Fourteen Federal Supply Catalogue numbers had been or were undergoing review as of Aug. 30, covering such components as resistors, circuit breakers, fuses, etc. Reduction of 40,695 of the total 102,291 items, 39% in all, has been proposed. Eventually, the 800,000 items the Electronics Center took over from the services may shake down to about 600,000.

Adequate technical description of existing items and of proposed new items is an essential ingredient to duplication, but errors in part number use also are a factor.

Three other areas of Defense Supply Agency operation are of possible interest to the aerospace industry:

- **Industrial production equipment** managed by the Defense Industrial Plant Equipment Center at Memphis, Tenn., which was activated this year. Though it has no procurement mission, this center screens all contractor tooling plans to ensure that existing machinery in government inventory at six storage sites that can fill requirements is used before new tooling is purchased. The center also handles disposal of surplus government machine tools.
- **Industrial and construction supplies.** Not generally considered as aerospace equipment, these do play a role in weapons systems. Of the 95,000 stock items for the Polaris Fleet Ballistic Missile System, including the launching submarine, Defense Supply manages 19,000; of Minuteman's 14,000 stock items, Defense Supply handles 4,000, many for the site portion of the USAF solid-propellant intercontinental ballistic missile; Army's Hawk anti-aircraft missile has 18,000 stock items and Defense Supply furnishes 3,550.
- **Fuel requirements** for military commands are handled by the Defense Petroleum Supply Center.

Defense Supply procurement is widely advertised, much in the Commerce Business Daily published by the Department of Commerce. Contractors can be placed on list for solicitation of bids by writing Defense Supply Centers and filling out required forms. For contractors, pre-award surveys are made prior to contract award, but are not required for bid invitation.

The following list provides addresses of Defense Supply Centers of possible interest to aerospace companies:

Headquarters
Defense Supply Agency
Cameron Station
Alexandria, Va.

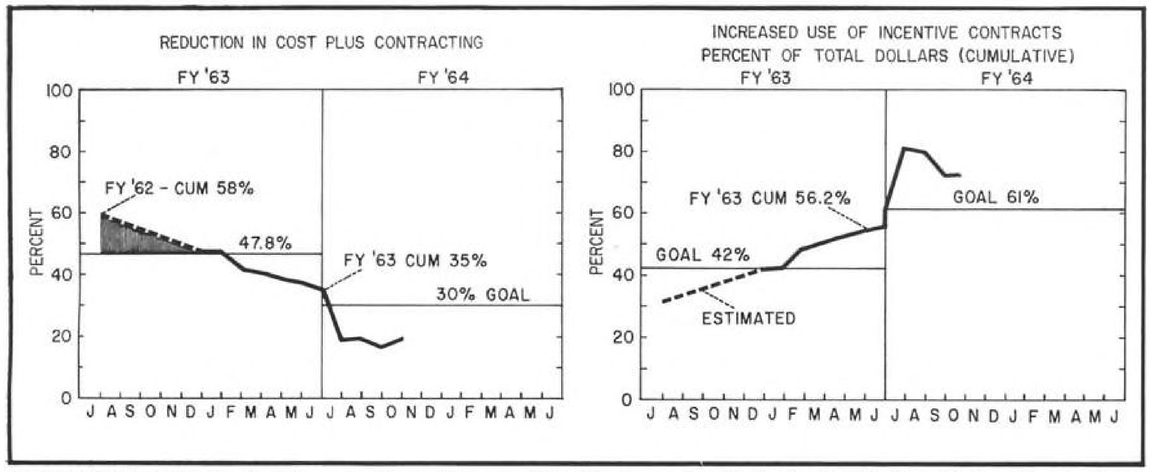
General
Defense General Supply Center
Richmond 12, Va.
Telephone: BElmont 2-3421

Petroleum Products
Defense Petroleum Supply Center
801 19th St., N. W.
Washington 25, D. C.
Telephone: OXford 6-6362

Industrial
Defense Industrial Supply Center
700 Robbins Ave.
Philadelphia 11, Pa.
Telephone: RAndolph 8-1212

Construction
Defense Construction Supply Center
Columbus 15, Ohio
Telephone: BElmont 1-1811
Atlanta Regional Procurement Sub-Office, DCSC
P. O. Box 1889
Atlanta 1, Ga.
Portland Regional Procurement Sub-Office, DCSC
783 Pittock Block
Portland 5, Oreg.

Electronics
Defense Electronics Supply Center
1507 Wilmington Pike
Dayton 20, Ohio
Telephone: 252-6551



REDUCTION IN COST plus fixed fee contracting and increase of incentive types of contracts for the Air Force Systems Command was emphasized in Fiscal 1963 and the first months of Fiscal 1964. Ceiling goal on cost plus contracts (left) and minimum 61% incentive target (right) also are indicated. The two relationships are not completely similar, because of use of some other types of contracts such as fixed price. Goals for Fiscal 1963 were not met until mid-year, but they have been exceeded in both categories initially in Fiscal 1964.

USAF Adapts Contracting to New Climate

Washington—Air Force is translating into a second generation of ballistic missile development and production and is refining its contracting techniques to fit the changing environment.

Even in advanced development areas there is increasing use of incentive contract types. As experience accumulates, the Air Force Systems Command is finding that fixed price contracting can be used in some development areas.

More emphasis is heard on pricing rather than cost as the Jan. 1 date for mandatory use of the new Defense weighted guidelines system nears. Pricing represents the total hardware cost to the government including profit; cost represents that portion of total price that represents costs of the contractor.

The distinction marks a change in government attitude toward the contractor's management role, a tendency to focus on total price control and let the contractor worry about controlling the costs.

Incentive Benefit

USAF Systems Command procurement specialists say that they have seen significant management improvements and cost reductions through incentive contract techniques used so far, and they feel these contracts do give industry opportunity to exercise broader management capability.

While the introduction of the incentive contract types into systems acquisition has attracted more attention and comment, pro and con, the Air Force Logistics Command also has been testing use of such contracting techniques in the support field of aerospace services.

One described by Maj. Gen. Lee W. Fulton, director of procurement and production and Logistics Command, is under way at the San Antonio Air Materiel Area covering overhaul of Curtiss Wright R3350 and Pratt & Whitney R4360 and R2000 piston engines by Aerodex, Inc., Dallas Airmotive, and Spartan Aircraft Co.'s Aviation Services Div.

Failure Rate

Experience has shown that if overhauled engines were going to fail because of defective workmanship, they would fail in the first 100 hr. In the incentive experiment, contractors are delivering engines with 100 hr., minimum guarantees, and they rework at their own expense any engines that fail before this period.

If failure experience rates are improved, the contractor can qualify for a bonus payment.

Results of the test will not be available until early in 1964. Evaluation then, Gen. Fulton said, will determine whether the principle can be applied in a broader field of aerospace services.

Systems Command is working against a set of goals on reduction of cost plus fixed fee contracts and use of cost plus incentive fee or fixed price contracting. The command's Fiscal 1963 target of no more than 48% of appropriations going into cost plus contracts produced an actual limit of about 35%. Goal for Fiscal 1964 is 30%.

Cost-plus contracts are not to be eliminated, however. Study contracts that produce no hardware are one category that does justify such a contract, but Systems Command is insisting on justification for cost-plus use and the burden of proof usually falls on the contractor.

Two other procurement problems are the subject of campaigns in Systems Command:

- **Reduction of letter contracts.**
- **Emphasis on two-step awards** to increase competition.

Letter contracts have been of special concern to Systems Command because it felt is peak $2.4 billion total in Fiscal 1962 compared unfavorably with other services.

The total has since been cut to about $750 million but further reductions are sought.

Various reasons exist for the problem, including inheritance from the previous USAF development and procurement structure. But the problem caused Brig. Gen. Gerald F. Keeling, Systems Command deputy chief of staff for production and procurement, to take industry to task earlier this year on the basis of USAF and Systems Command industry management surveys.

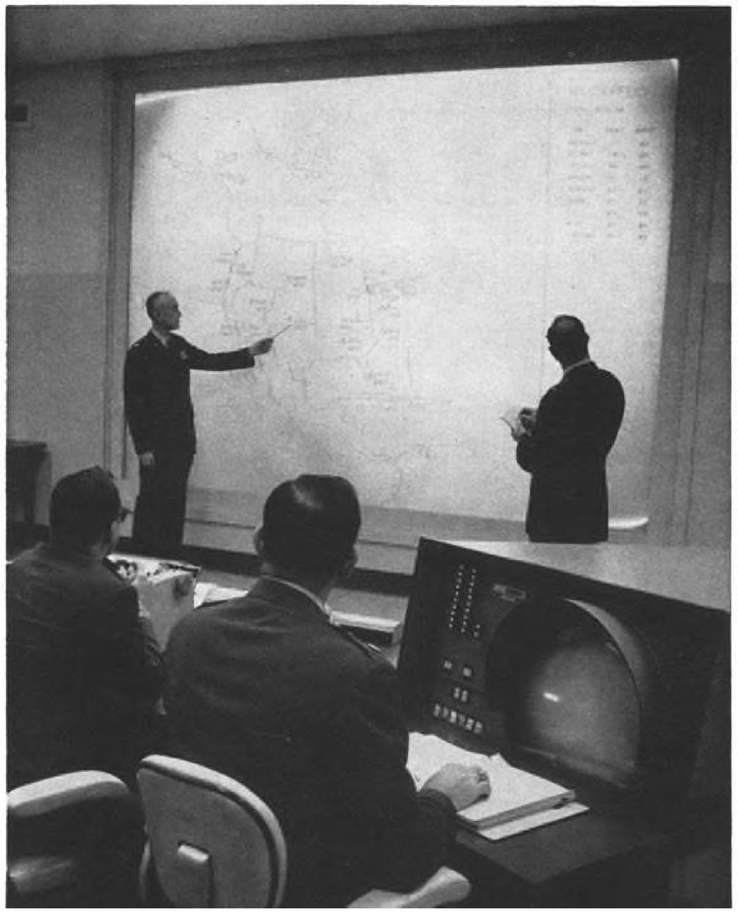
Cost Estimates

"In the functions of estimating costs and of definitizing letter contracts," Gen. Keeling said, "it was found that almost all contractors either did not have adequate methods for developing valid cost data, or else did not make use of the data available to them when



Electronic Command Posts Test Data Concepts

Officers at USAF's Electronic Systems Div., Hanscom Field, Mass., examine display equipment at the division's new Systems Development Laboratory, operated by the Air Force and Mitre Corp. Benson-Lehner plotter (above), tied-in directly to the laboratory's IBM 7030 (Stretch) computer, plots critical data such as satellite trajectories, radar returns and aircraft and missile positions. Large battle-map display (below), also generated by the 7030, can be used to outline defense sectors and status of forces, updated by computer.



preparing estimates. Almost always there was inadequate correlation between cost proposals and records of actual cost experience.

"Our general lack of confidence in industry cost estimates has contributed to the prolonged negotiation and delays we experience in definitizing letter contracts."

Systems Command is expanding its use of two-step procurement, both two-step formally advertised and two-step negotiated procurements. The former applies to more standardized items and leads generally to a fixed price contract. The latter would entail more development and some form of cost incentive contract.

Systems Command awarded $50 million in contracts in Fiscal 1963 and has a goal of $123 million in Fiscal 1964 using this procedure, which calls for submission of technical proposals first, and later price competition among those offering successful technical proposals.

Patrick AFB, Fla., has been a big user of this system for procurement of Atlantic Missile Range hardware. Electronic Systems Div. has an internal goal of awarding 50% of all procurement through two-step procedures.

Avionic hardware lends itself better than some other weapon system areas to this technique, because even in cases of specialized hardware, it often can be assembled from catalogue type or previously developed components.

Increasing price competition as part of DOD's cost reduction campaign can be done relatively easier at Aeronautical Systems Div. and Electronic Systems Div. than it can at Ballistic Systems Div. or Space Systems Div., Systems Command is finding. Obstacles are especially apparent at Ballistic Systems Div., where the bulk of funding is for one program, the Minuteman intercontinental ballistic missile.

Use of a break out program is being tried on Minuteman where certain components are put out again for competitive bidding. Even if a better price results, however, the saving may be illusory. Besides the costs entailed in holding the new competition, the care and feeding of a new item in the USAF inventory can more than offset the lower price.

Systems Command is testing a new type of cost plus contract, which National Aeronautics and Space Administration also is using, known as the cost plus award fee. This contract is handled much like a cost plus fixed fee contract, but there is provision for convening of a board after completion which can provide extra reward—though no penalty—if the contractor has achieved significant results through innovation, good management techniques, initiative, and the like.

Three such contracts are in effect now through Electronic Systems Div. No more will be written until these are evaluated, because they could pose administrative complications if they were used on a wide scale. Convening of the boards alone, which include representatives of the using command, contracting agency, and from Systems Command headquarters, could become a time and manpower consuming task.

Contractors interested in bidding on Systems Command programs can be placed on request for proposal lists by writing to the command's headquarters or buying activities and filling out AFSC Source Form 220. Companies can specify one or more capabilities in the Command's list of 843 technical areas of interest.

Some of these areas have vast numbers of companies listed, and in these cases Systems Command tries to rotate companies for solicitation. Other areas have only a few and some not any.

The following list gives addresses of Major Systems Command buying activities:

AIR FORCE SYSTEMS COMMAND

Headquarters, Air Force Systems Command, Andrews AFB, Washington 25, D. C.
Contractor Relations and Sources: Mr. Leroy E. Olson
Mail Office Symbol: SCKP-3
Telephone: Area Code 301—981-6331/981-3288

Electronic Systems Division, L. G. Hanscom Field, Bedford, Mass.
Contractor Relations, Sources, and Small Business Office: Mr. John Condon
Mail Office Symbol: ESKB
Telephone: Area Code 617-274-6100, Ext. 2244
Interests are: Complete acquisition program for electronic systems.

Aeronautical Systems Division, Wright-Patterson AFB, Ohio
Contractor Relations, Sources, and Small Business Office: Mr. George Rattenbury
Mail Office Symbol: ASKS
Telephone: Area Code 513-253-7111, Ext. 39250
Interests are: Complete acquisition program for aeronautical systems and applied research in guidance systems for aircraft and missiles, etc., flight control, propellers and rotors, testing, including aerodynamic structural and environmental tests. Powerplants, ground equipment, aeromedical equipment (aerial reconnaissance), airborne equipment, aeromedical equipment, human factors research, airborne electronics equipment, materials, aeronautical science research, including chemistry, mathematics, physics, fluid dynamics, mechanics and systems dynamics.

Aerospace Medical Division, Brooks AFB, Tex.
Contractor Relations: Sources, and Small Business Office: Mrs. Mildred Gibbs
Mail Office Symbol: AMKB
Telephone: Area Code 513—532-8811, Ext. 23202
Interests are: Life sciences, human factors, aerospace medicine, biosciences, biomedicine, behavioral sciences, space medicine, biotechnology, human engineering, human resources, aviation medicine and space biology.

Space Systems Division, AF Unit Post Office, Los Angeles 45, Calif.
Contractor Relations, Sources, and Small Business Office: Mr. Roy A. Watkins
Mail Office Symbol: SSKB
Telephone: Area Code 213—670-1444, Ext. 2414
Interests are: Acquisition of space vehicle systems and their components.

Ballistic Systems Division, Norton AFB, Calif.
Contractor Relations, Sources, and Small Business Office: Mr. L. R. McGary
Mail Office Symbol: BSKB
Telephone: Area Code 714—889-4411, Ext. 8553
Interests are: Acquisition of ballistic missile systems and their components

Air Force Flight Test Center, Edwards AFB, Calif.
Contractor Relations, Sources, and Small Business Office: Mr. J. A. Beucherie
Mail Office Symbol: FTKB
Telephone: Area Code 805—258-2111, Ext. 24151
Interests are: Testing of new aircraft systems, research aircraft, aircraft components, flight test instrumentation, rocket propulsion and parachutes.

Air Force Special Weapons Center, Kirtland AFB, N. M.
Contractor Relations, Sources, and Small Business Office: Mr. M. H. Nickerson
Mail Office Symbol: SWKB
Telephone: Area Code 505—247-1711, Ext. 2917
Interests are: Research, development, test, and evaluation of Air Force components of equipment related to atomic weapons.

Air Force Missile Test Center, Patrick AFB, Fla.
Contractor Relations, Sources, and Small Business Office: Mr. Charles C. Furtado
Mail Office Symbol: MTKSA
Telephone: Area Code 305—857-7545
Interests are: Test range instrumentation involving radar, trajectory computers and recorders, tracking and target analysis, wire communications, radio communications, programming timing and firing systems, telemetry receiving, data storage, data separation and presentation, optics and telemetry data reduction.

Rome Air Development Center, Griffiss AFB, N. Y.
Contractor Relations, Sources, and Small Business Office: Mr. John Vella
Mail Office Symbol: RAKS
Telephone: Area Code 315—336-3200, Ext. 5220/74166
Interests are: Radar communications, navigation, electronic warfare, intelligence, support equipment for radar and communications, specialized support, including human engineering and technical writing, guided missiles, including aerodynamics and ballistic guidance control, handling and launching and propulsion

Air Proving Ground Center, Eglin AFB, Fla.
Contractor Relations, Sources, and Small Business Office: Mr. J. V. Leftwich
Mail Office Symbol: PGKS
Telephone: Area Code 305—EGlin 67-2845
Interests are: Research, development, test and evaluation of guns and other aircraft weapons, ammunition, rockets, bombs, and fire control components and systems.

Air Force Missile Development Center, Holloman AFB, P. O. Box 393, N. M.
Contractor Relations, Sources, and Small Business Office: Mr. D. P. Hathcock
Mail Office Symbol: MDKB
Telephone: Area Code 505—473-6511, Ext. 46861
Interests are: Guided missiles—conduct of research and development of guided subsystems and components. R&D in the field of human factors, including biodynamics and space biology. Execute Air Force responsibilities incident to the operation of the proving ground, including operation of special instrumentation in direct support of the Center mission.

Arnold Engineering Development Center, Arnold Air Force Station, Tennessee
Contractor Relations, Sources, and Small Business Office: Mr. Joseph Moriarty
Mail Office Symbol: AEKS
Telephone: Area Code 615—455-2611, Ext. 509
Interests are: Aerodynamics, research and development of power plants related to operation and test of air breathing propulsion systems; i.e., turbojet, ramjet, and turboprop. Problems associated with high temperature materials and unique mechanical, electrical and thermodynamic problems all related to the construction of large and complex engine test facilities and wind tunnels involving heavy construction of complicated machinery and associated ducting.

Supply and maintenance of Air Force weapons systems after they become operational is the responsibility of the Air Force Logistics Command. The command and its major buying establishments:

AIR FORCE LOGISTICS COMMAND

Headquarters,
Wright Patterson AFB, Dayton, Ohio.

Middletown Air Materiel Area
Olmsted Air Force Base
Middletown, Pennsylvania
ATTN: Contractors Relations and Small Business Office
Tel: 717—944-5521
Interest areas include: Parachutes and aerial pickup, delivery, and cargo tie-down equipment; laundry and dry cleaning equipment; shoe repairing equipment; industrial sewing machines; wrapping and packaging machinery; miscellaneous service and trade equipment; navigational and flight instruments; automatic pilot mechanisms and airborne gyro components; engine, time measuring, optical, geophysical and astronomical, drafting, survey, and mapping, liquid and gas flow, liquid level, and mechanical motion measuring, pressure, temperature and humidity measuring and controlling instruments; chemicals dyes; gases, compressed and liquified; pest control agents and disinfectants; miscellaneous chemical specialties; food preparation and serving equipment; kitchen equipment and appliances, hand tools, utensils, cutlery, and flatware; tableware; food preparation and serving sets, kits, and outfits; gas cylinders; textile fabrics, yarns, notions, padding and fur material; tents and tarpaulins; special purpose clothing; men's outerwear, underwear and nightwear, footwear; luggage; individual equipment; solid fuels; liquid propellants, fuels, and oxydizers; oils and greases, cutting, lubricating, and hydraulic.

Mobile Air Materiel Area
Brookley Air Force Base
Mobile, Alabama
ATTN: Contractors Relations and Small Business Office
Tel: HE 8-6011, Ext. 3227
Interests include: Aircraft arresting, barrier, barricade, launching, ground servicing equipment; airfield specialized trucks and trailers; gas turbines and jet engines (except aircraft); miscellaneous engine accessories (aircraft); aircraft maintenance and repair shop specialized equipment; miscellaneous maintenance and repair shop specialized equipment.

Rome Air Materiel Area
Griffiss Air Force Base
Rome, New York
ATTN: Contractors Relations and Small Business Office
Tel: FF 6-3200, Ext. 74205
Interests include: Telephone and telegraph, teletype and facsimile equipment; ground radio and television communication, & radio navigation equipment; ground intercommunications and public address systems; sound recording and reproducing equipment; ground radar equipment; underwater sound equipment; visible and invisible light communications systems; miscellaneous communication equipment (ground countermeasures, radio, radar); headsets, microphones, and speakers; electric hardware and supplies; cable, cord and wire assembly (communication equip.); electrical control equipment; transformers, distribution, and power station; electrical rectifying equipment, wire and cable, batteries.

San Antonio Air Materiel Area
Kelly Air Force Base
San Antonio, Texas
ATTN: Contractors Relations and Small Business Office
Tel: WA 3-5411, Ext. 64192
Interests include: Atomic ordnance; miscellaneous aircraft accessories and components; aircraft engine and fuel systems components and engine electronic systems components; electric motors and converters; vehicle and aircraft lights and fixtures; hazard detecting instruments and apparatus.

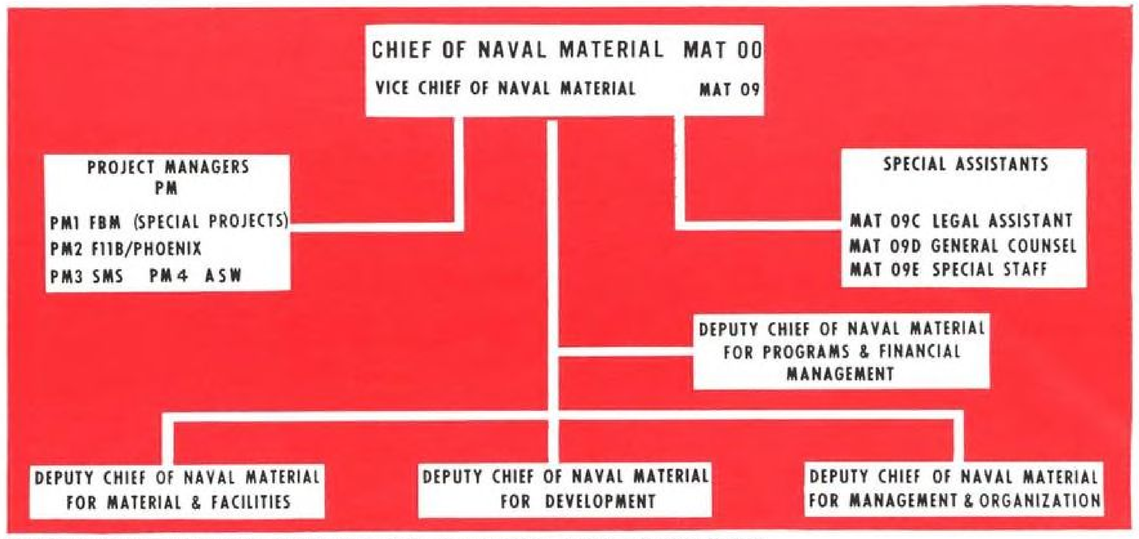
Warner Robins Air Materiel Area
Robins Air Force Base
Macon, Ga.
ATTN: Contractors Relations and Small Business Office
Tel: 926-2208, Ext. 63549
Interests include: Pneumatic tires and tubes; bearings; decontaminating, impregnating, safety and rescue equipment; centrifugals, separators; pressure and vacuum filters; driers, dehydrators, anhydrators—thermal; air purification equipment.

Ogden Air Materiel Area
Hill Air Force Base
Ogden, Utah
ATTN: Contractors Relations and Small Business Office
Tel: TA 5-1641, Ext. 5225
Interests include: Ammunition and explosives; landing shocks and struts; aircraft wheels and brakes; pneumatic aircraft tires and tubes; ammunition maintenance and repair shop equipment; guided missile maintenance, repair, and check-out specialized equipment; training aids; armament training devices; operational training devices; communication training devices; boxes, packages, special containers (ammunition, explosives only).

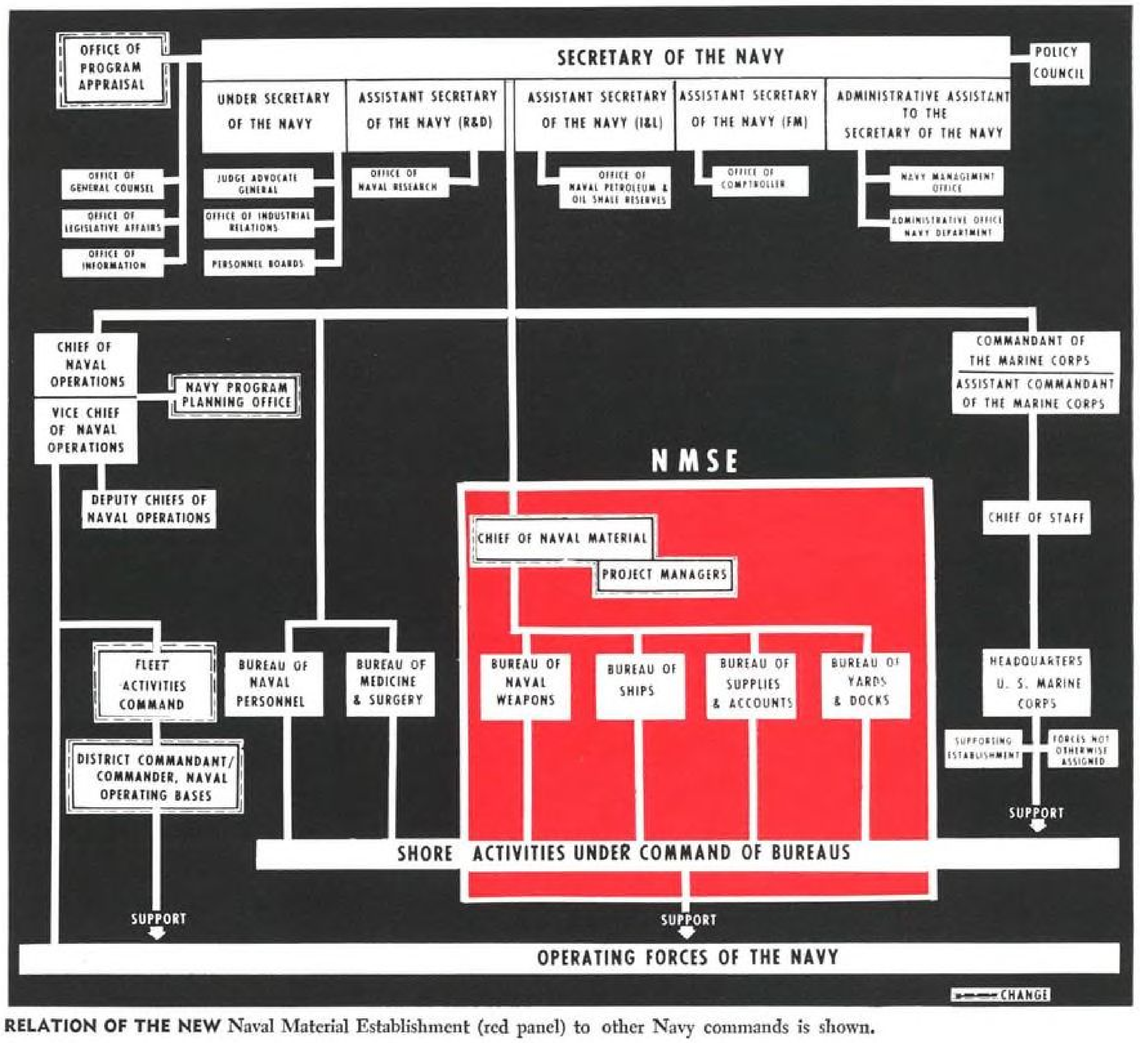
Oklahoma City Air Materiel Area
Tinker Air Force Base
Oklahoma City, Okla.
ATTN: Contractors Relations and Small Business Office
Tel: PE 2-7321, Ext. 2601
Interests include: Hydraulic vacuum and deicing system components, aircraft; air conditioning, heating, pressurizing equipment, aircraft; engine fuel sys. comp., aircraft; engine cooling sys. comp., aircraft; engine air and oil filters, strainers and cleaners, aircraft; spare parts for certain aircraft and engines.

Sacramento Air Materiel Area
McClellan Air Force Base
Sacramento, Calif.
ATTN: Contractors Relations and Small Business Office
Tel: WA 2-1511, Ext. 26219
Interests include: Tanks, aircraft auxiliary fuel; pylon assemblies, drop tank; generators and generator sets (gasoline and diesel engine driven); spare parts for certain aircraft.

San Bernardino Air Materiel Area
Norton Air Force Base
San Bernardino, Calif.
ATTN: Contractors Relations and Small Business Office
Tel: TU 9-4411, Ext. 26169
Interests include: Guided missile components for Atlas, Thor, and Titan—guided missile remote control systems; launchers; guided missile handling and services equipment; guided missile maintenance; repair and checkout space equipment. Rocket engines and components for Aerojet General components and Rocketdyne Division. Contract for repair, modification, and overhaul of aerospace ground equipment.



OFFICE OF THE CHIEF of Naval Material includes four deputies covering functional areas.



RELATION OF THE NEW Naval Material Establishment (red panel) to other Navy commands is shown.

Navy Activates Single Buying Command

Washington—Activation of the Naval Material Support Establishment this month ended the autonomous procurement roles of the Navy's functional bureaus.

Existence of the bureaus continues, under command of Vice Adm. William A. Schoech, Chief of Naval Material. As head of the Material Support Establishment, Adm. Schoech will now serve as the single spokesman for and contact point with the resource elements of the Navy.

Creation of the new command was not without dissent within the Navy. The step was recommended by the Dillon Board, headed by John Dillon, administrative assistant to the Secretary of the Navy, which was appointed by the Secretary in 1962 to review the management of the Department of the Navy.

The report itself echoes differing Navy viewpoints, for Adm. Claude Ricketts, vice chief of Naval Operations and a member of the board, opposed the establishment of the Material operation in a minority position published in the report. He later withdrew his opposition after some changes in the recommendations were made by the Navy Secretary.

Material Plan

Among the arguments advanced for the Material plan was that it would provide a clearly marked entrance door to the department for industry. But the predominant management reasons cited were that:

- **User interest** in the Navy had voices in the Chief of Naval Operations and commandant of the Marine Corps, but no such voice existed for resource interest.
- **Shortcomings were reported** in management of major weapons systems by the functional bureaus. Development of a lead bureau system to provide sufficent project authority to cross bureau lines, while helpful, was not felt to be an adequate answer.
- **Interface problems** among the bureaus could not be resolved except at the secretarial level.
- **Response to Defense Dept.** cost effectiveness requirements was not considered adequate. Furthermore, financial systems of Navy's functional procurement and development bureaus were not compatible in many cases with DOD's program budgeting system.

Adm. Ricketts' objections to the creation of a Chief of Naval Material were that the system would add an administrative layer between the bureaus and the Secretary of the Navy and the Chief of Naval Operations.

Either the office would become a clerical one for processing papers, Adm. Ricketts said, or it would require a large staff of technical and procurement experts. To be effective as a single point of contact, the new office would have to get into broad management functions, and the bureaus would consequently cease to function except in name, he contended.

Principal interface problems lay between the Bureau of Weapons and Bureau of Ships. Adm. Ricketts contended that people, not organizations, would have to solve these. As alternatives, he favored strengthening the lead bureau system, and expanding the project management concept.

Paradoxically, creation of the Material Support Establishment closely followed the majority recommendations of the report—except that adoption of the project manager system is proceeding much more conservatively than the report proposed.

Thirty programs were suggested by the report as suitable for program management, a third at the Chief of Naval Material level and the others at bureau level. Only four top level programs have in fact been established:

- **Fleet Ballistic Missile,** designated PM1 and commanded by Rear Adm. I. J. Galantin, who has been heading the existing Special Projects Office for the Polaris Missile.
- **F-111B/Phoenix missile,** designated PM2 and commanded by Capt. Aubrey R. Seiler.
- **Surface Missile Systems,** the Talos, Terrier, Tartar, Typhon anti-aircraft weapons, designated as PM3 and commanded by Rear Adm. Eli T. Reich.
- **Anti-submarine Warfare Systems,** designated PM-4 and commanded by Rear Adm. Joseph A. Jaap.

Here again the actual organization differs with the initial report, which commented that, because of the all-pervading nature of anti-submarine warfare, it would not be practical to assign a project manager to have responsibility for all research, development, and production in this area.

Navy approach to the project system, probably will continue to be conservative, for there is feeling that the pendulum effect in management technique enthusiasm may have carried this system farther than necessary. As a result, relatively more project managers at the deputy or bureau level and fewer at the top can be expected.

Actual organization of the office of the Chief of Naval Material consists—besides the designated project managers and special assistants—of four deputy chiefs, who are essentially opposite numbers of the civilian assistant secretaries. The Material deputies are responsible for programs and financial management, material and facilities, development, and management and organization, respectively.

Reporting to the Chief of Naval Material are the Bureaus of Naval Weapons, Ships, Supplies and Accounts, and Yards and Docks. Two other bureaus—Naval Personnel and Medicine and Surgery—were not incorporated into the Material establishment.

"The Office of Naval Material will be like a corporate headquarters," Adm. Schoech has said, "and, following that pattern, will control the bureaus without operating them. Each of the deputies will be charged with recommending policy and monitoring performance within the areas assigned. We will be concerned principally with the 'what' and 'when' of the Bureau's activities, but not so much with the 'how'."

Fleet Needs

Equipment needs of the fleet will continue to be stated by the Chief of Naval Operations as the spokesman for the using operating forces. In response to such a request, the Material Establishment will reply as to the feasibility of development.

No explicit responsibility is provided to mediate any disagreements in these two areas, which thus would go to the secretarial level if they could not be resolved otherwise.

These planning responsibilities and authorities are considered more clear cut than those of phases later in the cycle, and the unresolved questions and areas become foggier toward the end.

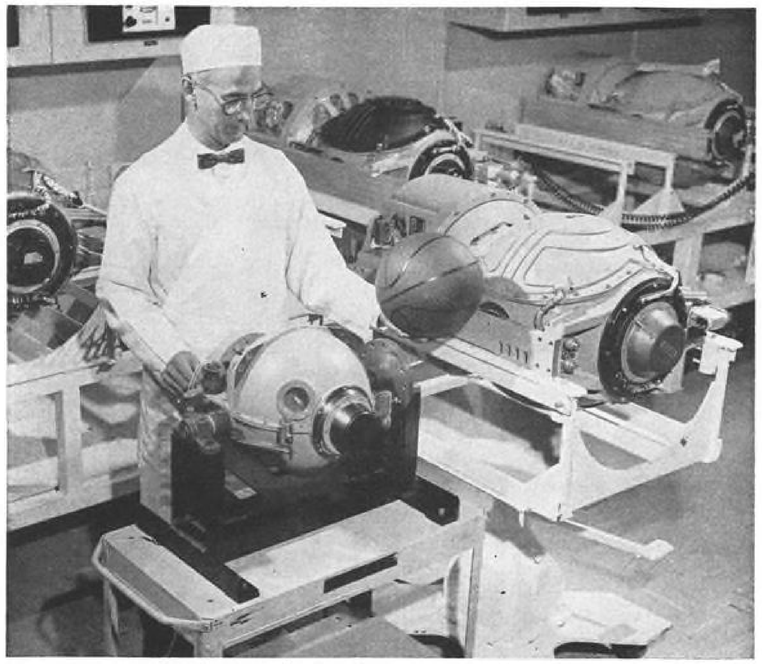
The Chief of Naval Operations in programming selects the work to be done on the basis of results of two steps in the planning phase. Performance of the work then is the sole responsibility of the Chief of Naval Material in the execution phase.

In the appraisal phase, each has equal level responsibilities and authority and it is here that the jurisdictional questions mainly arise. Both commanders review the work:

- **Chief of Naval Operations** for readiness and military worth.
- **Chief of Naval Material** for progress and efficient use of resources.

Implication of these dual responsibilities is that both commands conceivably might have personnel in the contractor's plant, for example, but this and similar detail functions are not yet settled. Experience may resolve some, but others may go to the Secretary's staff level for decision.

No final decision on many of these



Polaris A-3 Guidance System

Guidance system (left) developed for the A-3 Polaris, the 2,500-mi. fleet ballistic missile, compares in size with basketball held by technician at General Electric's Ordnance Dept., Pittsfield, Mass. Assembly in background is GE guidance system for earlier Polaris. The all-inertial system guided an A-3X Polaris in its first successful firing from a submerged submarine off Cape Canaveral Oct. 26 (AW Nov. 4, p. 32). A total of 40 research and development firings of the Polaris A-3 is planned in the missile test program.

areas will be made until all affected commands have their statements of mission and responsibilities on file with the secretarial staff. This has been completed by the Material Establishment as part of its pre-activation planning.

Some functions now performed by the chief of Naval Operations are considered as falling into the chief of naval material's province, but there is the problem of transferring the personnel from one department to the other department for performance of the work.

Adm. Schoech carried out the merger of the former Bureaus of Aeronautics and Ordnance into the Bureau of Naval Weapons. Consequently, his experience in detail advance planning is being applied in the new Material Establishment.

Procurement contacts with the Navy will not be changed as a result of the reorganization, at least initially. The following list includes major buying sources of the Department of the Navy. Though not listed here, inspectors of Naval Material at various plants and offices in the U. S. may also have some role in procurement, in subcontracting activities on large prime contracts, for example.

DEPARTMENT OF THE NAVY

Chief, Bureau of Naval Weapons, Department of the Navy, Washington 25, D. C.
Airframes, aircraft engines (jet and reciprocating), propellers, electronic equipment, aircraft armament target drones, ground handling equipment for aircraft, guided missiles, fire-control equipment (including radar), naval guns, gun mounts, missile launchers, torpedoes, mines, depth charges, nets and booms, aviation ordnance.

Chief, Bureau of Ships, Department of the Navy, Washington 25, D. C.
Ships and other watercraft, including hull and machinery (propulsion and control equipment);* electronic equipment, including radar, radio and other communications equipment and accessories; refrigeration equipment and laundry equipment for shipboard use.

Chief, Bureau of Yards and Docks, Department of the Navy, Washington 25, D. C.
Floating dry dock* and floating cranes;* major boiler plants and electrical generators; public utilities services and permanent facilities (including acquisition and disposal of real estate). This Bureau is responsible for the Navy's construction project, as well as station maintenance and repair. Contracts for such project, however, are let through the District Public Works Offices.

The Quartermaster General Headquarters, U. S. Marine Corps, Department of the Navy, Washington 25, D. C.
Automotive spare parts, engineering equipment and supplies, electronic equipment and spare parts, refrigeration and air-conditioning equipment, household supplies, galley equipment, and laundry equipment.

Officer in Charge, Navy Purchasing Office, Temporary Bldg. D, 4th St. and Independence Ave., S. W., Washington 25, D. C.
Machine tools, materials handling equipment,* air conditioning and refrigeration equipment, ferrous metal basic shapes and forms; also general procurement for naval activities in the area.

Officer in Charge, Navy Purchasing Office, 3d Ave. and 29th St., Brooklyn, New York, N. Y.
Insecticides,* waxes, precision instruments (navigational, optical, electrical-measuring), ecclesiastical items,* silverware (officers' mess gear),* rope, cordage, twine and vegetable fibers; also general procurement for naval activities in the area.

Commanding Officer, Aviation Supply Office, 700 Robbins Avenue, Philadelphia 11, Pa.
Aircraft spare parts, aeronautical instruments, aeronautical electronic equipment, paints and related products, clocks,* marine hardware, life saving equipment.

Commanding Officer, Electronic Supply Office, Great Lakes, Ill.
Electronic maintenance and repair parts in support of existing Navy electronic equipment.

Commanding Officer, Ships Parts Control Center, Naval Supply Depot, Mechanicsburg, Pa.
Spare parts for shipboard equipment—gasoline engines, Diesel engines, hull equipment, machinery components, searchlights, gyrocompasses and dead-reckoning equipment, navigation equipment.

Commanding Officer, Yards and Docks Supply Office, Naval Construction Center, Port Hueneme, Calif., Hueneme, Calif.
Tires, tubes, and retreading material; automotive repair equipment; building materials; prefabricated buildings;* Navy landing pontoons and propulsion units; electrical generating equipment; refrigeration equipment; station and utility repair parts, chemicals.

Commanding Officer, Fuel Supply Officer, Naval Gun Factory, Washington 25, D. C.
Coal and other solid fuels.*

Commanding Officer, Naval Ordnance Supply Office, Mechanicsburg, Pa.
Repair parts for ordnance equipment.

The following have procurement responsibilities of a special nature:

Chief, Bureau of Supplies and Accounts, Department of the Navy, Washington 25, D. C.
Exercises management control over the field purchasing activities (including all of those listed above except the technical bureaus and the Marine Corps) and technical control over such items as food, clothing, and textiles; common-use building materials; and products and services used in connection with the packaging, transportation, and storage of supplies (including materials handling equipment). Inquiries relating to policy matters covering these items may be addressed to this Bureau.

Chief, Bureau of Navy Personnel, Department of the Navy, Washington 25, D. C.
Responsible for procurement of training services from educational institutions and of training publications and aids.

Chief of Naval Research, Department of the Navy, Washington 25, D. C.
Responsible for basic research, including fundamental studies in such fields as electronics, chemistry, and physics, and serves to coordinate the research programs of the technical bureaus.

Commanding Officer and Director, Naval Training Devices Center, Port Washington, Long Island, N. Y.
Responsible for the development and procurement of training aids and devices for Navy Personnel.

Commanding Officer, Navy Ships Store Office, 29th Street and Third Avenue, Brooklyn 32, N. Y.
Purchase supplies, equipment, and merchandise for use or resale in Navy Exchanges throughout the world. Directs and procurement of supplies, equipment and resale merchandise for Navy Ships Stores (ashore and afloat) and Commissary Stores which are contracted for on a national, regional, or local basis by the individual stores or by Navy Purchasing Offices at this same address. Local Navy Exchanges, Commissary Stores and Ships Stores do most of their own purchasing and may be contacted for additional information. The same rules and regulations which govern purchases of supplies and services are applied to Ships Store and Commissary Store purchases, whether for use or for resale. These activities are operated under appropriated funds. However, since the Navy Exchanges are operated entirely under nonappropriated funds, separate legislation and regulations govern this purchasing operation which is more comparable to private commercial practice.

Commanding Officer, Navy Clothing and Textile Office, U. S. Naval Supply Activities, 29th Street and Third Avenue, Brooklyn 32, N. Y.
Determines requirements for standard articles of the naval uniform and special clothing for climatic protection. This office can furnish information concerning specifications and requirements.

* Purchased for all military departments in accordance with single service procurement assignment.



ARMY is beginning procurement of the Sikorsky S-64 Flying Crane, capable of lifting a useful load of 10 tons. The helicopter, powered by two JFTD12-A turboshaft engines, is shown taking off with a new troop carrying van at Ft. Benning, Ga. Civil certification limited the demonstration to 55 passengers, but there are seats for 68, or, alternatively, space for 48 litters.

Army Studies Procedure Standardization

Washington – Basic organization of the Army Materiel Command has emerged intact from its initial year of operational existence, but study is under way of realignment or standardization of its procurement, supply and distribution procedures.

Defense Dept.'s Project 60 is providing part of the impetus for the procurement structure examination, though this study is aimed at elimination of varying post-award contract management procedures of all the services.

Because of its relatively recent organization as the single service for all Army procurement of hardware ranging from off-the-shelf components to advanced missile and aircraft systems, the Army Materiel Command is faced as well with internal standardization problems.

Each of the former technical services, which the Materiel Command superseded, had its own methods for filling requirements.

No organization alteration is projected next year for the command, its commanding general, Lt. Gen. Frank S. Besson, Jr., said, but 1964 is likely to see revision of procurement structure.

Creation of the single Army Materiel Command went farther into development and procurement consolidation than top Defense Dept. officials felt advisable at the time.

Two major tasks confronted the command as a consequence as soon as it became operational in August, 1962:

• **Command control.** Both new elements and cut-outs from existing functional commands were incorporated into the new Materiel Command. These had to be shaped quickly into a working organization.

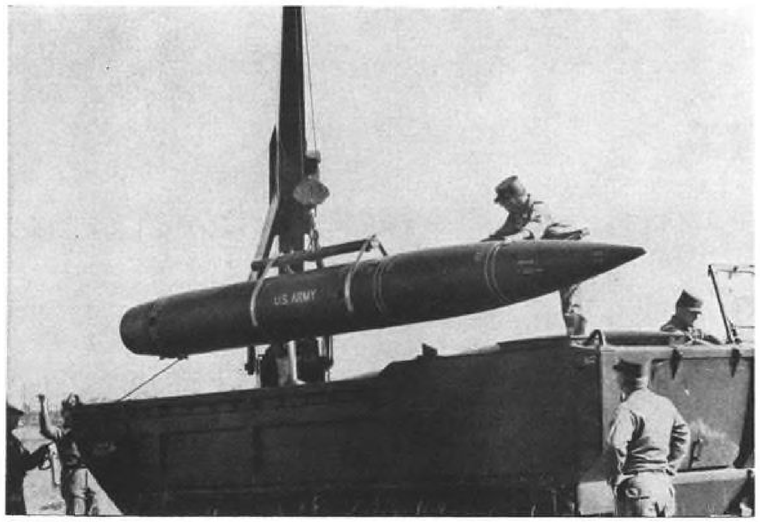
• **Continuity of operation.** Despite the disruption of the former technical command structure, the ability to perform the procurement and development function had to continue unbroken.

"We're still alive," Gen. Besson now says. But he feels the honeymoon period is over, the period in which DOD tended toward charitableness out of sympathy for the task faced by the command.

On top of its birthing pains, the new command had to digest the adoption of



VIETNAMESE troops, using a rubber raft, lighten an Army H-21 forced down in a rice paddy until an H-37 used as a flying crane can remove it. Soldier at right watches for Viet Cong attack. H-37s in Vietnam are a detachment of the 19th Transportation Company which is based in Korea.



DEMONSTRATION of Army's Lance missile using a full scale engineering mockup includes loading into its self-propelled, lightweight launcher. Army Materiel Command has established a project office for the Ling-Temco-Vought program.

the project manager system early in its life—and a relatively large project list that has run to 30-35 projects since. Again the Army went more extensively to the system than the Air Force had, or the Navy now is doing.

The most serious fears about the project manager system, Gen. Besson said, were that:

• **Such large numbers** of managers could not be giving instructions across the board without confusion or collision.

• **Normal functional operations** would be weakened.

Despite some over-exuberance on the part of managers, the system has shown initial promise, Gen. Besson said. Industry's reaction has been generally favorable, if for no other reason than it has eliminated staffing and simplified the decision-making process.

Projects are monitored through the Materiel Command's so-called PM_3P system, Project Management Monitoring Program. Under this system, a master plan with milestones is laid out for the year, and is reviewed at that time by the Command's functional staff. There is no formal staffing after that point. Project managers report directly to their designated operating superiors—Gen. Besson himself for about half the existing projects.

Even with these direct and simple internal command relationships, Army project management can become circuitous in the aerospace field.

In the case of the Vertol CH-47A Chinook heavy twin-turbine helicopter, the Army project manager deals with USAF's Chinook System Program Office at the Air Force Systems Command's Aeronautical Systems Div. at Wright Patterson AFB, Ohio, on all contractual matters. And the Vertol plant at Morton, Pa., is under Navy cognizance.

Army helicopter development and procurement interest, however, led this year to Army's first assumption of plant cognizance at an aircraft plant. This is Bell Helicopter's Ft. Worth, Tex., facility, where Army is the principal customer for the UH-1 Iroquois single turbine helicopter family.

Most recent addition to the Materiel Command's project manager list, made this year, is for a successor to the UH-1. Designated the Fire Support Aerial System, it calls for development of a system to provide the most efficient, responsive fire support aircraft for the ground soldier. It will be the first Army aircraft to go through a Program Definition Phase prior to award of a development contract, and to utilize the PERT-Cost management technique.

One new contracting technique where Army is pioneering is in multi-year procurement. Three such buys were made this year, and 10 are projected for next year.

Whether aerospace equipment will lend itself to such buying is open to question, however. Among the criteria for multi-year purchase are stable, substantial, long-term requirements for periods of two years or more, and stable design.

So far, multi-year procurement has included standard industrial type gasoline engines, with three-year requirements estimated at 53,292 engines; 5-ton trucks, with two-year requirements of 8,393 units, and engines for these trucks whose two-year requirements called for 9,176 units.

Savings estimated ranged from 9% for the industrial engines to ¼ of 1% for the trucks. Advantage of the system is, for one, it offers manufacturers an incentive to invest in tooling and commit plant capacity for defense production. To ensure against cancellation problems, a ceiling for cancellation charges is established, and funds to cover ceiling costs are authorized along with initial program funds.

Army was a late starter in DOD's incentive contract program, but by the end of Fiscal 1963 it had awarded 106 incentive type contracts with a $1.1-billion total value. Twenty-eight such contracts with a value of $200 million were awarded during the first three months of Fiscal 1964.

Letter contracts are being reduced to a handful. Only nine letter contracts out of 51 awarded in Fiscal 1963 by the Materiel Command remained to be definitized at year end, and the year's total was half that of Fiscal 1962. This year only eight letter contracts have been awarded, compared with 12 for the same period in Fiscal 1963.

Procurement specialists at the Army Materiel Command are showing preference for the two-step, competitive procurement in which technical proposals are evaluated first, and all those meeting technical objectives then go through price competition.

"This matter of competition is proving itself to me every day," Maj. Gen. E. J. Gibson, director of procurement and production for the Materiel Command, said.

"When you have good drawings and good specifications, competition gives the government a better price and a better product."

Five of the Army Materiel Command's seven subordinate commands have procurement functions. Those of primary interest to aerospace companies, together with their aeronautical and missile subdivisions are listed below.

For example, the Army Mobility Command's Transportation Research Command at Ft. Eustis, Va., and Transportation Materiel Command at St. Louis, can play important roles in development as well as procurement of helicopters.

ARMY MATERIEL COMMAND

Army Mobility Command
Warren, Mich.

Commanding Officer
U. S. Army Engineering R&D Lab.
ATTN: Dir. Procurement & Production
Ft. Belvoir, Va.

Typical R&D programs: Fuel cell research catalysts, studies, data system for optical evaluation complex study, study of power distribution techniques.
Typical end item procurement: materials, equipment and supplies used for research, development, tests and evaluation in R&D programs.

Commanding Officer
U. S. Army Transportation Research Command
ATTN: Dir. Procurement & Production

Typical R&D programs: aircraft: Design, propulsion, instrumentation, structures, etc., fluid mechanics, ground surface transportaton, marine and amphibious research.
Typical end items procurement: materials, equipment and supplies used in research, development, tests and evaluation in R&D programs.

U. S. Army Aviation and Surface Materiel Command

Commanding Officer
ATTN: Dir. Procurement & Production
12th & Spruce Streets
St. Louis, Mo.

Army Missile Command
Redstone Arsenal, Ala.

Commanding General
U. S. Army Missile Cmd.
ATTN: Dir. Research & Development
Redstone Arsenal, Ala.

Typical R&D programs: ablation of materials, aerodynamics and aeroballistics, atmospheric phenomena and meteorology, biological and physiological factors, communications, high temperature studies, improved fabrication methods, materials research, miniaturization, power supplies, propulsion systems, propellants, systems and instrumentation, reliability assurance, tracking and acquisition systems, trajectory studies, automation, modularization, digital computer techniques, ultrasonic inspection, packaging and preservation, rapid fuel transfer, printed circuits, missile structure, systems mathematics, counter-counter measure equipment, etc.

Commanding Officer
U. S. Army Missile Support Command
ATTN: Purchasing & Contracting Div.
Redstone Arsenal, Ala.

Typical end item procurement: supplies: calibration and computer equipment, electric and electronic equipment, troop food, library supplies, laboratory and test equipment and apparatus, communications equipment and supplies, safety and protective equipment, housekeeping and maintenance supplies etc. Services: construction, alteration and maintenance of facilities equipment, mechanical maintenance instructor and educational services, equipment rentals, etc.

Commanding Officer
U. S. Army Watertown Arsenal
Watertown, Mass.

Typical end item procurement: principal purchasing office for procurement of materials, equipment, and services in support of the U. S. Army Materials Research Agency, for the national procurement of missile containers and related items: metals, ferrous and non-ferrous, in brassware, plates, shapes, tubes: castings, forgings, bearings, packings, machine tools and production equipment: oil, grease, lubricants, fuel and petroleum, coal: boxes, fiberboard wood, hose, rubber, metal, etc.

Army Weapons Command
Rock Island Arsenal
Rock Island, Ill.

Commanding Officer
U. S. Army Springfield Armory
ATTN: SWEWV
Springfield, Mass.

Typical R&D programs: rifles, pistols, machine guns, grenade launchers, aircraft weapons, spotting rifles, shot guns, bayonets, knives, ammunition clips, magazines, bipods, tripods, and related small arms items.
Typical end item procurement: stocks, handguards, hammers, extractors, sights, operating rods, bolts, flash suppressors, firing pins, triggers, connectors, butt plates, gas cylinders, springs, gas pistons, etc.

Army Munitions Command
Picatinny Arsenal
Dover, N. J.

U. S. Army Edgewood Arsenal
ATTN: Chief, Procurement Procedures Office
Edgewood Arsenal, Md.

Typical R&D programs: air sampling—biological and chemical, chemical and medical properties of toxic compounds, biological and medical properties of infectious agents, engineering of protective devices, munitions engineering, processing and production chemical and biological materials.
Typical end item procurement: agents—irritant, simulant irritant, riot control, non-persistent, incapacitating, persistent, gas—simulated mustard, screening smokes, colored smokes, incendiary agents, protective gas masks, dust respirators, shoe impregnite, decontaminating agents, automatic gas alarm, smoke generators, radiological fallout predictors, airplane smoke tanks, portable flame throwers, etc.

U. S. Army Frankford Arsenal
ATTN: Principal Contracting Office
Philadelphia, Pa.

Typical R&D programs: design of instrumentation, optical systems design, prevention of corrosion, protection against fungi, new synthetic lubricants, properties of propellants, shock vibration studies, fire control, magnetism, microwaves, ceramics, artillery ammunition components, etc.
Typical end item procurement: bomb release accumulators, electric actuators, bomb ejectors, binoculars sighting devices, computers, rangefinders, delay-initiators, periscopes, etc.

U. S. Army Picatinny Arsenal
ATTN: Small Business Branch
Dover, N. J.

Typical R&D programs: characteristics of shell and high explosives, crystallography of explosives, burning rate of catalysts, arming and safeing devices, timers, energy storage units, and long shelf life power units, kinetics of rockets, exhaust gases, fuzing, etc.
Typical end item procurement: chemical glassware, dry ice, chemicals, cameras and accessories, metal components, industrial equipment, metals (aluminum and steel, copper, etc.) electronic equipment, etc.

Army Electronics Command
Fort Monmouth, N. J.

U. S. Army Electronics R&D Agency
ATTN: SELRA/SL-LNB Industrial Liaison Office
Hexagon Bldg.
Fort Monmouth, N. J.

Typical R&D programs: active in all fields of physical sciences leading to development of new techniques and the design and improvement of communications, radar, electronic countermeasures, electronic data processing, radiological, meteorological, photographic drones and other surveillance equipment, related components, and special electronic and solid state devices, and develops equipment, materiel, and systems for communications security.

U. S. Army Electronics R&D Activity
ATTN: Dir. of Research
White Sands, N. M.

Typical R&D programs: missile electronic warfare, missile surveillance, environmental sciences, range instrumentation, range communication and data transmission, radio frequency compatability investigations, etc.

U. S. Army Electronics R&D Activity
ATTN: Industrial Liaison Officer
Fort Huachuca, Ariz.

Typical R&D programs: special research in the field of micrometerorology.
Typical end item procurement: Procurement Office, ATTN: Small Business and Labor Surplus Advisor, procures communications equipment for immediate support of activity.

U. S. Army Air Defense Engineering Agency
ATTN: Commanding Officer
Fort Meade, Md.

Typical R&D programs: provides engineering and associated services in the research design, and development of electronic equipments, devices, systems, etc.

U. S. Army Avionics Field Office
ATTN: Commanding Officer
St. Louis, Mo.

Typical R&D programs: resolves logistical problems involving electronic equipment re: Army Aviation Program and Army Surface Transport Programs.

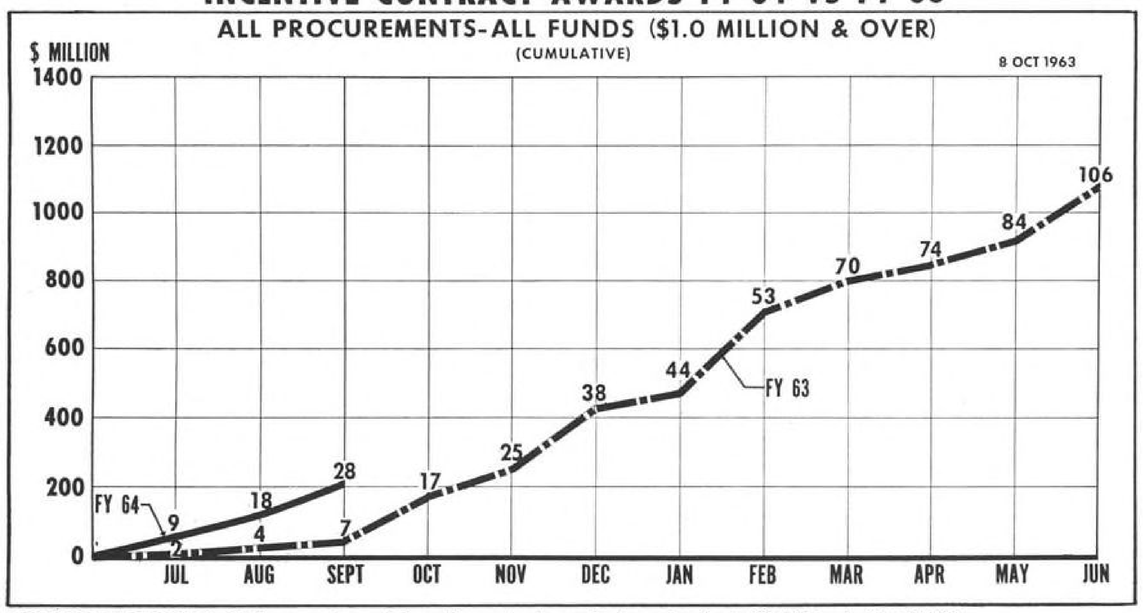
U. S. Army Electronics Materiel Agency
ATTN: Small Business and Labor Advisor
225 S. 18th Street
Philadelphia, Pa.

Typical end item procurement: commercial and military type communication equipment, items, telephone equipment, radar, radio and meteorological equipment, computers and automatic data processing equipment, teletypewriter and facsimile-equipment, dry batteries, and cameras, television equipment and cameras, instruments, meters, recorders, etc.

U. S. Army Electronics Materiel Agency
Fort Monmouth Procurement Office
ATTN: Small Business and Labor Advisor
Fort Monmouth, N. J.

Typical end item procurement: maintains bidders' lists for R&D projects, procures R&D services, studies, and pilots production for telephony, telegraphy, radio, radar, meteorology, radiation, radioactivity, metallurgy, crystalography, photography, television, cosmography, and allied subjects, procures research supplies, instruments, supplies for support activities.

INCENTIVE CONTRACT AWARDS-FY 64 VS FY 63



INCREASED ARMY Materiel Command use of incentive contracts reached a peak of over $1 billion in Fiscal 1963.

NASA Plans More Competition, Incentives

By Alfred P. Alibrando

Buying and contracting practices of the National Aeronautics and Space Administration are changing markedly, with increased emphasis on competitive awards and wider use of incentives the major outward signs of the change.

"We feel we've had very good results from our first incentive contracts, which we negotiated this year," said George J. Vecchietti, Jr., deputy director of procurement. "We plan to use more incentive contracting on a selective basis. . . . selective, because incentives are difficult to apply in research and development."

NASA's procurement regulations require that procurement plans for contracts valued at over $5 million consider incentives. All non-competitive contracts for over $5 million must be approved by the agency's top management.

In the last half of 1962, 51% of NASA's procurement was on a competitive basis. During the first half of 1963, this ratio increased to about 55%. But NASA is still not satisfied and may seek to increase competitive contracting by requiring that no non-competitive awards be made without approval of center directors or NASA headquarters top management.

There has been some pressure from industry for NASA to allow submission of proposals based on Defense Department's weighted guidelines scale for fee and profit. Under such a system, various aspects of work under a contract, such as engineering and production, are "weighted."

Although NASA has not made a decision on the weighted guidelines type of contract, it is the feeling of some in the agency's top management that this kind of contract is not suitable to a research and development oriented effort.

Agency officials advised they will continue to contract for industrial service, technical and scientific talent. There has been criticism by Congress, the Budget Bureau and the comptroller general of NASA's service contracts. The Bellcom and General Electric Apollo service contracts came under special scrutiny in Congress last year.

Despite this criticism, NASA maintains that it is more practical and cheaper in the long run to meet peak demands by contracting for outside services. Rather than abandon the hiring of outside services, NASA will try to write contracts for these services in such a way that they meet with the approval of inspecting government agencies.

NASA also plans to improve its cost estimating procedures because in almost every major program, the agency has underestimated costs by as much as 100% or more.

"We now have five years of experience to draw on," said Vecchietti. "NASA also will make a study of the methods used by industrial firms which historically have been the most accurate in estimating research and development costs."

Cost Reduction Programs

Cost reduction programs also are under study, and NASA is looking at both its own laboratory operations and those of its contractors as areas where costs might be cut. From these early studies will come recommendations on specific industries and NASA laboratories where cost reduction programs look most promising.

Still another tool NASA will use to improve its procurement machinery is the Defense Dept. contractor performance evaluation. NASA hasn't decided on precise methods it will use, but it is likely that the agency will rely on information on aerospace firms already available in the Defense Dept. data bank in performing the evaluation.

NASA's tighter procurement practices stem from both the agency's increasing maturity—it was five years old last Oct. 1—and the first stiff objections expressed last year in Congress to the Apollo manned lunar landing program. Although NASA Administrator James E. Webb repeatedly said the $5.72 billion requested for Fiscal 1964 represented an "austere" budget, Congress cut this to $5.35 billion in the authorization process and actually appropriated only $5.1 billion.

NASA was forced to slow down the Apollo program because of the cut in Fiscal 1964 funding, and there is a genuine fear within the agency that inadequate appropriations over the next two years—when the buildup in the manned lunar landing program should be at a peak—will further cripple the program.

President Johnson will ask about $5.5 billion for NASA in Fiscal 1965. But if Congress treats the Fiscal 1965 request the way it did the 1964 NASA budget, the agency will come out with no more than $5 billion.



First Production S-4B Tank

CYLINDRICAL SECTION OF LIQUID HYDROGEN tank of the first Douglas S-4B Saturn stage rests in a jig as it is prepared for welding of an angle ring on one end, to which a skirt will be bolted. This tank will be tested to destruction in a hydrostatic tower. Both final assembly and testing of the S-4B, up to the static-test firing stage, will be done at the new Douglas Space Systems Center at Huntington Beach, Calif. New manufacturing/assembly building has 120,000 sq. ft. Worker guides tubing from frame to which the angle is attached. Welder head is at the top of the welding tower at left.

In Contracts

Policy Changes

Policy shifts in procurement are directed at dispelling charges of waste and duplication in the space program and in spreading the work geographically as well as to more firms. Though the bulk of NASA prime contracts is still won by aerospace firms on the East and West Coasts, Webb said earlier this month that in 1963 NASA will have spent 93% of its funds, or more than $4 billion, through prime contracts with 2,500 firms in 49 states and the District of Columbia.

The Fiscal 1963 procurement report now in preparation will show little change from Fiscal 1962 in the 10 states receiving the largest dollar volume in NASA prime contracts. California, the leader, received more than $1 billion. Next in order are Missouri, Louisiana, New York, Alabama, Florida, New Jersey, Texas, and Maryland.

In Fiscal 1963, 18 of the 100 largest contracts let by the agency were received by small business. And small business received about $90 million in contracts over $25,000.

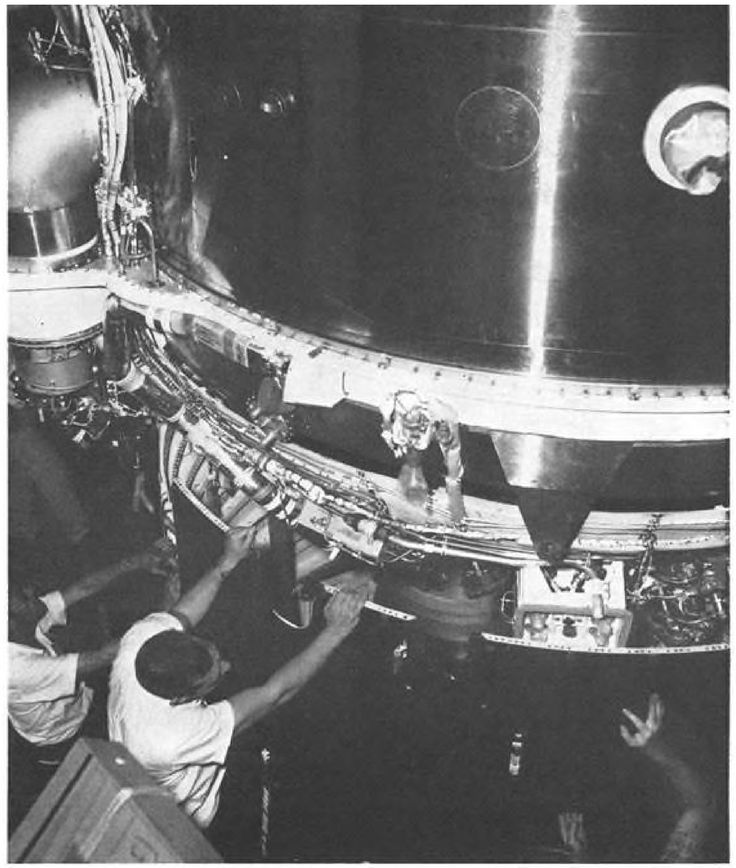
There is a small business adviser or specialist at NASA headquarters and at each center who screens proposed purchases or contracts over $2,500 to determine whether and how small firms can participate in the procurement. Small businesses desiring to acquaint NASA with their capabilities, or upon learning of subcontracting opportunities, should contact the small business advisers or specialists.

Following is a summary of activities conducted at the agency's headquarters and research centers:

Headquarters

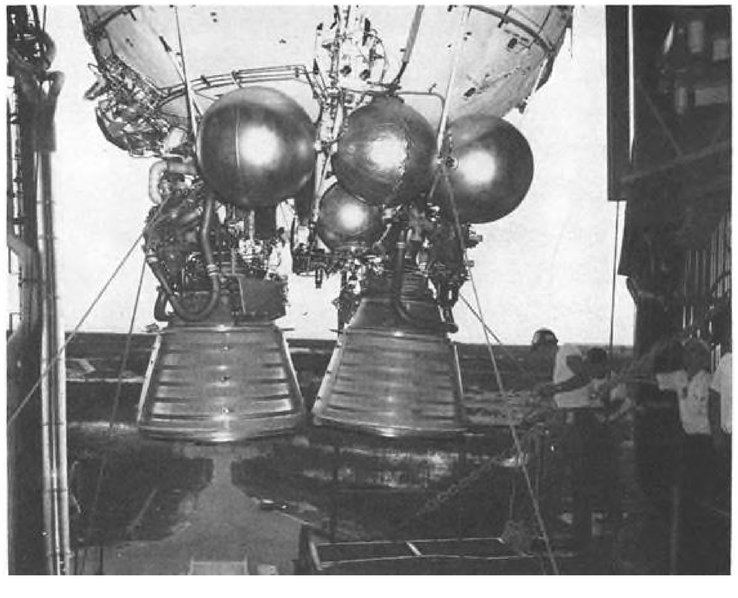
This division is responsible for headquarters procurements and contracts covering reliability studies, management analyses, the initial phases of research and development projects, feasibility studies, liquid hydrogen purchases and office equipment and supplies needed for support of headquarters activities.

Research grants and contracts with



Centaur Stage Mated to Booster

GENERAL DYNAMICS/ASTRONAUTICS CENTAUR high-energy upper stage is mated to its Atlas booster on Pad 36A prior to Nov. 27 launch from the John F. Kennedy Space Center at Cape Canaveral (AW Dec. 9, p. 30). Flight was first success after program management was shifted to NASA's Lewis Research Center. It also marked the first flight demonstration of liquid hydrogen as a launch vehicle fuel. Centaur's two Pratt & Whitney RL-10A-3 engines, each rated at 15,000 lb., are shown below as the stage was lifted into place. Ground test program which led to successful flight will continue through remaining six research and development Centaur vehicles. Next flight test vehicle is tentatively scheduled to fly early next year.



nonprofit and scientific and educational institutions are the responsibility of the Office of Grants and Research Contracts at headquarters.

Ames Center

Ames has project responsibility for the Pioneer spacecraft and the Biosatellite. Pioneer is an unmanned probe designed to study the space environment and Biosatellite will investigate the effect of this environment on earth organisms, including monkeys. NASA's life science laboratory also is located at Ames.

Research activities at the center include vertical and short takeoff aeronautical research; basic studies in planetary entry and environmental physics; guidance and control systems; exobiology; physiological and behavioral sciences, and human factors.

Flight Center

Mission of this center is research connected with flight in the atmosphere and space from low speeds to hypersonic velocities. Programs in which the center is participating include the X-15, supersonic transport and paraglider development. Ground-based and inflight research includes work on loads and structures, aerodynamics, thermodynamics and biotechnology.

Goddard Center

Goddard Space Flight Center has the broadest responsibility of any NASA installation. Its projects include most of the scientific satellite and agency responsibility for communication and weather satellite programs. Goddard also directs the operation of NASA's world-wide manned flight, minitrack and satellite tracking, communication and computing system networks and maintains launch teams at both the Pacific and Atlantic Missile Ranges.

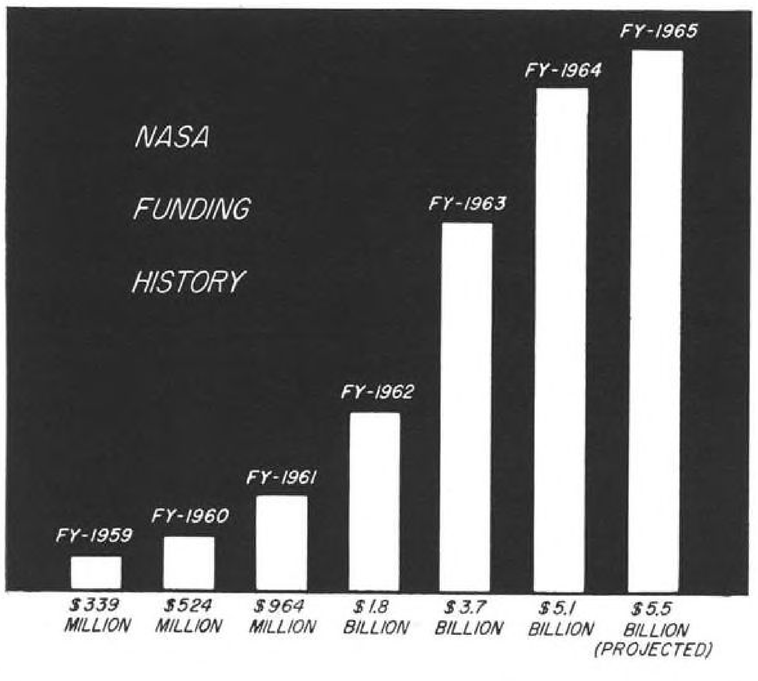
JPL

Government-owned, Jet Propulsion Laboratory is operated for NASA by the California Institute of Technology. Most of the laboratory's work is confined to the Ranger and Surveyor unmanned lunar flight programs. The Mariner planetary mission is managed by JPL.

JPL also manages the deep space tracking network.

Langley Center

Langley Research Center conducts scientific and technical investigations on a broad scale in the areas of vehicle configurations, materials and structures, re-entry, application of new materials, supersonic and hypersonic flight, rendezvous and lunar landing techniques, inflatable and erectable manned space stations and design and improvement of inflatable passive communication satellites. Langley Research Center also manages the lunar orbiter satellite program.



Kennedy Space Center

Recently re-named for the late President, this center has facilities at the Atlantic Missile Range and Merritt Island that include buildings and equipment—mostly under construction—for integration, test and checkout of the Apollo spacecraft. NASA operates or directs facilities on the Air Force portion of the Atlantic Missile Range for preparation, test and launch of the Gemini manned spacecraft and its unmanned satellites and probes projects.

Lewis Center

Primary mission of Lewis Research Center is research and development of advanced propulsion and space power generation. This includes high-energy chemical, nuclear and electric rocket engines and space power systems for converting chemical, nuclear and solar energy into electricity. Lewis also has project management responsibility for the M-1 liquid hydrogen engine, Centaur launch vehicle and Agena stage procurement.

Manned Spacecraft

Planning and carrying out manned space flight programs, from the standpoint of the manned vehicle, is the primary mission of the Manned Spacecraft Center. These missions include the successful Mercury program which was completed with USAF Maj. Gordon Cooper's MA-9 flight last May 16 and the current Gemini and Apollo programs. This center also studies future projects, such as manned space station and planetary missions.

Spacecraft design, crew training, space medicine and crew equipment also are responsibilities of this center.

Marshall Center

Development of large boosters is the primary responsibility of the Marshall Space Flight Center. Current programs include development of the Saturn 1, Saturn 1B and Saturn 5 launch vehicles. Marshall also is defining requirements for larger, Nova-class rockets for future planetary missions. These studies include combinations of large liquid and solid stages, nuclear and other high specific impulse upper stages.

Nuclear Office

Space Nuclear Propulsion Office is a joint NASA-Atomic Energy Commission facility, concerned primarily with the development of nuclear rocket engines for advanced launch vehicles. To accomplish the objective, the office is directing a program of research on reactors, engine systems, development of heat exchanger type reactors, engines and stages, and operation of nuclear-powered stages in launch vehicles for flight test, all parts of the Rover project.

NASA PROCUREMENT OFFICES

National Aeronautics and Space Administration, Washington 25, D. C.

Ernest W. Brackett, DU 2-8344
Director, Procurement and Supply

Jacob M. Raey, 382-8237
Industry Assistance Officer

HEADQUARTERS PROCUREMENT BRANCH
**Albert A. Clagett, WO-2-4017
*E. W. Quintrell, WO 2-4018

AMES RESEARCH CENTER
Moffett Field, Mountain View, California
Telephone: 966-1111
**Alvin S. Hertzog
*John C. Delaney

FLIGHT RESEARCH CENTER
Box 273, Edwards, California
Telephone: CL 8-2111
**Lloyd Walsh
*Stephen C. Kucharik

GODDARD SPACE FLIGHT CENTER
Greenbelt, Maryland
474-9000
**Gordon H. Tyler
*Harry T. O'Toole

JET PROPULSION LABORATORY
California Institute of Technology
4800 Oak Grove Drive, Pasadena 3, Calif.
Telephone: SY 0-6811
**T. W. Candee
*Gordon R. Lawrence

LANGLEY RESEARCH CENTER
Langley Station, Hampton, Virginia
Telephone: 722-7961
**Sherwood L. Butler
*Joseph F. Braig

LAUNCH OPERATIONS CENTER
Cocoa Beach, Florida
Telephone: SU 3-8003
**Gerard A. Michaud
*Tom McMillan Davis

LEWIS RESEARCH CENTER
21000 Brookpark Road, Cleveland 35, Ohio
Telephone: 252-7700
**Edward S. Hicks, Jr.
*Norman C. Prahst

MANNED SPACECRAFT CENTER
Houston 1, Texas
Telephone: WA 8-2811
**Dave W. Lang, Jr.
*H. T. Christman

GEORGE C. MARSHALL SPACE FLIGHT CENTER
Huntsville, Alabama
Telephone: 536-8516
**Wilbur S. Davis
*James S. Morrison

NORTH EASTERN OFFICE
30 Memorial Drive, Cambridge 42, Mass.
Telephone: 491-1500

SPACE NUCLEAR PROPULSION OFFICE
AEC Headquarters, Germantown, Md.
Telephone: HA 7-7800
Extension Office: Space Nuclear Propulsion Office, Lewis Research Center
**George Kimball, 252-7700
Las Vegas Extension:
Thurman H. Lautenschlager
385-4223

WALLOPS STATION
Wallops Island, Virginia
Telephone: VA 4-3411
**Louis T. Birch
*Harry Hammond

WESTERN OPERATIONS OFFICE
150 Pico Blvd., Santa Monica, California
Telephone: EX 3-9641
**Earle J. Sample
*Alexander Mirosav

** *Procurement Officer* * *Small Business Specialist*

Wallops Station

Wallops Station has been conducting rocket flights since 1945 in aeronautical and space research programs. Most launches from Wallops are sounding rocket flights using vehicles with as many as six stages.

Largest vehicle launched from Wallops is the Scout solid fuel launch vehicle which is used for both high altitude re-entry tests and unmanned orbital satellite flights. A second Scout launch pad is nearing completion.

Northeastern Office

Mission of the Northeastern Office is to provide liaison with industry, and scientific and educational institutions in the northeastern states. The office, located in Cambridge, Mass., also monitors, administers and audits NASA contracts and grants within the region and conducts special pre-award surveys.

Western Office

Western Operations Office, in Santa Monica, Calif., administers NASA contracts, performs technical monitoring and advises headquarters on technical developments and capabilities.

BRIEFING ON A GEMINI SPACECRAFT mockup was given to Astronauts at the IBM Space Guidance Center, Owego, N. Y., by IBM engineer Dale Bachman, left. He discussed the system with Astronaut Virgil I. Grissom, General Manager Arthur E. Cooper, Astronaut Neil A. Armstrong and James C. Hundley, IBM's Gemini technical manager.



Small Business Defense Role Stressed

By Katherine Johnsen

Washington—Small business—generally a firm with 500 or less employes—is now receiving about $9.2 billion annually in prime and subcontracts from Defense Dept. and National Aeronautics and Space Administration.

There has been a slight, but steady decline in the dollar-volume of prime awards to small firms, a few percentage points over the past few years, attributable to the almost inevitable result of the increasing complexity of weapons and space systems. To offset this downward trend, the government effort is directed toward programs and policies that will increase small business participation in subcontract work.

An expansive government organization watches over the interests of the small business segment of the economy, reaching from Congress to small procurement offices by these methods:

• **House and Senate** both have special committees on small business. The Senate committee is headed by Sen. John Sparkman (D.-Ala.), and the House committee by Rep. Joe L. Evins (D.-Tenn.). These committees have also served as a court of last resort for small firms that feel they have received inequitable treatment in government procurement or policy.

• **Small Business Administration,** which guides the small business programs of all other government agencies, is still growing. It now has about 3,500 employes and an annual budget of over $30 million. This agency gives financial, management and production assistance to small firms, as well as assistance in obtaining government business. It has field offices in 60 cities.

• **Defense Dept.** has small business offices at the top policy level here—in the office of the secretary of defense, and the Departments of Army, Navy and Air Force. In addition the department has about 500 small business specialists throughout the country.

• **NASA,** similarly, has a small business policy director in headquarters here, and small business specialists at each of its major centers.

Defense Dept. is now making about $4.6 billion a year in prime awards to small businesses. Small firms obtain about $108 million a year in prime awards from Defense Dept. for missile and space systems. This represents only 1.6% of the department's total annual awards of about $6.7 billion for these systems.

The area in which small business appears least equipped to compete is development. Small firms receive only 0.8% of Air Force's development work, 3.8% of Army's, and 4.4% of Navy's.

Small business participation in research is substantially greater than in development. Small firms obtain about 8% of Air Force's dollars for research, 14% of Army's, and 27% of Navy's.

Defense subcontract awards to small business are running about $4.3 billion a year. The department has divided the 400 largest defense contractors into four groups. Army, Navy, Air Force, and Defense Supply Agency each have responsibility for monitoring the small business subcontracting programs for one of these groups.

Defense now makes it mandatory that each prime contractor maintain records showing the extent to which small firms are given an opportunity to compete for subcontracts.

Defense Dept. admits that its small business program is conflicting with two other Defense procurement goals:

• **Cost reduction,** under which cost plus fixed fee contracts are being curtailed sharply and emphasis placed on fixed-price type contracts. "Contracts which are awarded after free and open competition with the price fixed by the bidding procedure encourage bidders to seek the most qualified subcontractors and vendors whose prices are most favorable without distinguishing between large and small," Defense Dept. says. "As the cost plus fixed fee contract is phased out, and as the fixed-price with incentive type contracts are used in its stead, the propriety of the government's control over the execution of subcontracts is brought into sharp focus."

• **Labor surplus area.** This program involves set-asides of prime and subcontract work for bidding by firms in areas of heavy unemployment. No distinction is made as to whether bidders in the unemployment area are small or big business. The program is in competition with the policy to set aside defense work exclusively for bidding by small business.

NASA prime awards to small business are now running about $140-$150 million a year—or about 10% of NASA's total direct awards.

Small business has had a rather low record of responding to NASA's solicitations to bid. In one period, NASA solicited bids from small business on 21% of the dollar volume of its total procurements. Small business submitted bids on only 52% of the dollar value of these solicitations.

Subcontracting to small business by NASA's 32 major prime contractors is at about $200 million a year. This is about 17% of NASA's total payments to the 32 companies.

NASA has established a semi-annual reporting system to determine the extent to which its primes are encouraging small business participation in subcontract work.

NASA and Defense contact points for small business are listed below:

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION SMALL BUSINESS POLICY HEADQUARTERS WASHINGTON, D. C.

Office of Procurement
Small Business Advisor: Jacob M. Roey
Room 54 B, Universal North Building, 1875 Connecticut Ave., N. W.
Telephone: DUdley 28236

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION SMALL BUSINESS FIELD REPRESENTATIVES

Headquarters, Washington, D. C.: Ralph Scroggs

Ames Research Center: Moffett Field, Calif., John C. Delaney

Flight Research Center: Edwards, Calif., Stephen C. Kucharik

Goddard Space Flight Center: Greenbelt, Md., Harry T. O'Toole

Jet Propulsion Laboratory: Pasadena, Calif., G. R. Lawrence

Langley Research Center: Hampton, Va., Joseph F. Braig

Launch Operations Center: Cocoa Beach, Fla., Thomas M. Davis

Lewis Research Center: Cleveland, Ohio, Norman C. Prahst

Manned Spacecraft Center: Houston, Tex., H. T. Christman

Marshall Space Flight Center: Huntsville, Ala., Emil J. Havrilla

Northeastern Office: Cambridge, Mass., Edward U. O'Donnell

Wallops Station: Wallops Island, Va., Elton R. Scott

Western Operations Office: Santa Monica, Calif., Alex Mirosav

DEPARTMENT OF DEFENSE SMALL BUSINESS POLICY HEADQUARTERS WASHINGTON, D. C.

Assistant Secretary of Defense (Installations and Logistics)
Directorate for Small Business Policy
Director: Richard W. Webb
Assistant Director: Robert Owens
Room 3E821 Pentagon
Telephone: OXford 76907, 74912, 71481

Assistant Secretary of the Army (Installations and Logistics)
Army Small Business Office
Director: Jack W. Askins
Room: 2E951 Pentagon
Telephone: OXford 78113

Executive Office of the Secretary of Navy
Small Business Branch
Director: Capt. A. Lotterhos, Jr.
Room: 2203A Main Navy Building
Telephone: OXford 66053

Air Force Deputy Chief of Staff (Systems and Logistics)
Deputy for Small Business: J. K. Weddell
Room: 4E276 Pentagon
Telephone: OXford 74126

DEPARTMENT OF DEFENSE SMALL BUSINESS FIELD REPRESENTATIVES DEPARTMENT OF DEFENSE SMALL BUSINESS SPECIALISTS

Alabama

Anniston: Anniston Army Depot: Robert W. Prather, Fort McClellan (Army): Lt. T. S. Epperson; **Birmingham:** Birmingham Procurement District (Army): Wilson B. Mathews, Fourth U. S. Army Corps: Mrs. Pauline G. Dean; **Huntsville:** U. S. Army Missile Command, Redstone Arsenal: Jeff D. Darwin; **Mobile:** Mobile Air Materiel Area: Brookley Air Force Base: L. L. McKean, Howard W. McNamee, William H. Freeman; **Ozark:** Fort Rucker (Army): Maj. Grant O. Mosher.

Alaska

Anchorage: Ft. Richardson (Army), Purchasing and Contracting Office: Leonard O. Jones, U. S. Army Headquarters, Fort Richardson: F. D. Eshenower, Headquarters Alaskan Air Command, Elmendorf Air Force Base: Lt. Col. P. C. Palmer; **Fairbanks:** Fort Wainwright, Purchasing and Contracting Office: Harold H. Leonard.

Arizona

Flagstaff: Navajo Army Depot: Glen T. Kerr; **Fort Huachuca:** Electronic Material Agency Procurement (Army): J. W. Horstman; **Phoenix:** Phoenix Air Force Contract Management: J. W. Gaskins; **Yuma:** Yuma Test Station (Army): James E. Rosney.

Arkansas

Fort Chaffee (Army): Capt. C. E. Shannon; **Pine Bluff:** U. S. Army Chemical Arsenal: Douglas F. Frew.

California

Alameda: Alameda Administration Center (Army): J. T. Simon, Procurement Support Office (Defense Supply Agency): J. T. Simon; **Barstow:** Fort Irwin (Army): Mrs. Beaulah Bell, Marine Corps Supply Center: T. L. Whisler; **Benicia:** Benicia Arsenal (Army): Mrs. Isabel H. Meaney; **Camp Pendleton:** Marine Corps Base: E. H. Sherman; **Edwards:** Edwards Flight Test Center, Edwards Air Force Base: J. A. Beucheric; **Herlong:** Sierra Army Depot: A. G. Hamel; **Lathrop:** Sharpe General Depot (Army): A. E. Renlund; **Los Angeles:** Corps of Engineers, Ballistic Missile Construction Office: James N. Oliver, U. S. Navy Purchasing Office: L. H. Porter, Space Systems Division, Air Force Systems Command: Roy A. Watkins, Air Force Contract Management District: G. J. Byrnes, M. Bennett, W. V. Stalew, Inspector of Material (Navy): L. L. Tjaden; **Mira Loma:** Western Contract Management Region: Mira Loma Air Force Station: Edgar L. Harris; **Monterey:** Fort Ord (Army): James W. Roberts; **Oakland:** U. S. Army Chemical Corps District: Richard D. Rookaird; San Francisco Procurement District (Army): Frank M. Mayfield, U. S. Navy Supply Center: G. R. Kinnear, San Francisco Air Force Contract Management District: Richard Quinn; **Pasadena:** Los Angeles Procurement District (Army): Edmund L. Stone, Western Regional Office (Army): Frank J. Brown, Jr., U. S. Naval Ordnance Test Station: C. V. Weaver; **Port Hueneme:** Yards and Docks Supply Office (Navy): Miss Olive E. Sherman; **Sacramento:** Sacramento Signal Depot: Richard C. Glenn, Sacramento Air Materiel Area, McClellan Air Force Base: Carroll O. Dudley, Jr.; **San Bernardino:** San Bernardino Air Materiel Area, Norton Air Force Base: William J. Dunkerley, Ballistics Systems Division, Norton Air Force Base: Laurence McGary; **San Diego:** San Diego Air Force Contract Management District: Robert Downing; **San Francisco:** U. S. Army Transportation Terminal Command: F. K. Mulhaupt, Lorne A. Michaelis, Sixth U. S. Army: Robert A. Allstead, Presidio of San Francisco: W. J. Curley, Military Sea Transportation Service, Fort Mason: H. K. Webb, San Francisco Naval Shipyard: J. J. Rauly, San Francisco Air Force Contract Management District: R. V. Madsen, Inspector of Material (Navy): R. V. Madsen; **San Pedro:** Fort MacArthur (Army): John W. Poteet.

Colorado

Colorado Springs: Headquarters Air Defense Command, Ent Air Force Base: John W. Jackson; **Denver:** U. S. Army Chemical Arsenal Rocky Mountain: Helen M. Peterson, Denver Air Force Contract Management: R. Wilson; **Fort Carson:** Fort Carson (Army): Lee B. White; **Pueblo:** Pueblo Army Depot: Robert L. McMichael.

Connecticut

Bridgeport: Inspector of Material (Navy): H. H. Bryson; **New London:** U. S. Naval Submarine Base: D. P. Sullivan.

Delaware

Lewes: Fort Miles (Army): Harold Brumund.

Florida

Cocoa Beach: Air Force Missile Test Center, Patrick Air Force Base: Charles Furtado; **Jacksonville:** U. S. Naval Air Station: F. C. Barnes, Jr.; **Key West:** U. S. Naval Station: D. W. Wiley; **Orlando:** Orlando Air Force Contract Management District: Orlando Air Force Base; DeForest A. Long; **Panama City:** U. S. Navy Mine Defense Laboratory: Cdr. A. A. Shawkey; **Pensacola:** U. S. Naval Air Station: Mrs. Margaret J. Horne; **Valparaiso:** Air Proving Ground Center, Air Force Systems Command, J. V. Leftwich.

Georgia

Albany: Marine Corps Supply Center: R. J. Thrower; **Atlanta:** Twelfth U. S. Army Corps: Mrs. M. E. Fuller, Atlanta Air Force Contract Management District: T. W. Turbiville, Jr., Inspector of Material (Navy): Cdr. E. B. Young; **Augusta:** Fort Gordon (Army): Lt. Col. C. L. Helms; **Columbus:** Fort Benning (Army): Jack H. Blalock; **Forest Park:** Atlanta General Depot (Army): J. D. Pittard; **Hinesville:** Fort Stewart (Army): Capt. A. S. Hensley, Nolan E. Purcell; **Macon:** U. S. Naval Ordnance Plant: G. W. Holcomb; **Warner Robins:** Warner Robins Air Materiel Area, Robins Air Force Base: Thomas B. Fowler, Wade H. Jordan, Headquarters Continental Air Command, Robins Air Force Base: Henry W. Dodd.

Hawaii

Honolulu: Headquarters U. S. Army: Henry Lai, Purchasing and Contracting Center (Army): Fred K. Antone; **Pearl Harbor:** U. S. Navy Purchasing Office, Naval Supply Center: T. H. Sunn.

Illinois

Belleville: Headquarters Military Transport Service, Scott Air Force Base: Maj. Ronald W. Helmick; **Chicago:** Chemical Corps Field Liaison Representative (Army): Morris Winer, Chicago Procurement District (Army): John C. Maaz, Eugene Wack, Headquarters Fifth U. S. Army: Bruno J. Sarocka, Chicago Air Force Contract Management District, O'Hare International Airport: Victor J. Ripp, Dean Stevenson, Inspector of Material (Navy): H. K. Watterson; **Forest Park:** U. S. Naval Ordnance Plant: J. C. Van Dyke; **Fort Sheridan:** Fifth U. S. Army: Donald Y. McKay; **Great Lakes:** Electronic Supply Office (Navy): A. J. Dowe, U. S. Naval Supply Depot: Mrs. Ruby M. Van Camp; **Joliet:** U. S. Army Procurement and Supply Agency: Gale W. Farris; **Rock Island:** U. S. Army Weapons Command: Mauritz Liljegren, James M. Peterson; **Savanna:** Savanna Army Depot: John A. Washburn.

Indiana

Charlestown: Indiana Ordnance Plant (Army): R. L. Goddin, U. S. Army Ordnance Safety Agency: Paul R. Jones; **Crane:** U. S. Naval Ammunition Depot: P. A. Anderson; **Edinburg:** Fifth U. S. Army: Dempsey E. Keller; **Fort Wayne:** Inspector of Material (Navy): N. M. Ross; **Indianapolis:** Fifth U. S. Army: Richard M. Murian, U. S. Naval Avionics Facility: M. T. Wampler, Indianapolis Air Force Contract Management District (Air Force): Robert Ranney; **Madison:** Jefferson Proving Ground (Army): Doyle F. Shaffer; **South Bend:** South Bend Air Force Contract Management Office: Ernest J. Koehler.

Iowa

Burlington: Iowa Ordnance Plant (Army): A. F. Wakefield; **Cedar Rapids:** Inspector of Material (Navy): G. F. DeMarrais.

Kansas

Fort Leavenworth: Fort Leavenworth (Army): Thomas K. Eisman; **Fort Riley:** Fort Riley Ordnance Works (Army): Helen Whorton; **Wichita:** Wichita Air Force Contract Management Office: E. K. Groskinsky.

Kentucky

Fort Campbell: Fort Campbell (Army): Eugene E. Greene; **Fort Knox:** Fort Knox (Army): Gwyn S. Walker; **Lexington:** Lexington Signal Depot (Army): Henry Morris; **Louisville:** Louisville Army Depot: Oscar M. Beck, U. S. Naval Ordnance Plant: R. S. Loebig; **Richmond:** Blue Grass Army Depot: Linus J. Webber.

Louisiana

Fort Polk: Fort Polk (Army): Alvin C. Cooley; **New Orleans:** Transportation Terminal Command (Army): Gaines A. Ranager, Military Sea Transportation Service: C. H. Eisendanger, U. S. Naval Station: P. L. Duane; **Shreveport:** Louisiana Ordnance Plant (Army): Gillis W. Womack.

Maryland

Aberdeen Proving Ground: Aberdeen Proving Ground (Army): Albert M. Ellis; **Baltimore:** Inspector of Material (Navy): Arnold T. Grahn; **Cascade:** Fort Ritchie (Army): Miss Adrienne I. White; **Dundalk:** Fort Holabird (Army): F. De P. Whitehurst; **Edgewood:** U. S. Army Chemical Center: John K. Kaufman, George J. Sugyik; **Fort George G. Meade:** Signal Procurement Office (Army): James E. Casey, Second U. S. Army: Mrs. Mildred K. Denny, Fort George G. Meade (Army): Patrick D. Brennan; **Frederick:** U. S. Army Chemical Corp Biological Laboratories: Ernest W. Taverner; **Indian Head:** U. S. Naval Propellant Plant: J. E. Anderson; **Patuxent:** U. S. Naval Air Station: Mrs. Grace Moore; **Silver Spring:** U. S. Naval Ordnance Laboratory: Ward Bull; **Suitland:** U. S. Navy Oceanographic Office: James R. Newberry.

Massachusetts

Bedford: Electronic Systems Division (Air Force), L. G. Hanscom Field: John Condon, Norman Mullen; **Boston:** Boston Procurement District (Army): William A. Thorpe, Boston Army Base: Harold A. Curtis, Boston Naval Shipyard: A. J. Dolan, Boston Air Force Contract Management District: E. J. Fitzgerald, John McManus, Inspector of Material (Navy): J. F. Good; **Fort Devens:** Fort Devens (Army): John J. O'Loughlin; **Springfield:** Springfield Regional Ordnance Office (Army): Harvey L. Rogers; **Watertown:** U. S. Army Materiels Research Agency: Harold F. Bacall.

Michigan

Battle Creek: Sixth U. S. Army Corps: James Daily, Fort Custer (Army): Miss Doris M. Clipston; **Center Line:** Detroit Arsenal (Army): Byron C. Biggs; **Detroit:** Detroit Procurement District (Army): C. M. Kaltwasser, Fort Wayne (Army): Karl E. Johnson, Detroit Air Force Contact Management District: Hugh E. McGowan, Defense Automotive Supply Center (Defense Supply Agency): E. A. Lulis; **Grand Rapids:** Grand Rapids Air Force Contract Management Office: John A. Barney, Inspector of Material (Navy): A. L. Knudsen.

Minnesota

Minneapolis: Fourteenth U. S. Army Corps.: Robert E. Lynch, Minneapolis Air Force Contract Management Office: R. T. Schumacher, Inspector of Material (Navy): Cdr. T. A. Smithey.

Missouri

Fort Leonard Wood: Fort Leonard Wood (Army): Maj. Daniel Jakovich, Jr.; **Independence:** Lake City Ordnance Plant (Army): Joseph F. Callahan; **Kansas City:** Kansas City Air Force Contract Management Office: F. Howard Whiteley; **St. Louis:** St. Louis Procurement District (Army): George Linsday, Transportation Materiel Command: Leonard H. Richman, Francis C. Brda, U. S. Army Support Center: Miss Florence G. Smicker, St. Louis Air Force Contract Management District: Kenneth E. Kichline, Inspector of Material (Navy): H. W. Short.

Nebraska

Omaha: Sixteenth U. S. Army Corps.: Floyd E. Elmgren, Headquarters Strategic Air Command, Offutt Air Force Base: William T. Haneline; **Sidney:** Sioux Army Depot: Ira C. Johnson.

New Hampshire

Portsmouth: Portsmouth Naval Shipyard: W. M. Varrell.

New Jersey

Dover: Picatinny Arsenal: Gale W. Farris, Harry Stevenson, U. S. Army Ordnance Special Weapons: Gale W. Farris; **Fort Dix:** Fort Dix (Army): Frank Campagna; **Fort Monmouth:** U. S. Army Electronics Command: Charles J. Hoyt, Mrs. Jean H. Nuttall, **Metuchen:** Raritan Arsenal (Army): James A. McKay; **Newark:** Newark Air Force Contract Management District: Vincent J. Farrell, Joseph L. Lewis, Inspector of Material (Navy): L. H. Hearne.

New Mexico

Alamogordo: Air Force Missile Development Center, Holloman Air Force Base: D. P. Hathcock; **Albuquerque:** Air Force Special Weapons Center, Kirtland Air Force Base: M. H. Nicherson, Defense Atomic Supply Agency, Sandia Base: W. H. Copeland; **Gallup:** Fort Wingate Army Depot: Herbert C. Stacher; **White Sands Missile Range:** White Sands Missile Range: Valda N. Cordell.

New York

Brooklyn: U. S. Navy Purchasing Office: Joseph Riemer; **Buffalo:** Inspector of Material (Navy): K. Souliske; **Long Island City:** Inspector of Material (Navy): C. W. Spencer; **New York:** U. S. Army Chemical Procurement District: Gene S. Sarli, New York Procurement District (Army): Theodore M. Everett, Headquarters, First U. S. Army: David S. Levison, New York Air Force Contract Management District: Wilbur V. Gould, Jr., Harry Stegeland, Inspector of Material (Navy): H. P. Gaffney, Jr.; **Rochester:** Rochester Regional Office of Procurement (Army): Harry F. Rapp, Rochester Air Force Contract Management: Harry B. Huntington; **Rome:** Rome Air Development Center: John Vella, Rome Air Materiel Area: Harley G. Grace; **Syracuse:** Inspector of Material (Navy): R. W. Brooks; **Schenectady:** Schenectady General Depot (Army): J. T. Tunney; **Youngstown:** Fort Niagra (Army): Sidney Mackean.

North Carolina

Cherry Point: U. S. Marine Corps Air Station: J. G. Gordon; **Fort Bragg:** Fort Bragg (Army): Charles R. Moore; **Greensboro:** Greensboro Ordnance District Regional Office (Army): Adee F. Thompson.

Ohio

Cincinnati: Cincinnati Procurement District (Army):

George H. Wilson, Cincinnati Air Force Contract Management Office: Chester R. Methena, Inspector of Material (Navy): G. B. Fitzpatrick, Jr.; **Cleveland:** Cleveland Procurement District (Army): Clifford A. Newell, Cleveland Air Force Contract Management District: R. W. Livingston, Inspector of Material (Navy): R. E. Altman; **Dayton:** Dayton Aeronautical Systems Division: George Rattenbury, Central Contract Management Region: Joseph H. Lammert, Dayton Air Force Contract Management Office: Paul E. Birkhold, Headquarters Air Force Logistics Command: Maurice L. Johnson, Defense Electronics Supply Center (Defense Supply Agency): B. L. Castle; **Port Clinton:** Erie Army Depot: James S. Stewart; **Toledo:** Rossford Army Depot: Lewis J. Bierbaum.

Oklahoma

Fort Sill (Army): Lydia L. Troop; **McAlester:** U. S. Naval Ammunition Depot: Dale H. Adams; **Oklahoma City:** Oklahoma City Air Materiel Area, Tinker Air Force Base: John B. Colwell, John Thompson.

Pennsylvania

Johnsville: U. S. Naval Air Development Center: J. W. Miller; **Mechanicsburg:** Ordnance Supply Office (Navy): L. A. Yeager; **Middletown:** Eastern Contract Management Region (Air Force): R. A. MacMillan, Middletown Air Materiel Area, Olmsted Air Force Base: William Lines; **Philadelphia:** Frankford Arsenal (Army): William Travis, Jr., Philadelphia Procurement District (Army): Albert B. Feldman, U. S. Army Electronics Materiel Agency: Edward J. O'Neill, James M. Beane, Albert Gerhardt, Aviation Supply Office: W. F. O'Connell, Naval Air Material Center: Miss Mildred G. Miller, Philadelphia Air Force Contract Management District: John A. Walter, Defense Industrial Supply Center (Defense Supply Agency): Sidney Charles; **Pittsburgh:** Pittsburgh Regional Office Procurement District (Army): George H. Kuhn, Inspector of Material (Navy): R. D. Wilcox; **Reading:** Inspector of Material (Navy): E. L. Buller; **Tobyhanna:** Tobyhanna Signal Depot (Army): John T. Orrson; **Upper Darby:** Inspector of Material (Navy): M. L. Tiffany; **York:** U. S. Naval Ordnance Plant: E. J. Yergo.

Rhode Island

Newport: U. S. Naval Supply Depot: Miss Lillian L. Whitty.

South Carolina

Charleston: Charleston Naval Shipyard: W. H. Heissenbuttel; **North Charleston:** Charleston Transportation Depot (Army): John F. McKewn.

Tennessee

Kingsport: Holston Ordnance Works (Army): Henry L. Creasman; **Memphis:** Memphis General Depot (Army): P. S. Mott, U. S. Naval Air Station: Wendell H. Watson; **Milan:** Milan Ordnance Plant (Army): E. W. Nelson; **Tullahoma:** Arnold Engineering Development Center (Air Force): Joseph F. Moriarity.

Texas

Amarillo: Pantex Ordnance Plant (Army): Robert C. Brewer; **Austin:** Eighth U. S. Army Corps: George G. Lockard; **Corpus Christi:** U. S. Naval Air Station: H. F. Hale; **Dallas:** Dallas Air Force Contract Management District: George R. Phillips; Inspector of Material (Navy): W. H. White, Jr.; **Fort Bliss:** Fort Bliss (Army): H. R. McMahen; **Fort Hood:** Fort Hood (Army): Carl V. Pearson; **Fort Sam Houston:** Fort Sam Houston: D. Hansborough, Fourth U. S. Army: James T. Hickey; **Fort Worth:** Fort Worth General Depot (Army): M. Olmstead; **Marshall:** Longhorn Ordnance Works (Army): Earl L. Malcolm; **San Antonio:** Aerospace Medical Division, Brooks Air Force Base: T/Sgt. Frank Vouri, San Antonio Air Materiel Area: J. E. Neri, Williard D. Barr, Headquarters Air Training Command: Glenn P. Ramsey, Headquarters U. S. Air Force Security Service: Cecil H. Mynier; **Texarkana:** Lone Star Ordnance Plant (Army): Lonnie S. Cannaday, Red River Army Depot: Johnny B. Brown.

Utah

Ogden: Utah General Depot (Army): R. F. Livsey, Ogden Air Force Contract Management District: Ralph Wilson, Ogden Air Materiel Area (Air Force): F. K. Jarrard; **Salt Lake City:** Dugway Purchasing Office (Army): Guy Neilson, U. S. Army Ordnance Small Business Office: Harley A. Porter, Fort Douglas (Army): Basil A. Beveridge; **Tooele:** Tooele Army Depot: Harley A. Porter.

Virginia

Arlington: Headquarters U. S. Army Security Agency: Lt. Col. Robert T. Aiger; **Dahlgren:** U. S. Naval Weapons Laboratory: R. N. Beeman; **Fort Eustis:** U. S. Army Transportation Center: Lt. Col. Owen J. Walsh, Emmitt J. Short, Transportation Research Command: Faulke O. Knudson; **Fort Monroe:** U. S. Continental Army Command: Raymond A. Dubriske; **Hampton:** Headquarters Tactical Air Command: Maj. Harry G. Walker; **Norfolk:** U. S. Navy Supply Center: Miss Esther M. Roberts; **Portsmouth:** Norfolk Naval Shipyard: L. C. Shaughnessy; **Radford:** Radford Ordnance Plant (Army): Charles E. Flynn; **Richmond:** Defense General Supply Center (Defense Supply Agency): George C. Tolton, Ward Randolph.

Washington

Bremerton: Puget Sound Naval Shipyard: R. I. Schennenberger; **Keyport:** U. S. Naval Torpedo Station: W. M. Bennett; **Seattle:** Seattle Regional Office Procurement District: Vernon D. Allen, Sr., U. S. Army Alaska Communications System: Karl W. Gunther, Seattle Air Force Contract Management Office: Arthur W. Perry, Inspector of Material (Navy): Leslie T. Lamb; **Tacoma:** Mt. Rainier Army Depot: Herschell F. Godfrey.

Wisconsin

Milwaukee: Milwaukee Air Procurement District (Air Force): Russell H. Leitch, Inspector of Material (Navy): James A. Shanahan.

Trunk, Local Service

Washington—Fully automated purchasing and supply system, first introduced in 1958 without drawing much industry support, is expected to come into its own in 1964 as a major inventory cost control function of the airlines and their suppliers.

The system, known as the Air Transport Assn. Specification 200—or Spec 200, thus far has been adopted by only five airlines and 20 manufacturers. However, Eastern Air Lines will incorporate the system into its purchasing operation in February and American, Pan American and TWA are expected to follow in quick order.

Spec 200 is an integrated data processing system employed between customer and supplier to produce an accurate flow and cost control over spares and parts purchased by the airlines. It has been estimated that the scheduled airlines of the U. S. will spend some $300 million next year for supplies and materials.

Chief advantages of Spec 200 are the time saved in placing orders, reduction in lead times for both supplier and purchaser, and cutbacks in inventory. Here, in capsule form, is how the system works:

- **Supplier organizes** and mechanizes data necessary to give inventory support to an aircraft. This is called initial provisioning.
- **Data is placed** on a procurement data card. Each card contains all the information necessary to identify and place an order for a part and is sent to the airline where it is retained in permanent file.
- **Airline machine-produces** an order card from information on the procurement data card. Order card is sent to the supplier when a part is needed. Supplier uses the order card to maintain his inventory control and machine-produces a packaging card which identifies the part and which is included with the shipment to the airline.
- **Supplier** has automatically reproduced an invoice card meanwhile from the packaging card, and the invoice card is sent to the airline where it is reproduced. Invoice card is included with payment to the supplier.

Card Procedure

Machine-punched cards are provided to the airline by the supplier, on which the carrier inserts the number of parts used, the number in inventory and the number on order. Number of overhauls, hours flown and time-between-overhaul data is also entered on the cards. Projected number of overhauls and hours to be flown are also included on the cards on a quarterly basis.

From this information, the supplier prepares two reports for the airline: an individual customer analysis, and an industry-wide comparison of inventory and parts consumption.

Carriers using the system have been enthusiastic over results obtained. Spec 200 has cut down time required to prepare special status reports and eliminates the need to assign a special staff to conduct inventory quantity and unit cost surveys: Spec 200 provides a running balance of inventory.

Airline purchasing officials are leaning more heavily on inventory statistics for parts and spares reliability, since reliability is a factor that is rapidly taking precedence over initial cost in selecting suppliers.

Purchasing Shift

As a result, there is a trend toward an organizational structure that places the purchasing agent directly under the vice president of maintenance or engineering rather than under the vice president of finance, which has been the practice in the past. The purchasing agent must still consider price and delivery dates as factors in selecting a supply source, but product reliability is now viewed as the prime element in controlling unit operating costs.

Thus, the purchasing agent relies upon the engineering evaluation of maintenance personnel in selecting products. In addition, there is a move toward granting purchasing departments authority to maintain their own cost accounting and statistical activities.

This engineering-purchasing relationship, when applied to buy-and-rebuy methods, is bolstered by the Spec 200 program and provides an airline with both a composite and detailed picture of costs as related to inventory and parts consumption. In addition, the three-way engineering-purchasing-manufacturer arrangement allows the airline to maintain a tighter inventory than was previously possible.

Now, an airline may stock sufficient supplies to support an aircraft fleet without running the risk of a parts shortage while, at the same time, holding inventory costs to a bare minimum

Airlines Consolidate, Automate Supply

through cautious quantity control. Engineering evaluation also enables an airline to avoid purchasing off-the-shelf items which may appear adequate but which, when placed into actual use, prove to be deficient.

One carrier, anxious to introduce its jets on as early a date as possible, selected its passenger seats off-the-shelf. Dissatisfaction with the product forced the carrier to design a completely new seat and repurchase the unit on a bid basis.

Purchase through contractual bids now appears to be the procedure most carriers employ for the inventory of new products. The carrier draws up its own specifications and then attempts to obtain as many as three bids for the project.

Roughly 15% of the 100,000 items the average carrier maintains in inventory are handled in this way. The balance of the items are normally ordered from the prime manufacturer.

In the local service airline industry, a newly formed Consolidated Airline Purchasing Corp. has been approved by the Civil Aeronautics Board.

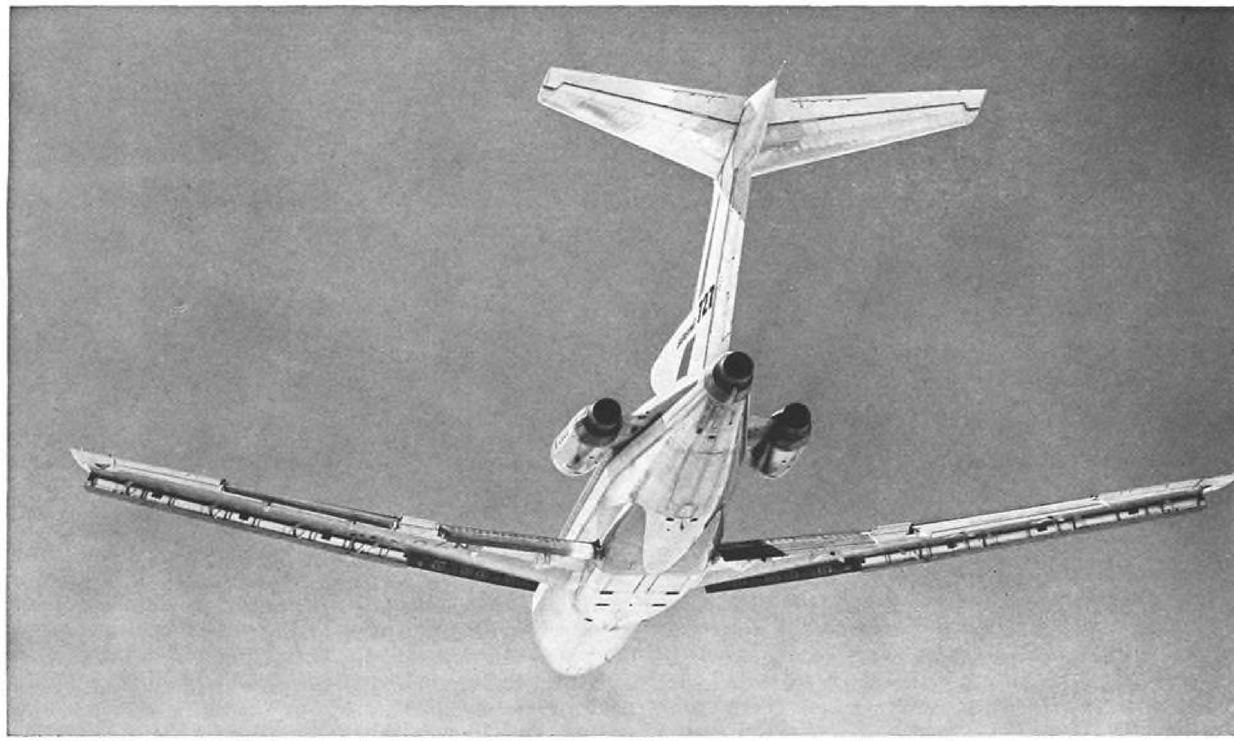
Purpose of the consolidated organization, initially considered by the Assn. of Local Transport Airlines two years ago, is to employ volume purchasing as a means of reducing business costs and lowering annual subsidy payments.

In practice, the corporation will be responsible for a continuing survey of airline member needs. Once it is determined that there is sufficient need for any specific item by several of the carriers, the corporation will be authorized to carry out the purchase, with emphasis on attaining the best possible discount on the basis of the order volume.

CAB has set a tentative limitation of $100,000 for the purchase of any single order by the corporation, plus a $250,000 limit on the amount of orders for the same item placed with any one company during the year.

As part of its operation, airline members will also list with the corporation any spare parts and equipment for sale. CAB has also conditioned its approval on the right to free access into the corporation's records and the location of the corporation's headquarters away from the headquarter cities of any of the local service airlines.

Other inventory and maintenance cost-reduction efforts by airlines include parts pooling and reciprocal engine overhauls. Trans World Airlines and American Airlines, for example, will overhaul each others powerplants (AW Aug. 19, p. 41). American can integrate the General Electric CJ805-3 engines from TWA's Convair 880 fleet into its work line for the CJ805-23B, the engine for American's Convair 990. TWA, in turn, will meld the Pratt & Whitney JT8D engines for American's Boeing 727s into its current P&W overhaul line. Both carriers will save substantially in tooling costs through the arrangement.



SLOW-FLIGHT CONFIGURATION of the Boeing 727 shows elaborate display of leading and trailing edge flaps and slats in extended position. Note that practically all of the wing rim area, except for tips and ailerons, is devoted to variable lift devices. Emergency fuel dumping is performed through trailing edge wingtip vents. In pre-delivery demonstration, the 727 has made 139 flights accumulating 195 hr. of flight time while covering 94,483 stat. mi.

Growing Need for Avionics Speeds Uses

By Kenneth J. Stein

Changing patterns of technology may reassert their influence on the direction of avionics developments in the coming year, reversing the swing that last year placed emphasis on funding considerations.

As the aerospace industry has become increasingly avionics oriented, it has required the services of advanced, high-speed data processors, more comprehensive and precise navigational gear, sophisticated communications and transponder capabilities, multichannel telemetry, and specialized input and output transducers.

Electronics producers have evolved systems and subsystems to meet the requirements in a continuing process of evolution that has seen individual discrete components develop to levels of capability and reliability compatible with the over-all demands of the system.

In effect, the changing technology tends to shift the identity of the proverbial weakest link.

A need to upgrade the quality of discrete components was intensified by the advent of solid-state circuitry and the inherent reliability of the transistor. Newer techniques, such as semiconductor microcircuits, already underscore the need for more attention to minute detail and more comprehensive testing and inspection.

As a growing number of aerospace and military avionics systems are committed to the use of semiconductor microcircuits, their application speeds the growth of a body of knowledge that leads to further developments in the art. Failures, as well as successes, will contribute to the body of knowledge.

Until communications satellites were actually in operation in orbit, no one could be sure that sufficient protection had been provided against irradiation effects and other environmental conditions in space. In the case of the Relay 1 satellite, for example, the weak link proved to be a wholly unexpected effect of extremely low temperatures on one critical transistor (AW Dec. 9, p. 53).

Irradiation, temperature and pressure may have been equally critical in other systems. Growing knowledge of the vagaries of the space environment and of the components and subsystems that may be exposed to it may be expected to lead to a more realistic appraisal of the parameters that must be measured to give meaningful projections of life expectancy.

With increasing use of semiconductor microcircuits, internal connections may become a new area of critical focus. Interconnections have already been a source of many problems as circuits have diminished in size, and one solution has been a master interconnect board as in the Advanced Minuteman computer system (AW Oct. 28, p. 70).

Solutions to these and similar problems will be forthcoming with increased application of semiconductor microcircuits, and current figures indicate that this increase is rapidly developing.

Sales of semiconductor microcircuits increased in the third quarter of 1963 to $4.2 million—a factor of almost three, compared with $1.4 million average quarterly sales for all of 1962. Shipments are expected to jump further next year.

Emphasis on command and control systems continues to expand, underscored by the recent dedication by USAF's Electronic Systems Div. of a new Systems Development Laboratory at Laurence G. Hanscom Field, Bedford, Mass.

The laboratory, to be operated by Electronic Systems Div. and the nonprofit Mitre Corp., will be to command and control systems what a wind tunnel is to airframes, one officer said. The facility will make use of its IBM 7030 (Stretch) computer and of rooms which may be configured as command posts for various systems under test to evaluate future command and control system concepts.

Corollary experiments will deal with improving communication between commanders and their data systems, with the intent of eliminating time-consuming programming of computers and translation of information into machine language. Future USAF L-designated systems are expected to benefit by the simulation techniques, which are certain to affect future procurement.

An application for the optical maser (laser) as a means of detecting clear-air turbulence through a laser radar technique which might detect shears, or discontinuities, not detectable by RF radars has been proposed. Scientists at Martin-Orlando speculate that the shear might provide sufficient reflection to laser energy.

In another application of the laser, NASA plans to test the device as a spacecraft-to-ground communications link.

Changing patterns are anticipated in another avionics area—aircraft nav/com equipment—according to guide lines established by Special Committee 101 of the Radio Technical Commission for Aeronautics.

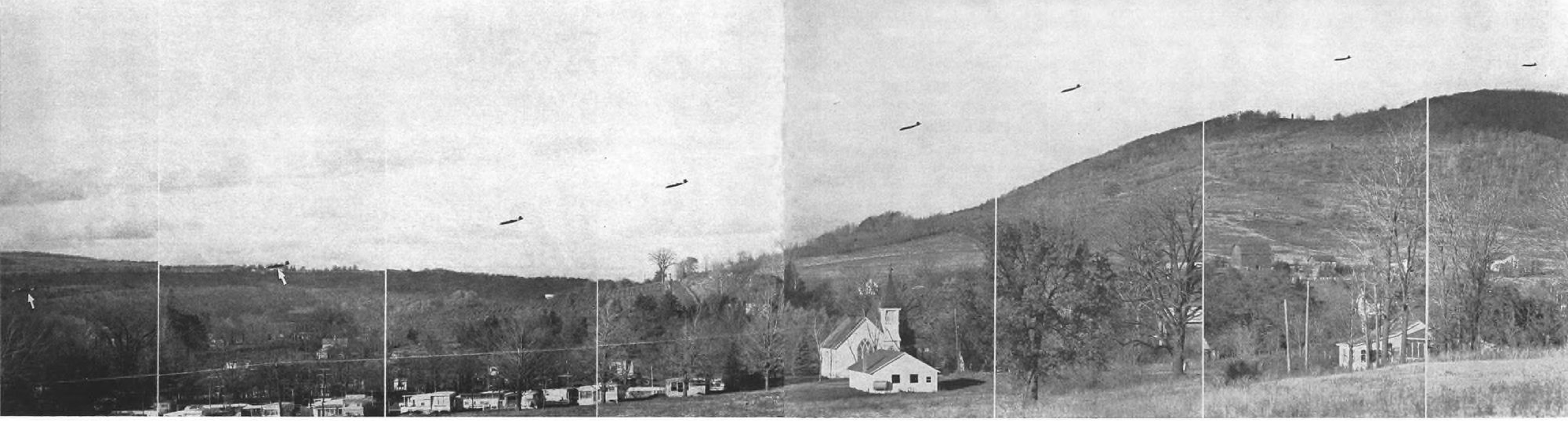
Prepared in the form of a priority list for avionics equipment for various classes of aircraft, the RTCA report considers the tools of air traffic control and navigation as related to Federal Aviation Agency plans for the future. On this basis, it establishes an order of priority for various equipment.

Equipment elements required, depending on services required from the ATC system, will include:

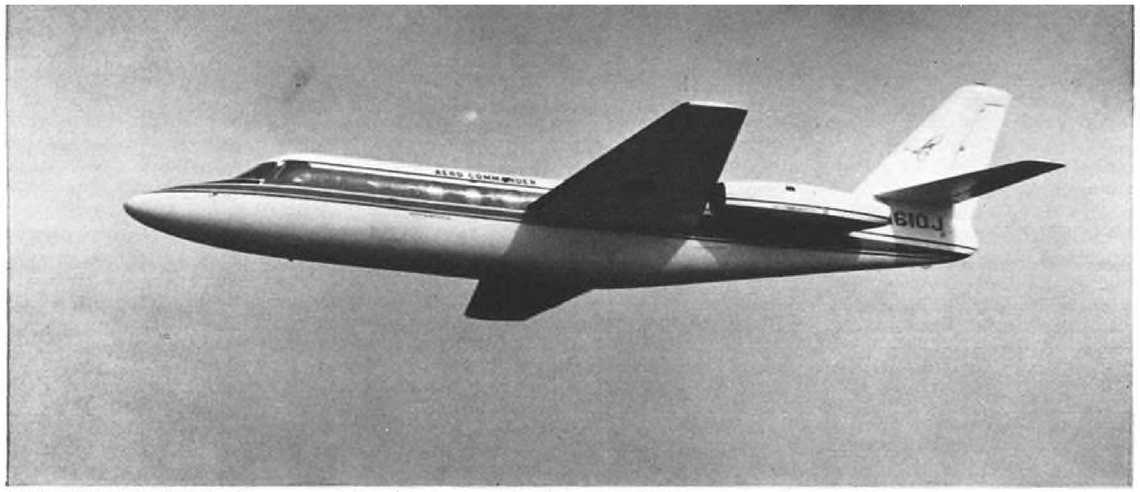
- **VHF communications.**
- **VOR navigation,** supplemented by distance measuring equipment (DME).
- **ATC transponder,** supplemented by automatic altitude reporing.
- **Off-set course capability** from VOR/DME by means of pictorial display or course-line computer.

The committee omits what it calls several "obvious" elements from its list, because they are not considered elements of the basic air navigation and ATC system, although they may be useful and functional. These omissions, and the reasons given for them, are:

- **Instrument Landing System (ILS),** facilities for which are currently provided only at major terminals constituting less than 3% of the total number of FAA-registered airports. Also, aircraft not equipped with ILS receivers can make IFR approaches through the use of other aids, the RTCA says. It calls ILS receivers a user's option.
- **Marker facilities,** for which the need is expected to decrease in future, particularly as DME is expanded. Alternate means are available for determining fixes, the commission says.
- **Automatic direction finder (ADF),** presently an "extremely useful and necessary equipment in certain airspace." However, use of the ADF as a basic navigation device is expected to decline in the future, and, for this reason, it is not listed in the required category, according to the RTCA.



MARTIN NB-57B FLYING FULLY-AUTOMATIC, low-level terrain avoidance system appears to maintain a constant altitude over sloping terrain in this series of rapid sequence photographs. Aircraft approached simulated target over low hills (far right) of the Finger Lakes area in New York state, then swept across the village. Cornell Aeronautical Laboratories, Buffalo, N. Y., developed the system, which it calls Autoflite, under contract from USAF Aeronautical Systems Div., Wright-Patterson AFB. Cornell's contract includes evaluation of advanced radar control systems and data processing techniques through ground simulation and flight experimentation. Cornell has been working in what it calls the terrain following field for more than 10 yr. Its work was presented to the President's Scientific Advisory Committee, along with these photographs. Pilot was John C. Seal of Cornell. Edward C. Schwartz, project engineer, monitored the equipment. Photographer used a Hulcher 70 mm. camera at five frames/sec.



AERO COMMANDER'S Jet Commander (above) is shown with added 30-in. fuselage section forward of the entrance door, lengthening fuselage to 50 ft. 11 in. Gross weight of the aircraft has been increased to 16,000 lb., allowing an increase in useful load to 8,760 lb. Jet Commander is powered by General Electric CJ610 turbojets. Upper wing surface is equipped with speed brakes.



NORTH AMERICAN SABRELINER (above) is shown during low-level turn with gear, flaps and speed brakes extended. Aircraft is powered by two Pratt & Whitney JT12A-5 engines. Dassault Mystere 20 mockup (below) has engine nacelles configured for the General Electric CF700 turbofan. Note Pan American World Airways markings on tail. Pan Am ordered 40 Mysteres (AW Aug. 12, p. 41), with options for 120 more. Dassaults sold in U.S. will have U.S.-built communications and landing gear components.



Manufacturers Review Component Buying

By Erwin J. Bulban

Dallas, Tex.—Business flying is continuing its record upward pace as a fast growing segment of the U.S. aerospace manufacturing and sales industry.

This year's production will probably run 600-700 more units than the 6,700 turned out in 1962, with a dollar volume approximately $15 million to $20 million higher than last year's $180 million retail value, the Aerospace Industries Assn. estimates. Industry leaders see no let-down in sight for next year.

Already the largest user of U.S. skies in number—80,000 airplanes versus approximately 2,000 scheduled airliners and 19,700 military aircraft—the private air fleet will markedly increase this disparity in just a few years, the Federal Aviation Agency estimates. In five years, 99,000 general aviation airplanes will be sharing the airspace over this country with approximately 16,500 airline and military types, the agency forecasts. Seasoned business aircraft industry observers believe FAA figures are on the conservative side.

Buyer preference continues towards faster, heavier, better-equipped, more costly single- and twin-engine aircraft. In five years, multi-engine business airplanes will outnumber scheduled airliners by nearly 12 to 1, FAA forecasts.

Growing sophistication in business aircraft and their equipment will be further accented in the coming year with deliveries starting of the new class of light jets, characterized by the Aero Jet Commander and the Lear Jet. This development, though several years behind the scheduled airline jet equipment transition, holds promise of exerting a comparable impact on business flying, although its portent probably will not be clear until 1965. Some now consider it plausible that the business aircraft jet fleet could number 3,500 units in the next decade.

The over-all numbers forecast by government and industry personnel in itself points toward the sizable market developing for suppliers and vendors to business flying airframe, powerplant and equipment companies and also in the service and maintenance fields. But they likewise point to problem areas that must be solved.

Competition in new product lines will definitely increase as additional suppliers tend to seek their share of the available business. From the airframe manufacturer's standpoint, he will be increasingly critical of quality and reliability and is looking more and more at his product as a system, rather than an airframe carrying a collection of equipment.

Indications are that the airframe builders are becoming less tolerant towards suppliers whose products show low scores in quality of workmanship or reliability, and they are developing approved supplier lists from which sources will be selected and rated continuously. In some cases, there is thought being given by airframe manufacturers towards developing new equipment specifications and then putting these out for bids and evaluation, similar to the system used by the military services.

Beech Aircraft Corp., one of the major business aircraft builders, spent $12 million in its 1963 fiscal year with suppliers and vendors—not counting raw materials, such as sheet metal stock—and does a spare parts and accessories business of better than $7 million annually. Expectations are that this latter phase of its operations is headed for a large increase in future years. Other airframe builders are showing similar robust spares and accessories sales.

This part of the business itself is an indication of where problems are developing. The airframe builders are tending to enlarge their volume of items purchased from vendors, but with the aircraft manufacturer's trade name on it and his own distributor-dealer network handling marketing. The original parts manufacturer is attempting to market similar items under his own trade name, often to the operators of the same airplane. Then there are major distributors of these part lines and equipment manufacturers who are trying to hew out a share of this market and are also increasing competition.

Exact data on how much business these distributors are currently doing is difficult to assess, since they do not readily furnish sales figures. But 31 members of one distributor association are doing approximately $7 million monthly supplying the needs of airlines and fixed base operators, with probably less than half this dollar volume in airline sales.

A typical large parts and accessories distributor, Southwest Airmotive Corp., expects to do about $4 million in business in its 1964 fiscal year, half of this in the general aviation market. The territory Southwest Airmotive serves covers 15 states, requiring nine district offices in addition to its home base at Love Field, Dallas. Southwest Airmotive estimates it has about 1,000 customers in its territory and these can range in volume from $200 per month to as much as $50,000 monthly for bigger accounts.

This distributor has been gearing for the build-up in the general aviation market in recent years. At one time approximately 80-90% of its volume was with scheduled airlines.

A primary concern for both airframe and equipment manufacturers is development of additional sales outlets to be able to reach more prospects and provide the airplanes that are flying with greater utility by making more landing and service facilities available.

It is already apparent that such facilities have not kept pace with the growth of the industry. Hangar space is at a premium. A recent Beech survey showed that the bulk of this country's general aviation fleet—about half the multi-engine and three-fourths of the single-engine aircraft—are located in 400 communities, all of which have populations of 75,000 or less. But at airports at these localities there were approximately 28 airplanes for every maintenance or storage hangar.

Also, a detailed Cessna survey, completed this year, pointed out that there were only 3,054 verified fixed base operators against a total of over 7,000 airports, indicating a dearth of operators. Considering that attended airports averaged 2.5 operators, this means that several thousand airports lack adequate sales, service and maintenance facilities.

General Aviation Aircraft By Category Estimated 1960-1970 Fleets

Year	Multi-Engine	Single-Engine 4-5 Place	Single-Engine Other	Total
1960	6,926	34,478	34,424	75,828
1961	7,700	35,500	33,400	76,600
1962	8,300	37,500	34,100	79,900
1963	8,900	39,500	34,800	83,200
1964	9,500	41,500	35,500	86,500
1965	10,000	44,000	36,000	90,000
1966	10,800	46,400	35,800	93,000
1967	11,600	48,800	35,600	96,000
1968	12,400	51,200	35,400	99,000
1969	13,000	53,600	35,200	102,000
1970	14,000	56,000	35,000	105,000

Source—Federal Aviation Agency



AMPLIFICATION/DISPLAY of TRANSDUCER SIGNALS

Compact portable unit includes oscillator for transducer ac excitation, high-gain carrier-type amplifier, phase-sensitive demodulator, power supply and large, multi-scale meter. Model 311, $375. Battery-operated 2-pound version, Model 312, $300. Wide range of Sanborn transducers also available for linear displacement, velocity, low force, pressure; prices on request.



100th Sec. X-Y RECORDING

Optical recording speeds to 2500 in/sec., frequency response to 130 cps within 3 db. Direct readout 8" x 8" daylight-loading charts; 1% linearity; interchangeable "850" preamps for each axis. Model 670A X-Y Recorder including case, $2,335 (without preamps).

7-CHANNEL FM or DIRECT RECORD DATA RECORDING



Economical 4-speed (3¾" to 30"/sec) magnetic data recording system, with interchangeable FM and direct record/reproduce electronics in 7" panel space. Compatible with Sanborn preamplifiers and systems, meets IRIG telemetry standards. Series 2000 with FM electronics, $7200. Compatible Model 769 17" Multi-Trace scope, for visual readout or input monitoring, $1145 (not including Gating Amplifiers).



EVENT RECORDING

Up to 120 channels of on/off events as short as 1.3 ms, on 16" wide, dry-process electrically-sensitive chart; complete system with blowers in 19¼" panel space. 9 standard speeds, 9 more optional. Model 360 Event Recorder, $3900; Model 360-2100 Writing Control, $975. Rack mounted 30-channel Model 361 also available, price on request.

Sanborn

RECORDING, READOUT AND DATA HANDLING INSTRUMENTATION

Ask your nearby Sanborn-Industrial Sales-Engineering Representative for a complete Industrial Catalog and experienced application help. Representatives in principal cities throughout the U.S., Canada and foreign countries.

INDUSTRIAL DIVISION

SANBORN COMPANY

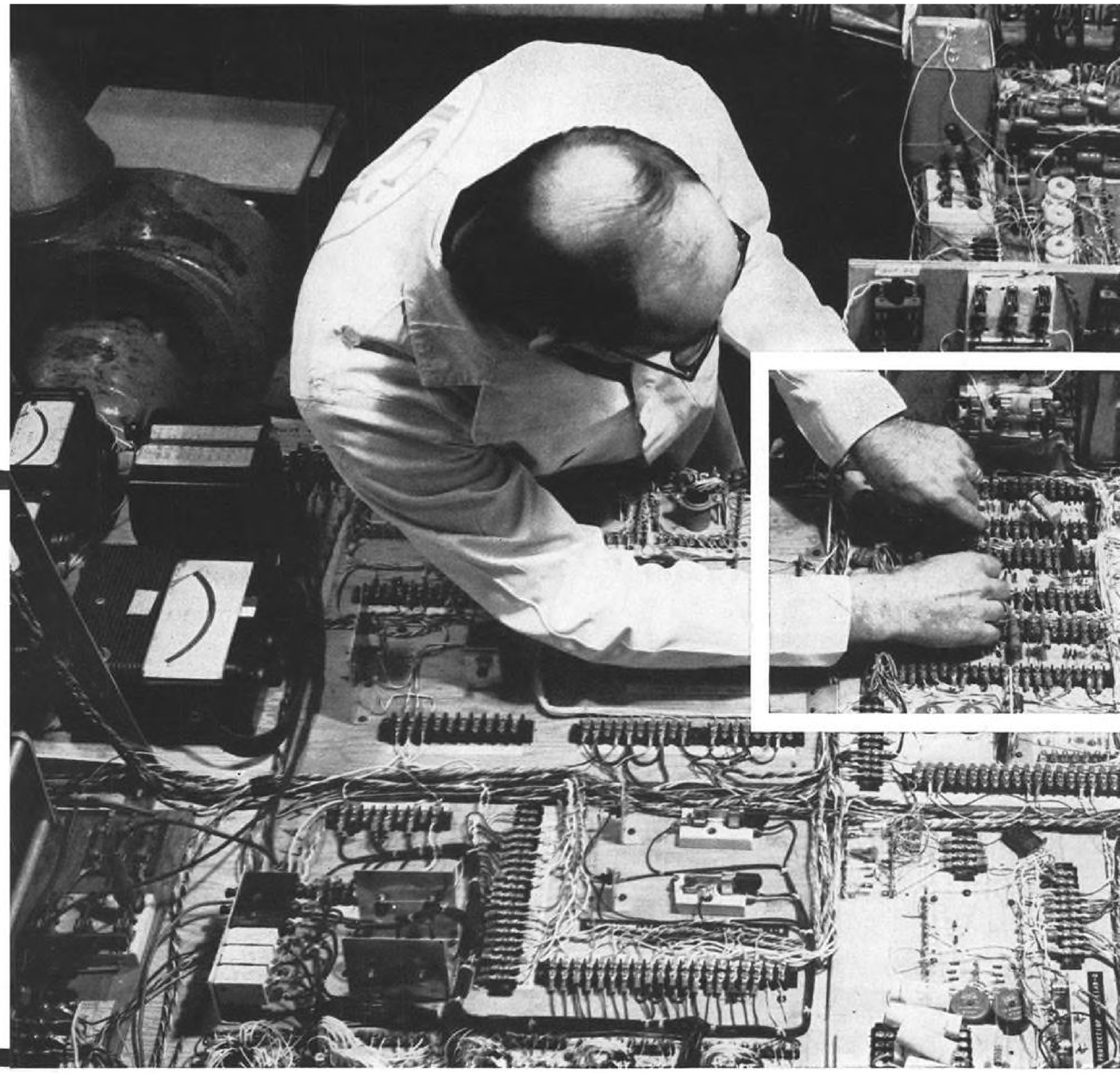
WALTHAM 54, MASSACHUSETTS

A Subsidiary of Hewlett-Packard Company



DC-5 KC DIRECT-READOUT RECORDING

Up to 24 channels of direct-readout optical oscillographic recording; response to 3 KC over full scale, DC to 5 KC over 4" amplitudes with single set of galvanometers; 7" high medium-gain amplifier in 8-channel modules. Model 650 system with 8-channel galvanometer block but without inserts or amplifier, $3200.



DATA AMPLIFIERS



Miniaturized (2" x 7" panel), versatile amplifiers. DC-10 KC "FIFO" (Floating Input, Floating Output), completely transistorized; gain 1000, particularly useful for extracting low level signals in the presence of high common mode. 1 ms recovery from 20 V overload, high common mode rejection. Other models with DC-50 KC and DC-100 cps bandwidths. Model 860-4000 FIFO, $825. Prices of others on request.



DIRECT WRITING OSCILLOGRAPHIC RECORDING — 1 to 16 Channels

Clear, rectangular coordinate recording by heated stylus. Wide choice of basic systems for 1, 2, 4, 6, 8, 12, 14 and 16 channels; most have plug-in interchangeable preamplifiers or 8-channel amplifier modules. Basic assembly prices (without amplifiers) range from $3300 for 8-channel "950" style to $6270 for 8-channel "350" style. Typical 2-channel mobile basic assembly, $1575. Single channel portables from $700-$750. Prices of wide variety of amplifiers on request.



ALL PRICES F.O.B. WALTHAM, MASS., U.S.A., AND SUBJECT TO CHANGE WITHOUT NOTICE. STATE AND LOCAL TAXES ADDED WHERE APPLICABLE.

Circle Number 66 on Reader-Service Card

LEAR-SIEGLER, INC. / LSi

POWER EQUIPMENT DIVISION

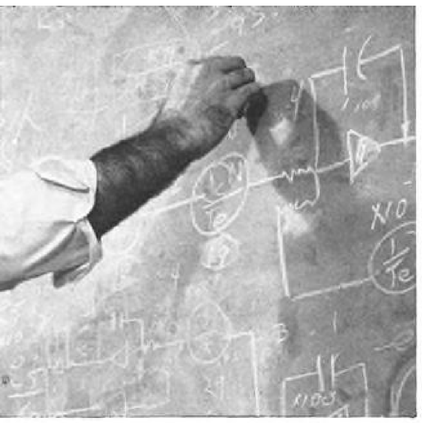
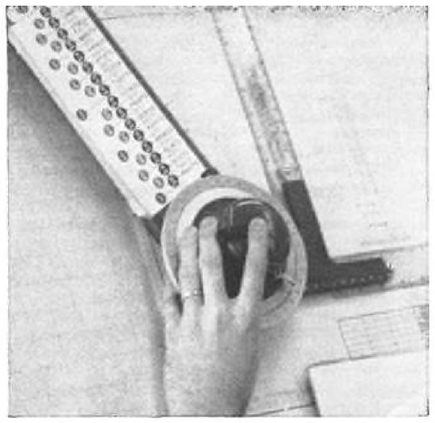
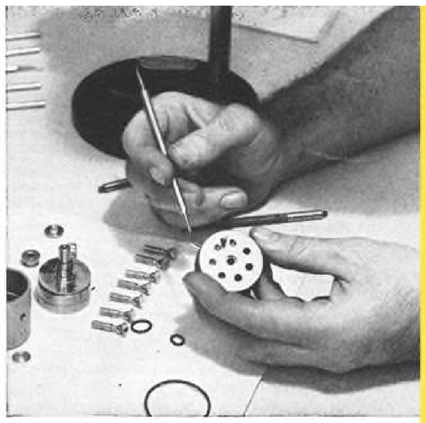
Formerly Jack & Heintz, Lear Romec and Lear Electro-Mechanical

P. O. Box 6719, Cleveland 1, Ohio • Phone 216-662-1000

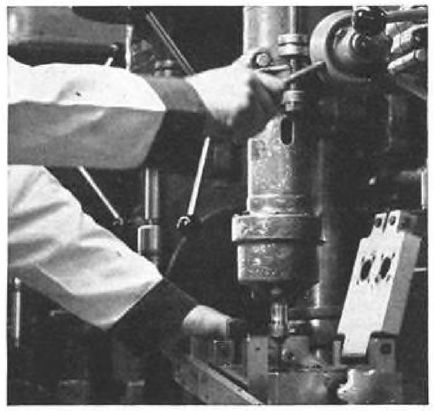
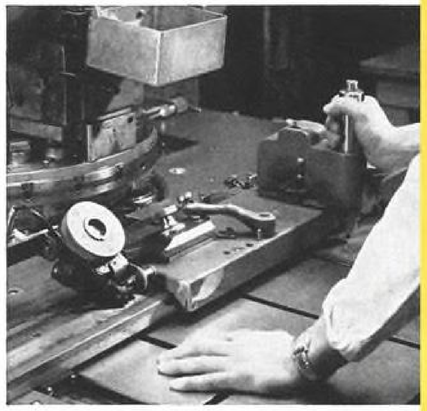
ROMEC FACILITY

241 South Abbe Road, Elyria, Ohio • Phone 216-323-3211

ELECTRIC GENERATING SYSTEMS • MOTORS, STARTERS AND ACTUATORS

LET
PED*
GIVE
YOU
A HAND

11161-LS

* PED is the new Power Equipment Division of Lear Siegler, Inc. . . . the combined resources of three famous names in the aerospace industry . . .
Jack & Heintz, Lear Romec and Lear Electro-Mechanical.
Now . . . with a new combination of capabilities, men and ideas, PED is developing high performance electro-mechanical, hydraulic and pneumatic sub-systems to provide the muscle for tomorrow's aerospace vehicles and support systems. If your requirements call for reliable energy conversion sub-systems to withstand space environments you should consult PED.

FLUID SYSTEMS • SERVOS AND CLUTCHES • ELECTRIC DRIVE SYSTEMS

Circle Number 95 on Reader-Service Card

THE PRODUCT

Over 15,000 different products backed by more than 3,300 U.S. and foreign patents issued or pending. A solution to almost every conceivable connection problem in the electrical/electronic industries. Dependable product performance and long-lasting reliability assured by quality control checks all along the line of manufacture from receipt of raw materials on through to the finished product. Research and Testing facilities second to none in the industry with constant and continuing efforts to improve existing products and developments of new products for Space Age needs.

THE TECHNIQUE

A controlled compression crimping technique for terminating the widest range of wire sizes of every type—solid, stranded and irregularly shaped —singly or in any combination. Reliability assured through matching tool to terminal so that every connection of a given size and type is perfectly identical in appearance and performance by the tens or the tens of thousands. Color coding of terminal and matching tool to maintain operator errors at an absolute minimum and further add to the quality control measures utilized in creating the basic product. An end result of unqualified superior performance, maximum reliability and conformance to the most stringent commercial and military requirements.

THE COMPANY

A worldwide network of manufacturing and distributing facilities with complete duplication of products and services strategically located to fulfill customer needs promptly and efficiently. A knowledgeable sales force backed by Field Service Engineers, Creative Analysis Teams, Employee Instruction Personnel, New Product Seminars, the AMP Mobilab, modern Research and Testing facilities and a Speed Order Service for fastest possible delivery of the product.

AMP . . . PIONEER AND WORLD LEADER IN THE DEVELOPMENT AND MANUFACTURE OF SOLDERLESS TERMINAL AND CONNECTOR PRODUCTS FOR SPACE AGE ELECTRICAL/ ELECTRONICS CIRCUITRY.

AMP

For a brief description of the products listed below, see the following pages:

- Coaxial cable and shielded wire products
- Pin and socket multiple connectors
- Programming devices
- Printed circuit connectors
- Taper technique
- Hermaphroditic connectors
- Application tooling

FOR FURTHER INFORMATION ON ANY OF THE PRODUCTS LISTED, CIRCLE THE READER SERVICE CARD NUMBER INDICATED NEXT TO THE PRODUCT.

COAXIAL CABLE AND SHIELDED WIRE PRODUCTS

COAXICON★ CONNECTORS (1)

A complete line of multiple and single-in-line connectors for coaxial cable covering RG/U cable sizes .075" to .250". Terminations are made with AMP's exclusive one-stroke crimping action—**one stroke of the matching A-MP★ crimping tool terminates inner conductor, outer braid and cable support**—simultaneously! Contact plating—AMP standard **gold over nickel**—assures maximum conductivity and long time reliability.



MINIATURE—(Type IV Contact) 12 and 20 positions



STANDARD—18, 24 and 34 positions



BNC—bayonet coaxial connector for quick connect/disconnect — meets requirements of MIL-C-3608



Threaded Nut Connector — standard and miniature sizes —special hardware adaptation for through panel installation



Coaxial and Pin and Socket mix

TERMASHIELD★ SPLICES AND FERRULES (2)



Selection includes pre-and-post insulated types for both single and multiple conductors. Choice of nylon and TEFLON† insulation. Included are special heat-resistant ferrules and specially designed pre-insulated ferrule for use with printed circuit boards. Crimping process assures connections of maximum conductivity, high resistance to adverse environmental factors and a tensile strength approaching that of the wire itself.

PRINTED CIRCUIT CONNECTORS

AMP-INCERT Printed Circuit Connectors are available in one and two piece types featuring crimp, snap-in contacts. Connectors are **not** pre-loaded—**only those contacts necessary to meet circuit requirements need be used!** Special contact design assures controlled pressures . . . reduces wear on circuit paths. Matching A-MP tooling for crimping contacts available in choice of hand, semi-automatic and fully automatic types. Contacts feature gold over nickel plating.



RIGHT ANGLE CONNECTOR —Pin and Socket contacts . . . 19 positions. Sealed and/or unsealed.



AMP-LEAF★ CONNECTORS —8, 15, 18, 22 and 30 positions. Conforms to MIL-C-21097A.

(5)



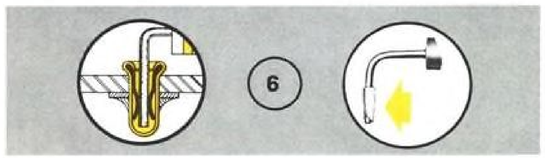
AMP-BLADE★ CONNECTORS —17, 23, 29, 35, 41 and 47 positions. Conforms to MIL-C-21097A.



DUO-TYNE★ FLAG CONNECTORS —One-piece right angle connector. 3 to 22 positions.

REUSABLE COMPONENT TEST RECEPTACLE (left)—provides easier, faster . . . **least expensive** method of mounting components for "burn-in" and other test procedures. Component leads are hand-inserted into drawn brass cup and held in place by integral spring receptacle. Solderless method extends board life . . . saves valuable components from damage. One size receptacle accepts leads of varying diameters and can be used up to 100 times.

CIRCUITIP★ TERMINALS (right)—component tip for improved solder dip attachments. Can be applied at rates up to 7,200 tips per hour with A-MP Component Tipping Machine.



(6)

PIN AND SOCKET MULTIPLE CONNECTORS



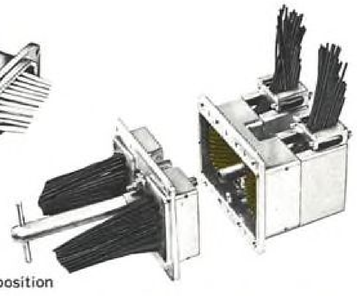
SERIES "M" 14, 20, 21, 26, 34, 41, 50, 75 and 104 position



SERIES "D"—78 position



SERIES "W" 26 and 40 position



SERIES "D-D"—156 position

(3)

AMP-INCERT★ Pin and Socket Connectors in a full range of sizes and configurations. Connectors feature crimp, snap-in type contacts. Standard hardware available for all connectors. Line satisfies and exceeds applicable Military and commercial requirements. Choice of screw-machine or formed contacts in single-piece or strip form for application with A-MP hand, semi-automatic or fully automatic matching crimping tools. Plating—gold over nickel—standard with AMP!



SERIES "A"—Meets electrical and environmental requirements of MIL-C-26518. Metallic shell—sealed or unsealed—50 and 100 positions. Rack and panel or bulkhead mounting. Screw-machine contacts exclusively. Center to center spacing of .150".



SUBMINIATURE—High density, 50 position connector. Center contact spacing of .060". Wire range 25-32. Insulation support.

TAPER TECHNIQUE

Miniaturized terminals for high density applications. Both pre-and-post insulated, formed and solid type taper pins to mate with a variety of one or two piece stackable nylon taper blocks. Pins are self-cleaning and self-locking—compression-crimped to the conductor for insured uniformity of connections. Newest addition to the line, TAYP-AIR★ Pins, feature elongated pins which provide extreme vibration resistance.



TAYP-AIR ASSEMBLY

(7)



STANDARD ASSEMBLY



INSULATED and NON-INSULATED



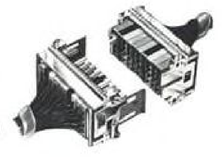
STACKED TAPER BLOCKS

DUALATCH* CONNECTORS

Hermaphroditic connector line in standard and miniature sizes —modular miniature, 40, 60 and 132 position miniature and 200 position standard. Self-cleaning contacts are crimp, snap-in type and gold over nickel plated to AMP standards to resist oxide-insulation build-up. Same contact fits both connector halves.



(8)



200 CONTACT CABLE CONNECTOR—can be electrically disengaged without mechanical uncoupling. Cable outlet positioned at either 45° or 90°.



PROGRAMMING DEVICES

PATCHCORD—Boards in both universal and shielded construction. Standard rack mounted types and new "space-saver" model which mounts **into** rather than **onto** panel. Crimped contact design offers double wiping action for assured reliability. Double detent retention feature of patchcord prevents accidental dislodgement.

(4)





TOOLING

The AMP concept of matching tool and terminal has resulted in a precision crimp which assures maximum tensile strength and electrical conductivity. From hand tools for limited production, to high speed automatic crimping machines capable of 12,000 terminations per hour, the AMP crimping method is identical and precise.

(9)



★Trademark of AMP INCORPORATED.

†Trademark of E. I. duPONT.

A-MP® U.S.A. and Foreign. A-MP® products covered by U.S. and foreign patents and/or patents pending.

TERMINALS AND SPLICES

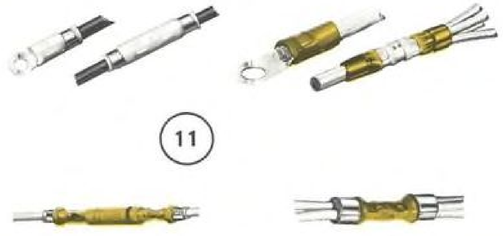
In these categories, we offer industry's broadest lines of products designed for basic connection problems in the electrical/electronic fields. Available in every shape and size, and covering the entire spread of industry used wire size ranges, our terminals not only meet but in many cases actually exceed the most stringent commercial and military specifications. They are available in un-insulated and pre-insulated types, in various base materials and in a complete selection of platings ranging from the most common to precious metals. All of them offer the advantages that go with our matched tool and terminal crimping technique — high resistance to corrosion, shock and vibration and superior conductive ability.

All of the above features can also be ascribed to our line of splices. Again, these are available in both un-insulated and pre-insulated types for the entire range of most commonly used wire sizes. The line also includes specially designed splices which are highly resistant to adverse environmental factors such as moisture or extremes of heat and cold.

From computers to power-stations, in ground control installations and in super-sonic aircraft, in the whole range of consumer oriented products, wherever a wire must be terminated to complete a circuit or in any manner effect the workings of an electrical or electronic function, you'll find A-MP Terminals and Splices. Industry proved, over the years, they offer superior performance and long-lasting reliability at the lowest possible installed cost.



10



11

RESEARCH AND TESTING

12

Our research and testing facilities have always played a very important part in the improvement of existing products and the creation and development of new products. From the very beginings, our concern with reliability and quality has manifested itself in considerable expenditure and effort and facilities second to none in the industry. Continuing programs in research have been responsible for the development of new platings and plating techniques designed for today's refined and complex equipments. Out of this activity has come an X-ray technique for measuring metal thicknesses which helps control platings to one-millionth of an inch. In our research and testing activities, continuing study is being given to the effects of radiation on electrical connections.

In our Testing Laboratory, the very latest equipment is employed to subject all products, existing and in the making, to thorough and rigorous testing under all conditions with the result that in many instances the findings have been adopted as standards by both commercial and military segments served by the industry.

In keeping with the reliability demands of our Space Age technology, this facility includes four "white rooms" for the ultra-refined testing of electrical/electronic connections and components.



For specific information on all AMP products, write to:

AMP INCORPORATED
Harrisburg, Pennsylvania

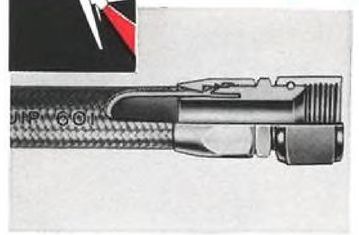
INDUSTRIAL SALES DIVISION

AMP products and engineering assistance are available through subsidiary companies in: Australia Canada • England • France • Holland • Italy • Japan • Mexico • West Germany

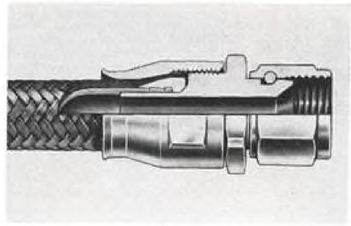
E-11-3—180M—PP—6-63

Printed in U.S.A.

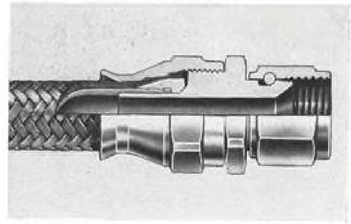
Aeroquip Quality Products Simplify



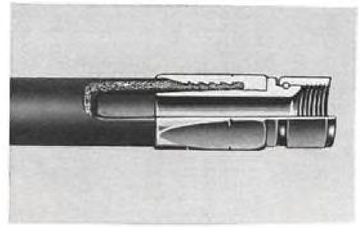
Aeroquip 601 Lightweight Engine Hose and reusable ***"little gem"*** Fittings for engine fuel and oil lines. Temperature range −65° to +300°F. Hose sizes -3 to -24. Fittings in steel for -3 to -5, aluminum -6 to -24. Catalog 105.



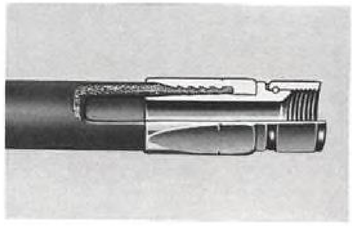
Aeroquip 666 and 667 Hose of Teflon* and reusable ***"super gem"*** Fittings for 1500 psi. systems in accordance with MIL-H-27267 (USAF). Hose sizes —3 to —20. Fittings in stainless steel, carbon steel and aluminum. Catalog 106.



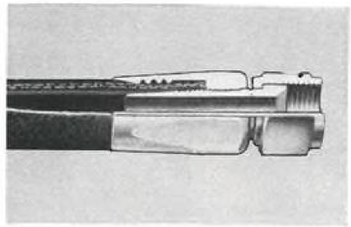
Aeroquip 677 Hose of Teflon and reusable ***"super gem"*** Fittings for 3000 psi systems in accordance with ARP604A. Hose sizes available —4 thru-12. Fittings in stainless steel and carbon steel. Catalog 106.



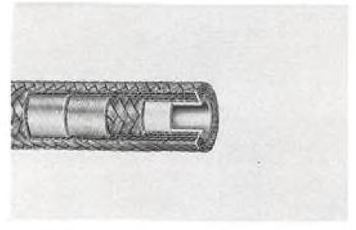
Aeroquip 611 and 602 Hose and reusable fittings for SKYDROL ** fire-resistant hydraulic fluid systems. 611 Hose for 3000 psi systems; 602 Hose for 1500 psi systems. Hose and fittings conform to military specifications. Hose sizes -4 to -20. Catalog 105.



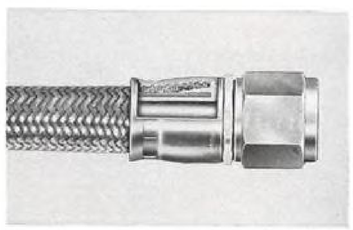
Aeroquip 309 Hose and reusable fittings for 3000 psi hydraulic and pneumatic systems in accordance with MIL-H-8790. Hose sizes -4 to -16. Fittings conform to MS28760 and MS28761. Catalog 105.



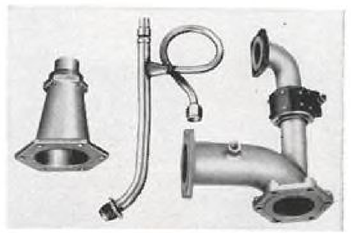
Aeroquip 303, 302A Hose and reusable fittings for aircraft hydraulic, pneumatic, fuel, oil and coolant systems in accordance with MIL-H-8795. Hose sizes -3 to -48. Fittings conform to MS28740. Catalog 105.



Aeroquip High Pressure Pneumatic and Oxygen Hose for ground support equipment. High density polyethylene hose for pneumatic applications (air) to 6000 psig. Hose of Teflon is recommended for extreme temperature gaseous applications. Write for Catalog 106.



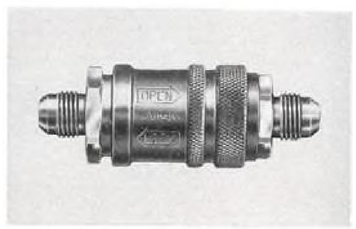
Aeroquip Hose of Teflon with Super-C permanently attached Fittings handles fuels, oils, alcohols, coolants and solvents used in aircraft. Temperature range: —67° to +400°F. Medium pressure assemblies (1500 psi) meet specification MIL-H-25579B, and high pressure (3000 psi) meets ARP604A industry standard.



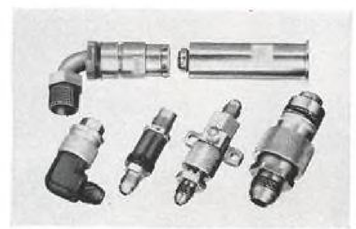
Aeroquip Precision Tube and Fitting Assemblies to specification. Capable of bend ratios less than 1 to 1 and with controlled wall thin out. Seamless aluminum, carbon or stainless steel, titanium, monel and others in standard and thin wall. Certified welding and brazing facilities. Write for information.



Aeroquip 3200 Self-Sealing Coupling for 3000 psi aircraft and missile hydraulic systems. Conforms to MIL-C-25427. Temperature range —65° to +275°F. Sizes -4 to -16. Bulletin AEB-65.



The Aeroquip 3900 Series Quick-Disconnect Coupling is designed for safety and reliability when used with hard-to-handle fluids. Positive valve action eliminates spilling, leaking or spraying and permits easy one-hand connection. Operating pressure 1000 psi, sizes -4 through -20.



Aeroquip Special Quick Disconnect Couplings can be designed and produced to meet practically any requirement on aircraft, missile, ground support and electronic equipment; for hydraulic, pneumatic, fuel, lube oil, corrosive fluids, gases and electronic coolants. Write for Bulletin 254.

"super gem" Fitting U.S. Patent Nos. 2,833,567 and 2,731,279

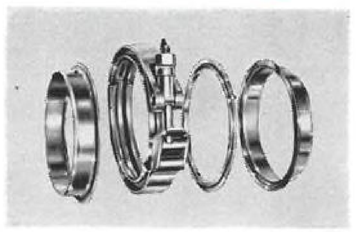
*Du Pont trade name for its tetrafluoroethylene resin.

**Monsanto trade name for its phosphate-ester base hydraulic fluid.

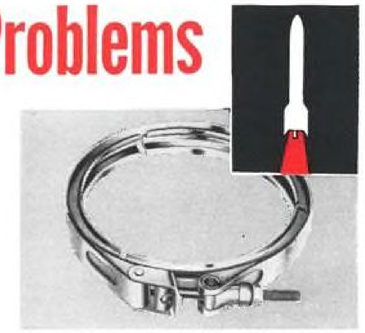
Aircraft and Missile Design Problems



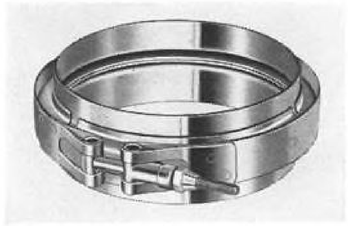
Marman All-Metal CONOSEAL Joints for connection of tubing and ducting of dissimilar metals subject to extreme temperatures, pressures and linear deflections. Temp. range —425° to +1500°F; up to 4500 psi, union fitting 16,000 psi. Standard sizes for 1″ to 12″ O.D. tubing. Catalog 800. *MARMAN DIVISION.*



Marman J11 and LJ11 Joints are used to connect standard tubing for fuel, hot air, and gas systems. Sizes range from 1″ through 8″ tube O.D. Temperature range is —65° F. to +1000° F., operating pressures to 840 psi. Catalog 800. *MARMAN DIVISION.*



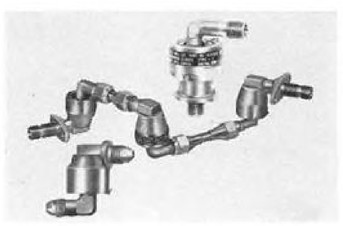
Marman V-Band Couplings and Flanges connect and seal all types of tubing, piping, ducts, and containers. Sizes are available from 1″ through 12″ tube O.D. Temperature range —65° F. to +800° F., operating pressures to 840 psi. Catalog 800. *MARMAN DIVISION.*



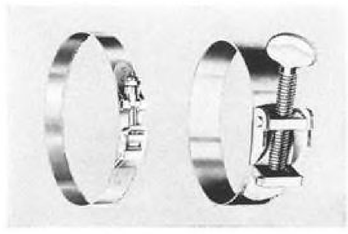
Marman TJ-13 Joint with titanium flanges for use on bleed air applications with titanium ducting, where weight is a critical factor. With no gasket to install, the joint is easy to assemble. Available in other materials to meet a wide range of performance capabilities. Catalog 800. *MARMAN DIVISION.*



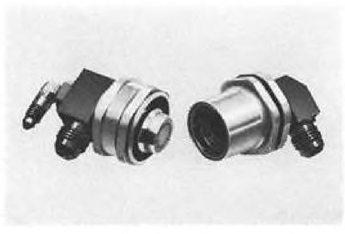
Barco Ball Joint for Cryogenic Piping handles fluid fuels and oxidizers including liquid oxygen. Temperatures: —320°F to +275°F. Pressures: 200 psi operating, 300 psi proof, 700 psi burst. Sizes 3″—12″. Write for information. *BARCO DIVISION.*



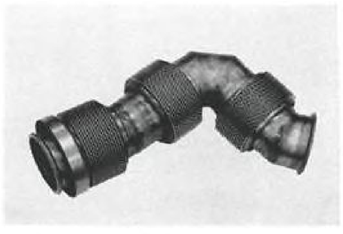
Barco Self-Aligning Swivel Joints designed to meet practically any aerospace requirement. 360° swivel, 10°-15° self-alignment, lightweight, compact. For systems up to 8000 psi, in accordance with MIL-J-5513A; temperature range —320°F. to +1200°F. Catalog BPB-103 and 104. *BARCO DIVISION.*



Marman Band Clamps and Straps for support and connection of components and accessories. Wide range of sizes and styles in aluminum, steel and stainless steel. Write for information. *MARMAN DIVISION.*



Aeroquip Electronic Coolant Quick Disconnect for rack-and-panel mounted electronic modules provides for automatic connection and disconnection of fluid lines as modules are inserted and removed. Write for Bulletin 254.



Marman Flexible Duct Assemblies for compressible or non-compressible fluids can be fabricated to special requirements in stainless steel and aluminum ducting, with straight, link and gimbal type bellows assemblies, connected with high performance tube and duct joints. Write for information. *MARMAN DIVISION.*

"super gem", "little gem" and CONOSEAL are Aeroquip Trademarks.

Aeroquip

REG. TRADEMARK

AEROQUIP CORPORATION • AIRCRAFT DIVISION • JACKSON, MICHIGAN

JACKSON PLANT, JACKSON, MICH. • WESTERN PLANT, BURBANK, CALIF. • ELBEECO PLANT, JACKSON, MICH. • DALLAS PLANT, DALLAS, TEX.

AEROQUIP CORPORATION • MARMAN DIVISION • LOS ANGELES, CALIFORNIA

AEROQUIP CORPORATION • BARCO DIVISION • BARRINGTON, ILLINOIS

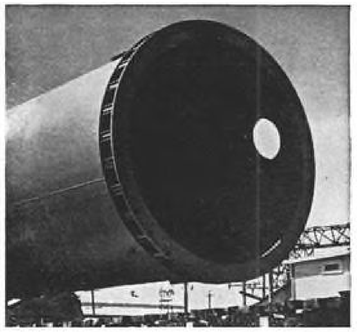
In Canada: Aeroquip (Canada) Ltd., Toronto 19, Ontario • In Germany: Aeroquip G.m.b.H., Baden Baden-Oos

AEROQUIP PRODUCTS ARE PROTECTED BY PATENTS IN U.S.A., CANADA AND ABROAD

Circle Number 107 on Reader-Service Card

For the frozen frontiers: a family of steels to which zero means nothing

Strange things happen in the world of ultracold. Some metals get stronger but sometimes so brittle they shatter like glass. Others become superconductors. The load-carrying capacity of some fluctuates wildly. Material selection, in this strange Pandora's Box world, must depend on carefully accumulated perform-



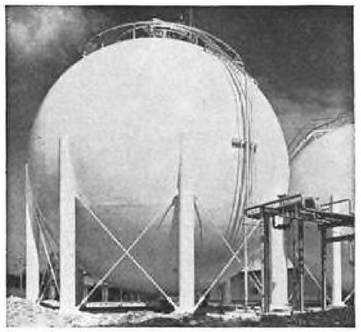
This 56-ft.-long absorber unit is fabricated of A212 steel plate, popular for services requiring notch toughness down to —50F.

ASTM A201 and A212: for many years the only low-temperature steels available

These two carbon steel grades are widely used for a variety of applications requiring notch toughness down to —50F, such as refrigerated vessels for the storage of liquid propane or ammonia.

ASME allowable design stresses (¼ tensile) are 15,000 psi for A201 Grade B and 17,500 psi for A212 Grade B steels.

Both grades are available in flange or firebox qualities. When specified to meet the impact requirements of ASTM A300 to —50F, the plates may be furnished in the normalized or normalized and stress-relieved condition to meet the minimum requirements for the specific application.



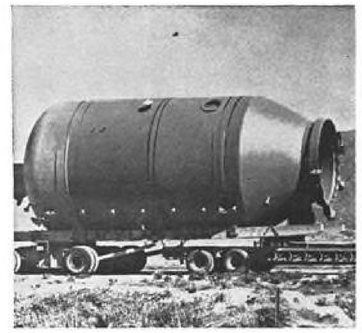
USS "T-1" Steel's excellent notch toughness, high strength, and weldability permit high working stresses in low temperature service.

USS "T-1" Steel: can cut pressure vessel weight up to 50%

USS "T-1" Steel combines great strength (100,000 psi min. yield strength), weldability, and low-temperature toughness (15 ft.-lb. min. Charpy keyhole at —50F). It is particularly suited for highly stressed pressure vessels operating at temperatures down to —50F, tank trucks for hauling LP gases, and welded lightweight structures.

Present allowable ASME stress for "T-1" Steel is 28,750 psi for plates up to 2" thick. In non-Code vessels, "T-1" Steel has been used at allowable stress levels as high as 50,000 psi.

In a series of dramatic burst tests, USS "T-1" Steel vessels withstood internal hydraulic pressures up to 2850 psi at about —45F before bursting, equivalent to a circumferential stress of 136,000 psi. Another series of "T-1" vessels, refrigerated to about —45F and pressurized to 1875 psi, were tested to destruction by impact from a 13-ton ingot dropped successively from 52, 73, and 101 feet. An impact energy of nearly 2,700,000 ft.-lbs. was required to rupture the vessel.



This 2¼% nickel steel static altitude test chamber operates at temperatures ranging from —65F to 500F.

USS 2¼% Nickel Steel: down to –75F

2¼% nickel steel has been used widely for tanks, vessels, and piping handling liquid propane and other liquefied gases at temperatures down to —75F. It has been used particularly by the chemical industry for process and containment vessels. Specialized uses include equipment such as static altitude test chambers operating at temperatures as low as —65F to simulate 75,000 ft. heights.

2¼% nickel steel is governed by ASTM A203, Grades A and B. Grade B is most widely used because of its allowable design stress of 17,500 psi compared to 16,250 psi for Grade A.

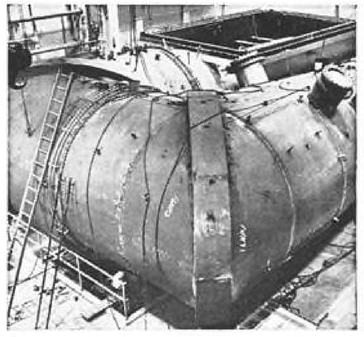
These steels are also covered by SA-203 of the ASME Boiler and Pressure Vessel Code.

This mark tells you a product is made of modern, dependable Steel.

ance data. We have a wealth of such data at United States Steel, plus comparative design studies, that will make your material problems easier. Ask for a USS cryogenics specialist by calling our nearest sales office, or writing United States Steel, Room 6834, 525 William Penn Place, Pittsburgh, Pennsylvania 15230.



Non-stress-relieved 9% nickel steel vessel was refrigerated to —320F, pressurized to failure—at four times ASME allowable stress. Note ductile manner of failure.



3½% nickel steel wind tunnel simulates, among other things, the frigid temperatures of altitudes up to 16 miles and over.



Type 304 stainless coil heat exchanger retains strength, stability, and shock resistance in cryopump operating at —443F.

USS 9% Nickel Steel: excellent strength and notch toughness down to –320F

Developed, tested, and proven for cryogenic service, 9% nickel steel offers a rare combination of high yield strength, toughness, and weldability. It is particularly suited for large-tonnage oxygen producing equipment, and for the transportation and storage of liquid methane, oxygen, nitrogen, and argon. Because it doesn't require stress relief after fabrication in most shell thicknesses, it is a natural for large field erected tanks and vessels.

The ASME allowable working stress of 23,750 psi (Code Case 1308) is more than double that of 10,000 psi permitted the aluminum alloy 5083-0. Plate thicknesses can be reduced to less than half those of aluminum with sizeable reductions in cost per square foot.

Where strength is vital, 9% nickel steel is a natural alternate for aluminum. Its ease of fabrication results in substantial savings; data accumulated to date suggest savings of at least 10% of final erected cost compared to aluminum vessels.

USS 3½% Nickel Steel: used for land-based facilities and ocean-going tankers

Low carbon 3½% nickel steel has been used for land-based facilities for the containment of liquid propane, carbon dioxide, acetylene, ethane, ethylene and other liquefied gases at temperatures down to —175F. Its excellent low-temperature toughness makes it suitable for use in shipboard tanks to transport liquid ethylene. Its formability, also excellent, has resulted in its use for tanks, vessels, piping, valves, fittings, heads, and many other components.

3½% nickel steel is covered by ASTM A203 Grades D and E. Allowable design stresses are 16,250 psi and 17,500 psi, respectively. These steels are covered under SA-203, ASME Boiler and Pressure Vessel Code.

USS Type 304 Stainless Steel: the #1 cryogenic metal down to absolute zero

The austenitic chromium-nickel stainless steels, 304 and 304L, are by far the most popular metals for cryogenic service down as low as —459F. They are used widely in liquid oxygen production and storage, and the storage of liquid hydrogen and liquid helium. Wherever high purity is essential, such as handling liquid missile fuels, stainless is a must because its surface remains chemically clean and won't scale.

Type 304 stainless steel is easy to weld and fabricate, doesn't require stress relief after fabrication, and possesses high strength with excellent stability and shock resistance at very low temperatures. Its allowable design stress is 18,750 psi.

USS and "T-1" are registered trademarks.

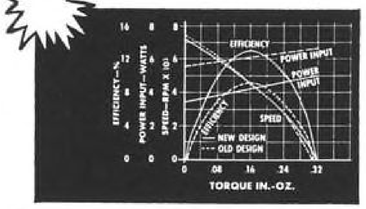
United States Steel

Circle Number 111 on Reader-Service Card

NEW from CPPC

CUSTOM DESIGN LINE of SERVO MOTORS





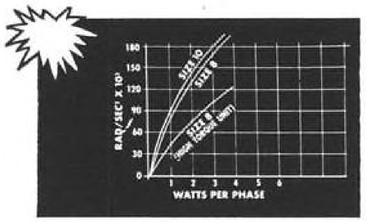
Greater EFFICIENCY

TYPE NUMBER	Voltage (volts) Fixed ∅	Control ∅	Current Stalled (ma.) Fixed ∅	Control ∅	Power Stalled (watts) Fixed ∅	Control ∅	Ave. Stall Torque* (in-ozs)	Ave. No Load Speed (rpm)	Efficiency (%)
ACH-8-□-04	26	35	148	110	2.5	2.5	0.26	7,200	10
AWH-10-□-01	26	80	124	50	2.14	2.36	0.31	7,200	12
AFH-10-□-1	115	40	31	91	2.35	2.57	0.30	10,000	16.2
AWH-10-□-04	26	35	135	140	2.0	2.9	0.31	7,200	12.8

Measured per S.A.E. A.R.P. 497

CPPC's new Custom Design motors minimize the incompatibility of efficiency and a linear torque speed curve. Efficiency on the above unit types has been improved by factors as large as 40%, i.e. from 9% to 13%, at no expense to torque speed linearity. This improvement has also been accomplished with no degeneration of air gap dimensions. These improvements mean: more torque for the same power input; same torque with less power consumption by the amplifier (consequently more amplifier reliability); better theoretical acceleration with the same power input; lower heat rise for the same torque; a cooler, more reliable motor with high capacities for being "over driven" if necessary.

The increase in efficiency of the above servo motors has not sacrificed single phasing considerations.



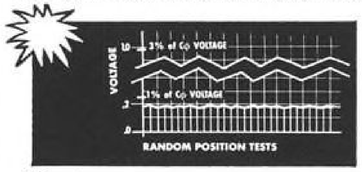
Higher TORQUE/INERTIA RATIO

TYPE NUMBER	Torque (in-ozs)	Inertia (gm-cm²)	Power (watts) Fixed ∅	Control ∅	Acceleration at Stall (rad/sec²)	No Load Speed (rpm)	Rated Input (volts) Fixed ∅	Control ∅	Length to Mounting Face (inches)
AZL-8-BF-1	0.48	0.361	4.2	4.2	95,000	7,100	26	26	1.11
AZH-8-A-4	0.16	0.164	1.7	1.7	71,000	7,600	26	50	0.76
AZH-8-A-3	0.24	0.164	2.7	2.7	103,000	7,525	26	50	0.76
APC-8-B-4	0.16	0.067	3.0	3.0	168,000	7,200	26	26	0.76
AFZ-8-A-1	0.21	0.164	2.4	2.4	90,400	10,500	26	26	0.76
AZC-10-A-1	0.40	0.164	3.0	3.0	172,000	7,400	26	26	0.76
AZH-10-A-4	0.32	0.164	2.72	2.8	137,000	7,500	26	50	0.76

Measurements made per S.A.E. methods. All values typical.

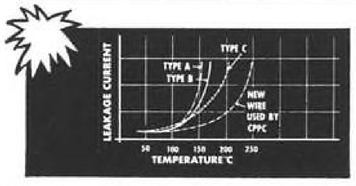
Listed above are motor designs in which special efforts have been made to reduce inertia and increase torque. The graph shown also includes a high torque design in which no attempt has been made to reduce inertia. Some of the advantages of these motors are: decreased dead zone; increased slew rate; reduced velocity error term; reduced cost, space and heat rise (because of the possible use of smaller gear ratios and the replacement of a motor tachometer with a motor).

MOTOR RATE TACHOMETERS. Because of the improved torque to inertia designs mentioned above, several considerations can now be given to the generators which are coupled with these motors. No generator is necessary in cases where inherent self damping is sufficient. Smaller generators with less output, less length and less power consumption can now be used. Removal of generators or reduction of generator requirements should result in increased reliability and decreased cost. Synchro length motors or motor tachometers are now possible.



Lower STARTING VOLTAGE

Low starting voltage increases the dynamic range of a servo system. Industry standards for starting voltage have been set at 3% of control phase voltage. CPPC at the present time is working to levels as low as 1%. This starting voltage is measured by a number of random position tests both in the clockwise and counter-clockwise direction. An optical servo loop and recording apparatus have been used to evaluate our new designs on starting voltage. This type of test simulates very closely actual servo systems in which motors will be used. The graph of starting voltage shown depicts tests on a typical new Custom Design Line servo motor in which special design considerations have been given to low starting voltage. Another obvious design advantage of these motors is the uniformity of starting voltages shown by the graph.



Less heat vulnerable MATERIALS

The materials used in our Custom Design Line of servo motors are capable of withstanding 200°C temperatures. Each of the improvements listed below has been incorporated in our new designs thus permitting these motors to operate at higher temperatures with more reliability. The specific improvements are: improved high temperature resistant Magnet Wire; improved Lubricant; improved Slot Insulation; Welded Leads; Flanged and Shielded Bearings; Glass to Metal Seals; high temperature resistant Impregnation.

As already described, we are also reducing heat rise by achieving the same or greater efficiency for less power input. In addition, we are reducing heat rise by the use of materials and designs with high thermal conductivity for improved heat dissipation.

cppc

CLIFTON PRECISION
Clifton Heights, Pa.

COMPANY SALES OFFICES

EASTERN SALES OFFICE
5050 State Road
Drexel Hill, Pennsylvania
Area 215 MAdison 2-1000
TWX 215 623-6068

MIDWESTERN SALES OFFICE
Room 309, Bartan Bldg.
200 South Bemiston
Clayton 5, Missouri
Area 314 PArkview 6-5330
TWX 314 556-0521

MILITARY AFFAIRS OFFICE
5899 Huberville Avenue
Dayton 31, Ohio
Area 513 CLearwater 4-2627
TWX 513 944-0078

WASHINGTON
Enright Engineering Company
c/o Myron R. Smith & Co.
6361 First Avenue
Seattle 8, Washington
Area 206 PArkway 3-1665

# of SYNCHROS AND ROTATING COMPONENTS

QUALITY LINE



SIZE 8 SIZE 10 SIZE 11 SIZE 15

SYNCHROS

Sizes 8, 10, 11, 15, and 22 are available. Clifton Precision synchros offer highest accuracy in production quantities (7′ maximum error is typical), lowest nulls, lowest phase shifts, corrosion resistant construction, stainless steel or aluminum housings. Double ended shafts, BuWeps types and ultra high temperature resistant (450°F) types all available. CPPC offers an extremely wide variety of synchros as Transmitters, Receivers, Control Transformers, Differentials, Resolvers.

ROTATING COMPONENTS



GYRO PICK-OFF SYNCHROS & RESOLVERS

Gyro pick-offs generally require individual mounting configurations and electrical parameters. CPPC can custom design them for your particular needs. Aluminum, stainless steel, or beryllium housings. A wide selection of bores, stack heights, widths and diameters are available from existing laminations.



PRECISION COMPUTING RESOLVERS

Sizes 8, 11, and 15. Highest accuracy (functional error .03% to .1%). Excellent nulls, low phase shift. Units can operate at 450°F. Resistive, feedback winding or thermistor compensation. Types for transistor circuitry. BuWeps shafts and Mk4 Mod 0 brush block obtainable.



LINEAR TRANSFORMERS

(Induction Potentiometers.) Sizes 8, 10, and 11. These units feature low secondary impedances. Can be designed to work with wide range of load impedances. Infinite resolution. Linearity .5%. Wide variety. Can be temperature compensated.



GEAR HEAD MOTORS

Sizes 8, 10, and 11. In CPPC's new unitized gearhead, the gear train is within a single, machined block of metal. This assures more accurate axial alignment, smoother operation, greater ease of servicing. Ratios up to 784:1. A wide variety of integrally mounted motors available. The entire package is designed to resist high temperatures.

PRODUCTS CO., INC.

Colorado Springs, Colo.

REPRESENTATIVES

CALIFORNIA
Enright Engineering Company
139 West Arbor Vitae Street
Inglewood, Calif. (Los Angeles)
Area 213 ORegon 8-2663
TWX 213 673-3548

ARIZONA
Enright Engineering Company
8649 E. MacDonald Drive
Scottsdale, Arizona
Area 602 947-4311
TWX 602 949-0139

EXPORT SALES
Andrew S. Szucs, Inc.
50 Broad Street
New York 4, N. Y.
Area 212 WHitehall 4-7486
CABLE: SUCANDEX

MASSACHUSETTS
The Darbury Corp.
437 Cherry Street
West Newton 65, Mass.
Area 617 Bigelow 4-2053
TWX 617 332-8698

NEW YORK
H. W. Brede Co.
689 Glen Cove Road
Glen Head, L. I., N. Y.
Area 516 ORiole 6-4900
TWX 516 671-1232
712 State Tower Building
Syracuse 2, N. Y.
Area 315 GRanite 1-3441

TEXAS
Ammon & Champion Co.
2746 Seelco Street
Dallas, Texas
Area 214 FLeetwood 7-8441
TWX 214 899-8306
11505 Chimney Rock
Houston, Texas
Area 713 PArkview 9-1233





SOME OF OUR PRODUCTS NEVER GET OFF THE GROUND

They aren't supposed to. ■ Like this helmet mounted radio receiver for field communications. Or its companion miniature transmitter. ■ The U. S. Army Electronics Research and Development Laboratories, Ft. Monmouth, New Jersey, have contracted for these new all-transistor units for service test use. For the first time, communications travel with the squad, lighten the load that soldiers must take into battle, and—in many cases—provide the means to save lives by doing away with hand signals or shouted commands. Fighting men are able to react to orders *instantly*—regardless of their field positions, the size of their units, or the combat conditions surrounding them. ■ Delco Radio goes *wherever* miniature portable communication systems can help solve a problem. ■ Perhaps we can help solve yours. Forward your specifications to Delco Radio, Military Requirements Department, Kokomo, Ind.

DELCO RADIO

Division of General Motors, Kokomo, Indiana

Massey Dickinson Co., Inc.
Matrix Research and Development Corp.
McDONNELL AIRCRAFT CORP. SEE ADV. P. 230
McMichael Radio, Ltd.
McQuiston Associates
Methode Electronics, Inc.
Metro-Tel Div., The Grow Corp.
Microsemiconductor Corp.
Missouri Research Laboratories
Moore Associates, Inc.
Morey Corp.
Motorola, Inc., Military Electronic Div.
North Electric Co.
Northrop Corp.
Photocircuits Corp.
Piasecki Aircraft Corp.
Precision Circuits, Inc.
Presentey Engineering Products, Ltd.
Radiation, Inc.
Radiation Systems, Inc.
Radiation Technology, Inc.
Radio Corp. of America
Radium Dial Corp.
Ransom Research/Wyle Labs.
Raytheon Co., Government Marketing
Rogers Corp.
W. H. Sanders Electronics, Ltd.
Siliconix, Inc.
Siltronics, Inc.
Societe Francaise Pour la Navigation Aerienne
Spectran Electronics Corp.
Sperry Gyroscope Co., Div. Sperry Rand Corp.
Sylvania Electronic Systems, Div. Sylvania Electric Products, Inc.
Systems Engineering Labs., Inc.
Tasker Instruments Corp.
Taylor Corp.
Telkor, Inc.
Theta Instrument Corp.
Thompson Ramo Wooldridge, Inc.
Tri-Dex, Co.
Varian Associates, Bomac Div.
Virginia Electronics Co., Inc.
Vitro Laboratories, Div. Vitro Corp. of America
Walkrit Co.
Wang Laboratories, Inc.
Westinghouse Electric Corp., Aerospace Electrical Dept.
Westinghouse Electric Corp., Air Arm Div.
Westinghouse Electric Corp., Electronics Div.
Westinghouse Electric Corp., Ordnance Div.
Westinghouse Electric Corp., Systems Management Dept.
Westwood Cable Corp.
Wheaton Engineering, Div. Hurletron, Inc.

Clamps

1. Metallic, 2. Non-metallic

AGC, Inc., 1
Aeroquip Canada, Ltd., 1
Aeroquip Corp., Marman Div., 1
American Aero Parts
American Welding & Mfg. Co., 1
Augat, Inc., 1
Avica Equipment, Ltd., 1
Bells Asbestos & Engineering, Ltd., 1
Blackhawk Industrial Products Co., Enerpac Div., 1
Brown & Sharpe Mfg. Co., 1
Camloc Fastener Corp., 1
Cannon Electric (G. B.), Ltd., 1
Chrysler Corp., Defense Space Group, 1
Chrysler Corp., Missile Div., Florida Missile Operations, 1
Continental Motors Corp., Aircraft Engine Div., 1
Crosby-Laughlin Div., American Hoist & Derrick Co., 1
D. S. D. Mfg. Co., The, 1
Detroit Stamping Co., 1
Dominion Fasteners, Ltd., 1
Emerson Plastics Corp., 2
Fabri-Form Co., The, 2
Flight Equipment & Engineering Corp., 1
Geo. K. Garrett Co., Div. MSL Industries, Inc., 1
GENERAL METALS CORP., ADEL DIV., 1, 2. SEE ADV. P. 14
Hanler Corp., 1
HARTWELL CORP., THE, 2. SEE ADV. P. 268
Houston Fearless Corp., Westwood Div., 1
Hunter Spring, Div. Ametek, Inc., 1
Ideal Corp., 1
Illumitronic Engineering Corp., 2
Instru-Lec Corp.,
Jaros Aircrafters, 1, 2
Jay Mfg. Corp., 1
Jervis Corp., 1
Joclin Mfg. Co., 1, 2
Kentucky Metals, Inc., 1
Kickhaefer Mfg. Co., 1
Kwikset Powdered Metal Products, Kwikset Div., American Hardware, 1
Laminated Shim Co., Inc., 1
Lapine Scientific Co., 1
Lawrence Aviation Industries, Inc., 1
Little Giant Products, Inc.
Lucas Aircraft Supply Co., 1
McGraw-Edison Co., Line Material Industries, 1
Micronics Corp. of America, 1
National Utilities Corp., 1
Newton Div., Vlier Engineering Corp., 1
Norco, Inc., 1
PIC Design Corp., Sub. Benrus Watch Co., Inc., 1
Perfect Gear & Instrument Corp., 1
Proto Tool Co., Div. Pendleton Tool Industries, Inc., 1
Reliable Spring & Wire Forms Co., The, 1
Richardson Co., The, 2
J. H. Sessions & Son, 1
Silicone Insulation, Inc., 2
C. S. Joberg & Son, 1
Skyron Corp., 1
Southern Plastics Co., 2
Spaulding Fibre Co., Inc., 2
Specialty Products Corp., 1
TA Mfg. Corp., 1
Tech-Serv, Inc.
Templet Industries, Inc.
Herbert Terry & Sons, Ltd., 1
Tinnerman Products, Inc., 1
Trico Fuse Mfg. Co., 1
Umpco, 1
United-Carr Fastener Corp., Cinch-Monadnock Div., 1, 2
Victaulic Co. of America, 1
Vlier Engineering Corp., 1
Ward Brooke & Co., Ltd., 2
Weckesser Co., Inc., 2
Welch Tool Sales, Inc., 1
J. H. Williams & Co., 1
Winder Aircraft Corp., 1, 2
Wittek Mfg. Co., 1
Wollam Aircraft & Marine Products Co., 1

Clean Room Equipment

Acoustica Associates, Inc.
Agnew-Higgins, Inc.
Airflow Co.
Airline Welding & Engineering
AMERICAN AIR FILTER CO., INC. SEE ADV. P. 148
Angelica Uniform Co.
Bar-Ray Products, Inc.
Blackstone Ultrasonics, Inc.
Brent Chemical Products, Ltd.
G. F. Bush Associates
Cambridge Filter Corp.
Chrysler Corp., Defense Space Group
Cincinnati Cleaning & Finishing Machinery Co.
Dynasonics Corp.
Garrett Mfg., Ltd., Sub. The Garrett Corp.
General Acoustics Corp.
General Scientific Equipment Co.
B. H. Hadley, Inc.
Hamilton Standard Div., United Aircraft Corp.
Hollywood Plastics, Inc.
Ionics, Inc.
C. E. Johansson Gage Co., Swedish Gage Co. Affiliate
Lamson Corp.
Micronics Corp. of America
Milburn Co.
Millipore Filter Corp.
Mini-Tool Technical Industries, Inc.
National Ultrasonic Corp.
Philco Corp., Lansdale Div., Sub. Ford Motor Co.
Phillips Mfg. Co.
Plastigage Corp.
Prodesco, Inc.
PYLE-NATIONAL CO., THE. SEE ADV. P. 35
Radex Corp.
Sabema Corp.
Shielding, Inc.
Stellardyne Laboratories, Inc.
F. J. Stokes Corp.
Technic, Inc.
Torit Mfg. Co.
Ultrasonic Industries, Inc.
Ultra-Violet Products, Inc.
Unitron Engineering Co.
Verosolv Safety Solvents, United Research & Development Associates, Inc.
Westinghouse Electric Corp.
Wheelabrator Corp.
EDWIN L. WIEGAND CO. SEE ADV. P. 218, 219
Wilbur & Williams Co., Inc., The

Clean Room Facilities—Service

Advanced Technology Laboratories, Div. American Standard
Aero Precision Industries, Inc.
Agnew-Higgins, Inc.
Airaterra
Airman Enterprises, Inc.
American Welding & Mfg. Co.
Antelline Constructors
Autometric Corp., The
Barco Div., Aeroquip Corp.
Bearing Inspection, Inc.
Bell Aerosystems Co., Div. Bell Aerospace Corp., A Textron Co.
Bell Aerosystems Co., Tucson Research Laboratory
Belock Instrument Corp.
Benbow Mfg. Corp.
Benson Mfg. Co.
CHANDLER EVANS CORP. SEE ADV. P. 164
Chrysler Corp., Defense Space Group
Crysler Corp., Missile Div., Florida Missile Operations
Chrysler Corp., Space Div.
Clary Corp., Dynamics Div.
Cleveland Pneumatic, Div. Pneumodynamics Corp.
COMPUTING DEVICES OF CANADA, LTD. SEE ADV. P. 238
Cook Electric Co., Technological Center Div.
Cosmodyne Corp.
Cubic Corp.
DK Mfg. Co.
De Havilland Aircraft of Canada, Ltd. Special Products & Applied Research Div.
Douglas Aircraft Co., Inc. Missile & Space Systems Div.
Dunbar Kapple Div., DK Mfg. Co.
Essex Mfg. Co., Inc.
Ex-Cell-O Corp.
Fairchild Stratos Corp.
Feedback Systems, Inc.
Ford Instrument Co., Div. Sperry Rand Corp.
General Acoustics Corp.
Hamilton Standard Div., United Aircraft Corp.
Hamilton Watch Co., Industrial Div.
Harris Mfg. Co., Inc.
Hawker Siddeley Canada, Ltd., Engineering Div.
Hayes Corp., The
Herlo Engineering Corp.
Heroux
Hickok Electrical Instrument Co., The
Honeywell, Military Products Group
Hughes Aircraft Co.
Idaho Maryland Industries, Inc.
International Tel. & Tel. Corp., ITT Federal Laboratories Div.
C. E. Johansson Gage Co., Swedish Gage Co. Affiliate
K. P. T. Mfg. Co.
Lear Siegler GmbH
Lear Siegler Service, Inc., Sub. Lear Siegler, Inc.
Ling-Temco-Vought, Inc.
MARTIN CO., DIV. MARTIN-MARIETTA CORP. SEE ADV. P. 224
Mechanism, Ltd., Gyro Works
Micromatic Hone Corp., Micro Precision Div.
Micro Products Corp.
Milburn Co.
Puritan Equipment, Inc., Aerospace Div.
Radio Corp. of America
Raytee Co.
Republic Mfg. Co.
Robertshaw Controls Co., Aeronautical & Instrument Div.
Scans Associates, Inc.
Sheffield Corp., The, Sub. The Bendix Corp.
Snap-Tite, Inc.
Solar, Sub. International Harvester Co.
Space Equipment Corp.
Sparton Corp., Sparton Electronics Div.
Standard Steel Corp.
Stellardyne Laboratories, Inc.
Swiss Electro Instruments, Div. Pastushin Industries, Inc.
Sylvania Electronic Systems, Div. Sylvania Electric Products, Inc.
Tracerlab, Div. Laboratory For Electronics, Inc.
Trans-Sonics, Inc.
Universal Match Corp., Unidynamics Div.
Western Gear Corp., Precision Products Div.
Westinghouse Electric Corp.
Westwood Cable Corp.
E. B. Wiggin Oil Tool Co., Inc.

Cleaners, Chemical

Airman Enterprises, Inc.
Allied Research Products, Inc.
Amchem Products, Inc.
Ashland Oil & Refining Co.
Barco Chemical Products Co.
George Basch Co., The, Aircraft Div.
Blackstone Ultrasonics, Inc.
Branson Equipment Co.
Brent Chemical Products, Ltd.
Brulin & Co., Inc.
Canadian Industries, Ltd.
Cee Bee Chemical Co., Inc.
Clarkson Laboratories, Inc., The
Cox Instruments, Div. Lynch Corp.
Dels Tumbling Service
Detrex Chemical Industries, Inc.
Dow Chemical Co., The, Dow Metal Products Co. Div.
Drill Mfg. Co.
Dubois Chemicals, Inc.
E. I. duPont de Nemours & Co., Inc.
Economics Laboratory, Inc., Aviation & Military Div.
Federal Mining & Mfg. Co.
Fidelity Chemical Products Corp.
Fine Organics, Inc., Aviation Industrial Chemicals Div.
Finnell System, Inc.
Gasoilair Equipment Co.
Hanson-Van Winkle-Munning Co.
Heatbath Corp.
R. M. Hollingshead Corp., Government Aviation Div.
Hooker Chemical Corp.
E. F. Houghton Co.
Indosil Co.
International Metal Polish Co., Inc.
Isochem Resins Co.
Jenard International Corp., Precision Tools Div.
Kelite Corp.
Lix Corp. of Missouri
MacDermid, Inc.
Magna Corp., Research & Development Div.
Magnaflux Corp.
Magnuson Products Corp.
Masury Young Co.
Merix Chemical Co.
Micronics Corp. of America
Mitchell-Bradford Chemical Co.
Murphy-Phoenix Co., The
Nu-Steel Co.
Oakite Products, Inc.
G. H. Packwood Mfg. Co.
Penetone Co., The
Pennsalt Chemicals Corp.
Phillips Mfg. Co.
Phoenix Oil Co.
Photographic Applications Co.
Pillsbury Chemicals
Symplastics, Inc.
Topper Mfg. Co., Inc.
Trio Chemical Works, Inc.
Turco Products, Inc.
Ultrasonic Industries, Inc.
Verosolv Safety Solvents, United Research & Development Associates
Wyandotte Chemicals Corp., J. B. Ford Div.

Cleaning, Aerospace Systems

Airman Enterprises, Inc.
Benbow Mfg. Corp.
Blackstone Ultraconics, Inc.
Cee Bee Chemical Co., Inc.
Chrysler Corp., Defense Space Group
Chrysler Corp., Missile Div., Florida Missile Operations
Cox Instruments, Div. Lynch Corp.
Detrex Chemical Industries, Inc.
Douglas Aircraft Co., Inc., Missile & Space Systems Div.
Economics Laboratory, Inc., Aviation & Military Div.
Fidelity Chemical Products Corp.
Gasoilair Equipment Co.
Hamilton Standard Div., United Aircraft Corp.
Idaho-Maryland Industries, Inc.
Jonard International Corp., Precision Tools Div.
George W. Klein Aviation Engines & Parts, Inc.
Langley Corp.
Lockheed Aircraft Corp.
MARTIN CO., DIV. MARTIN-MARIETTA CORP. SEE ADV. P. 224.
Merix Chemical Co.
Oakite Products, Inc.
Stellardyne Laboratories, Inc.
Ultrasonic Industries, Inc.
Ultrasonic Research & Testing Laboratories
Verosolv Safety Solvents, United Research & Development Associates
Weston Hydraulics, Ltd., Sub. Borg-Warner Corp.
E. B. Wiggin Oil Tool Co., Inc.

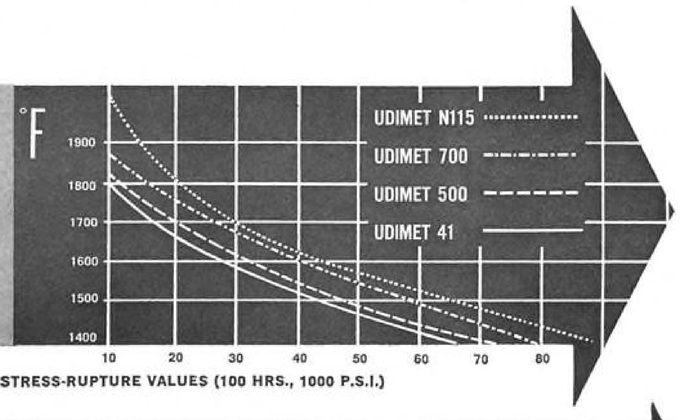
Cleaning Equipment

1. Chemical, 2. Hydraulic, 3. Mechanical, 4. Ultrasonic

Ace-Sycamore, Inc., 3
Aero Precision Industries, Inc., 1
Aeroil Products Co., Inc., 1, 3
AIRCRAFT POROUS MEDIA, INC., SUB. OF PALL CORP., 4. SEE ADV. 157
Airman Enterprises, Inc., 1, 4
Ajax Electric Co., 1
Alcar Instruments, Inc., 4
American Sterilizer Co., 4
American Time Products, Div. of Bulova Watch Co., Inc., 4
Bearing Inspection, Inc., 3
Behr-Manning Co., Div. Norton Co., 3
Berne Telecommunications, Ltd., 4
Blackstone Ultrasonics, Inc., 1, 4
Branson Equipment Co., 4
Brent Chemical Products, Ltd., 1
Bulova Electronics, Div. Bulova Watch Co., Inc., 4
Cee Bee Chemical Co., Inc., 1, 2, 3
Chrysler Corp., Defense Space Group, 2, 3
Chrysler Corp., Missile Div., Florida Missile Operations, 2, 3
Cincinnati Cleaning & Finishing Machinery Co., 1, 2, 3, 4
Clayton Mfg. Co., 1
Cook Electric Co., Technological Center Div., 1, 2, 3, 4
Cosmodyne Corp., 1
Cox Instruments, Div. Lynch Corp., 1, 2
Cyclo Mfg. Co., 1, 3
Dels Tumbling Service, 3
Detrex Chemical Industries, Inc.
Devilbiss Co., The, 1, 2
Drill Mfg. Co., 1, 2
Dubois Chemicals, Inc., 1
Dynalectron Corp., 2
Dynasonics Corp., 4
Economics Laboratory, Inc., Aviation & Military Div., 1, 2, 4
Emerson Electric Mfg. Co., The, Electronics & Avionics Div.
Fidelity Chemical Products Corp., 1, 4
Finnell System, Inc., 1, 3
Fram Aerospace Div., Fram Corp., 4
Garwin, Inc., 1
Gasoilair Equipment Co.

WIDENING THE DESIGNER'S HORIZON

VACUUM MELTED ALLOYS



NICKEL BASE HIGH TEMPERATURE SUPERALLOYS

UDIMET® N-115
For use up to 1900°F.

UDIMET® 700
U. S. Pat. Pending
Suitable for short term service at 2000°F. Normal range 1400-1700°F.

UDIMET® 520
U. S. Pat. No. 3,107,167
Service range 1400-1700°F. Excellent forgeability.

UDIMET® 500
U. S. Pat. No. 2,809,110
An alloy for 1400-1700°F. High stress rupture performance.

UDIMET® 41
Service temperature 1400-1700°F. High tensile properties.

WASPALOY
Traditional superalloy for 1200-1600°F. range. Wide range of applications.

M-252
Another alloy in the 1200-1600°F category.

UDIMET® 718
Age-hardening alloy with high yield strength up to 1400°F.

UDIMET® 200
(known also as Inco 901)
Alloy of superior forgeability for use at 1000-1500°F.

The properties of these nickel base high temperature alloys are all markedly improved by vacuum induction melting (followed by arc remelting where required). Melting procedure permits the closest control of chemistry and the highest degree of purity commercially attainable. Special Metals has pioneered in this field — Udimet 500, 520, and 700 are, in fact, proprietary alloys. Our engineers are eminently well qualified to help you with your material problems in these temperature ranges.

IRON BASE HIGH TEMPERATURE ALLOYS

V-57
High stress rupture and endurance limit. Used for wheels, torque rings, buckets, and afterburner nozzles.

A-286
Widely used material for jet engines and missiles in wheels, frames, casings, and fasteners.

These iron base high temperature alloys have properties appropriate for applications at moderate temperatures up to 1200°F.

ULTRA HIGH STRENGTH STEELS

Standard alloys now offered with guaranteed minimum properties are Udimar B250 and Udimar B300. The new 'maraging' steels have widened design horizons in many fields. These steels have tensile strengths up to 325,000 psi. They have proved to have excellent cryogenic properties as well as being serviceable up to 600°F.

COPPER AND COPPER BASE ALLOYS

Vacuum melting at Special Metals makes available, for the first time on an industrial scale, high purity, gas-free copper for space and electronics engineering. Unique alloying systems possible only with vacuum induction melting have evolved new high strength, high integrity alloys based on cupro-nickel and aluminum bronze.

SPECIAL METALS, INC.
NEW HARTFORD, NEW YORK

- *Pioneer in Vacuum Metallurgy*
- *World's Largest Producer*
- *Integrated Facilities*
- *Research-Development Oriented*

120

Circle Number 120 on Reader-Service Card



. . . comes through head heat unscathed!

Higher and higher recording speeds mean instrumentation progress—and *problems!* Increased speed and tension on tape generates friction that concentrates heat around recording heads and can make ordinary tape unreliable. Signal dropout or distortion can result when this localized, high-temperature build-up separates recording oxides from tape backing.

"SCOTCH" BRAND Heavy Duty Instrumentation Tapes carry signals coolly through head-heat environments. They withstand temperatures from −40°F up to +250°F. They last *at least* 15 times longer than ordinary tapes. Their heavy duty oxides and binders are formulated to resist heat extremes, minimize ruboff. Exclusive Silicone lubrication eases head wear, tape wear. They offer 1000 times more conductivity than ordinary tapes to drain off dust-gathering static.



16 different "SCOTCH" Heavy Duty Tapes are available in 3 series. Polyester backings offered are .65, 1 and 1.5 mils. Choice of coating thicknesses includes .18 and .43 mils. "*400*" *series:* excellent high and low frequency resolution. "*500*" *series:* smooth, sharp resolution for broad band, other high frequency uses. "*900*" *series:* ultra-smooth surfaces for predetection recording systems, critical wide band needs.

TECHNICAL TALK Bulletin No. 3 explains temperature effects on recording tape, discusses heavy duty oxide and binder combinations. Free. Just write 3M Magnetic Products Division, Dept. MCJ-123, St. Paul 19, Minn.

"SCOTCH" AND THE PLAID DESIGN ARE REGISTERED TRADEMARKS OF MINNESOTA MINING & MANUFACTURING CO., ST. PAUL 19, MINN. EXPORT: 99 PARK AVE., NEW YORK. CANADA: LONDON, ONTARIO. ©1963, 3M CO.

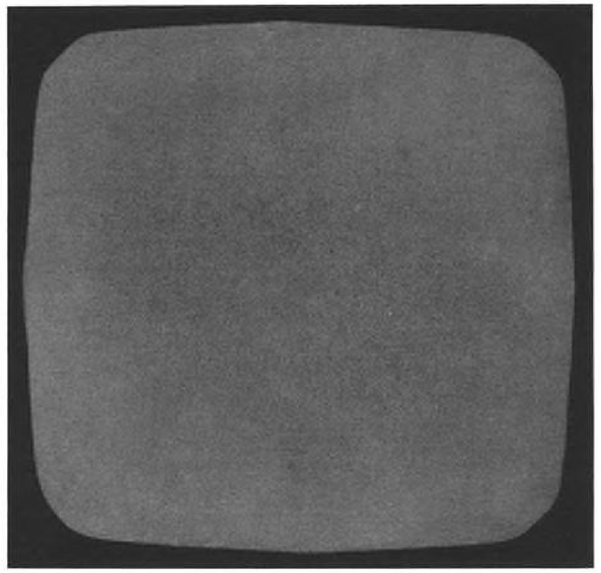
Magnetic Products Division 3M COMPANY

Circle Number 123 on Reader-Service Card

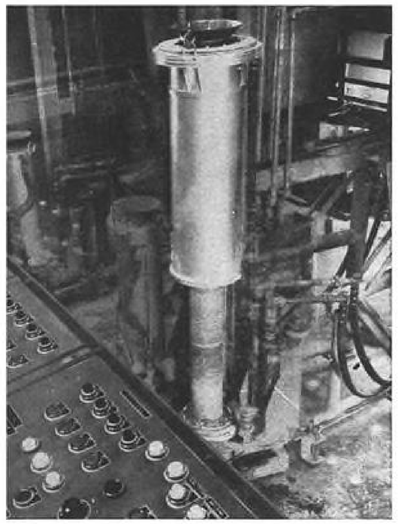
123

ANNOUNCING FS-X-750

HIGH NICKEL ALLOY BY FIRTH STERLING



. . . EXTREMELY CLEAN, SOUND AND FINE GRAINED, WITH GOOD FORGEABILITY, WELDABILITY AND MACHINABILITY CHARACTERISTICS



Firth Sterling's new high temperature alloy FS-X-750 is produced by the exclusive Hopkins Process of consumable electrode melting under a flux blanket which minimizes non-metallic inclusions—so important in critical applications such as jet engines, missiles and nuclear power mechanisms. You get a high quality metal, practically free of segregation, requiring less conditioning. So you can order material closer to finished size and save three ways . . . original cost, shipping cost and machining cost. And because of its unusually clean, fine grained structure, FS-X-750 is readily forgeable, weldable and machinable. Available in ingots, billets, bars, rod and wire.

Chemical analysis: C—.04%; Mn—.70%; Cr—15%; Ni—73%; Ti—2.50%; Al—.80%; Cb—.85%; Fe—6.75%.

Other Firth Sterling high temperature alloys produced by the Hopkins Process include Grades 16-25-6, Waspaloy, Rene 41, FS-600, FS-718, FS-901, A-286, M-252, V-57.

	AMS-5667-F	FS-X-750*
TENSILE STRENGTH (Room temp.)	160,000	176,700 psi
.2 YIELD	100,000	110,200 psi
% ELONGATION	15.0%	27.6%
% REDUCTION OF AREA	17.0%	37.0%

*Test data developed from 3 to 1 transverse pancakes directly from billet stock; bar stock capability test significantly better.

Data sheets and technical service are available. Write or call . . .

Firth Sterling INC

Pioneer in specialty steels and sintered tungsten carbides

3113 FORBES AVENUE, PITTSBURGH 30, PENNSYLVANIA

OFFICES AND WAREHOUSES: HARTFORD, MOUNTAINSIDE, N. J., PITTSBURGH, CLEVELAND, DAYTON, DETROIT, MELROSE PARK, ILL., BIRMINGHAM, LOS ANGELES, HOUSTON

Circle Number 124 on Reader-Service Card

The only *COMPLETE FASTENING SYSTEM* for the Aircraft and Missile Industry



STANDARD CHERRYLOCK Rivets for solid rivet strength . . . top performance in a complete range of diameters and grips. Qualifies under NAS Specification 1400 and Standards Pages 1398 and 1399. (U.S. Patent No. 2931532)

BULBED CHERRYLOCK Rivets for thin sheet and double-dimple applications. Short grip . . . strong joint . . . extremely large blind head and bearing surface.

CHERRY "9000" series serrated stem MS rivets and Cherry Standard MS knob stem rivets for a complete line.

CHERRY AIRCRAFT LOCKBOLTS for high strength . . . high temperature and corrosion resistant service, are available in a full range of diameters, grip lengths and head styles.

*A-286 STAINLESS STEEL * MONEL * ALLOY STEEL * ALUMINUM*

The Complete Fastening System
Cherry Blind Rivets—Cherry Aircraft Lockbolts*—and
Cherry Installation Tools

*Licensed under Huck Patents 2,527,307; 2,531,048; 2,531,049; and 2,754,703

Cherry Rivet Division
Santa Ana, Calif.

SEE OUR SPECIFICATIONS IN VSMF THE MICROFILM CATALOG FILE

Townsend Company
ESTABLISHED 1816 • BEAVER FALLS, PA. • A textron COMPANY

In Canada: Parmenter & Bulloch Manufacturing Company, Limited, Gananoque, Ontario

Bendix Corp., The, Scintilla Div., 1, 2
Bill Jack Industries, 1, 2
Blowers, Inc.
British Insulated Callenders Cables, Ltd., 1
Bruning Co., The, 3
Burndept, 1
Burndy Canada, Ltd., 1, 2
Burndy Corp., Omaton Div., 1, 2
CSF-Compagnie Generale de Telegraphie Sans Fil, 1
Calumet & Hecla, Inc., Flexonics Div.
Cambridge Thermionic Corp., 1
Canadian Curtiss-Wright, Ltd., 1
Cannon Electric Canada, Ltd., 1, 2
Cannon Electric Co., 1, 2, 3
Cannon Electric (G. B.), Ltd., 1, 2
Carborundum Co., The, 2
Carmac Aviation, 3
Cinch Mfg. Co., 1, 2
Circon Component Corp., 1
Cole Electric Co., 1, 2
Connecticut Hard Rubber Co., the, 3
Co-Operative Industries, Inc., 2, 3
Dage Electric Co., 1, 2
R. E. Darling Co., Inc., 3
Deutsch Co., The, Electronic Components Div., 1, 2
Deutsch Co., Hydraulic Components Div., 3
Dialight Corp., 1
Diamonite Products Mfg. Co., Div. U. S. Ceramic Tile Co., 1, 2
Dunbar Kapple Div., DK Mfg. Co.
Dunlop Rubber Co., Ltd., 1, 3
E-Z Hook Test Products, 1
Eagle-Picher Co., 1
Hugh H. Eby Co., 1, 2
Eitel-McCullough, Inc., 2
Elano Corp., 3
Electronic Fittings Corp., 1
Electrospace Corp., 1
Essex Mfg. Co., Inc., 3
Flexco, Inc., 3
G. W. Galloway Co., 1, 2
Gamah Corp., 3
Garlock, Inc., 1
Garrett Corp., The.
Gasoilair Equipment Co., 3
General Radio Co., 1
Girdleston Electronics, Ltd., 1, 2
Glenair, Inc., 1
Gorn Electronics, Div. Gorn Electric Co., 1
Gray & Huleguard, Inc., 1
Gulton Industries, Inc., 1, 2
Hallett Mfg. Co., 1, 2, 3
Hansen Mfg. Co., 3
Haveg Industries, Inc., 2
Hobson Bros., Inc., 1
Houston Fearless Corp., Westwood Div., 1
Hughes Aircraft Co., 1
Hughes Aircraft Co., Electronic Products Div., 1, 2
International Electric Industries, Inc., 1
International Tel. & Tel. Corp.
Jamieson Industries, Inc., 2
Jettron Products, Inc., 1
Joclin Mfg. Co., 2
E. F. Johnson Co., 1
Johnson Metal Hose, Inc., 3
Joy Mfg. Co., Electrical Products Dept., 1, 2
Kent Mfg. Corp., 1
King Electric Co., Inc., 1, 2
Lab-Tronics, Inc., 1
LEAR SIEGLER, INC., POWER EQUIPMENT DIV., 3. SEE ADV. P. 94, 95
Liquidometer Corp., The, 1
Magnetic Research Corp., 1
Malco Mfg. Co., 1
Marconi Co., Ltd., The, 1
McCormick-Selph Associates, Inc., 1, 2
Metal Bellows Corp., 2
Methode Electronics, Inc., 1, 2
MICRODOT, INC., 1, 2. SEE ADV. P. 198
Minnesota Mining & Mfg. Co.
Minnesota Mining & Mfg. Co., New Product Liaison, 1
Molded Insulation, 1
National Automatic Products Co., The, 3
National Connector Corp., 1, 2
Louis Newmark, Ltd., 1
North Electric Co., 1
Nugent Electronics Co., Inc., 1
Nu-Line Industries, Inc., 1, 2
Omega Laboratories, Inc., 1
Omni-Spectra, Inc.
Ozone Aircraft Components Corp., 3
Packard Electric Div., General Motors Corp., 1
Parts Mfg. Associates, Inc., 3
Permonite Mfg. Co., 1
PHELPS DODGE ELECTRONIC PRODUCTS CORP., 1. SEE ADV. P. 33
Physical Sciences Corp., 1, 2
Piasecki Aircraft Corp., 1
Pomona Electronics Co., Inc.
H. K. Porter Co., Inc., Thermoid Div., Chanute Works, 3
Purolator Products (Canada), Ltd., 3
PYLE-NATIONAL CO., THE, 1, 2. SEE ADV. P. 35
Raytheon Co., Industrial Components Div., 1
Reaction Motors Div., Thiokol Chemical Corp., 2
Remler Co., 2
Resistoflex Corp., 3
Rocket Jet Engineering Corp., 1, 3
Rubber-Teck, Inc., 3
Sedco (Service Equipment Design Co.), 3
Scanivalve Co., 3
Sealtron Corp., 2
Seaton Wilson Mfg. Co., 3
Sierra Engineering Co., 3
C. S. Joberg & Son, 1
Skytronics, Inc., 1
Smart & Brown Connectors, Ltd., 1
S. Smith & Sons England, Ltd., Smiths Aviation Div., 1
Snap-Tite, Inc., 3
Somers-Kendall Aircraft, Ltd., 1
Space Instrumentation Corp., 1, 2
Statham Instruments, Inc., 2
Stewart-Warner Corp., Alemite Div., 3
Stoddart Aircraft Radio Co., Inc., Sub. Tamar Electronics, Inc., 1
Strat-O-Seal Mfg. Co., 2
E. G. Styberg Engineering Co., Inc., 3
Superior Cable Corp., 1
Superior Electric Co., The, 1
Switchcraft, Inc., 1
Tamar Electronics, Inc., 1
Thorn Electrical Industries, Ltd., Special Products Div., 1, 2
Ultra Electronics, Ltd., 1
U. S. Components, Inc., 1, 2
Univox Corp., 1
Veritron West, Inc., 1, 2
Vibraseal Corp., 3
Viking Industries, Inc., 1, 2
Waldom Electronics, Inc., 1
Waltham Precision Instrument Co., Electromechanical Div., 1
Warren Components Div., El-Tronics, Inc., 2
Weatherhead Co., The, 3
Weatherhead Co. of Canada, Ltd., 3
Westinghouse Electric Corp., 1
E. B. Wiggin Oil Tool Co., Inc., 1, 2, 3
Winchester Electronics, Inc., 1, 2
Zep Aero, 3

Consoles

1. Aircraft, 2. Electronic ground equipment, 3. Spacecraft

ACEC, 2
AMCO Engineering Co., 1, 2, 3
Accessory Products Co., Div. Textron, Inc., 1, 3
Adler Electronics, Inc.
Aero Precision Industries, Inc., 2
Aerocraft, Inc., 2, 3
AEROFLEX LABORATORIES, INC., 2. SEE ADV. P. 230
Aerojet-General Corp., Corporate Offices, 2, 3
Aeronca Mfg. Corp., 2
Aeronca Mfg. Corp., Aerocal Div., 2
Aerosmith Products Corp., 1, 2, 3
Aerospace Products, Inc., 1
Airborne Instruments Laboratory, Div. Cutler-Hammer, Inc., 2, 3
Airtech, Ltd., 2
American Gyro, Div. Tamar Electronics Industries, Inc., 2
Anchor Specialty Mfg. Co., Inc., 1, 2, 3
Aviation Traders Engineering, Ltd., 1
Avimo, Ltd., 2
Avionic Products Engineering Corp., 1
Avnet Instrument Corp., Div. Avnet Electronics Corp.
Avtron Mfg., Inc., 2
Basic Industries, Inc., 2
Beckman Instruments, Inc., Systems Div.
Bell Aerosystems Co., Div. Bell Aerospace Corp., A Textron Co., 2
Bendix Corp., The, Bendix Mishawaka Div., 2
Bendix Corp., The, Bendix Radio Div., 2, 3
Bristol Aero-Industries, Inc., Winnipeg Div., 1, 2, 3
BROOKS & PERKINS, INC., 1, 2, 3. SEE ADV. P. 20
Bud Radio, Inc., 2
Bulova Systems and Instruments Div. (Incl. Bulova R & D Laboratories), Bulova Watch Co., Inc., 2
Burroughs Corp., 2
CSF-Compagnie Generale de Telegraphie Sans Fil, 2
Canadian Aviation Electronics, Ltd., 2
Canadian Curtiss-Wright, Ltd., 1, 2
Central Dynamics, Ltd., 2
J. S. Chinn & Co., Ltd., 2
Chrysler Corp., Defense Space Group, 2
Chrysler Corp., Missile Div., Florida Missile Operations, 2
Chrysler Corp., Space Div., 2, 3
Cook Electric Co., Technological Center Div., 2
A. C. Cossor, Ltd., Cossor Electronics, Ltd., 2
Cox Instruments, Div. Lynch Corp.
Cubic Corp., 1, 2, 3
S. Davoll & Sons, Ltd., 2
Delcon Corp., 2
Douglas Aircraft Co., Inc., Missile & Space Systems Div., 2
Dunlap & Associates, Inc.
Dynalectron Corp., 2
Dynamics Instrumentation Co., 2, 3
Dynatronics, Inc., 2
Electro-Rack, 1, 2, 3
Electronic Products Corp., 2
Elzee Metal Products Co., Inc.
Emerson Electric Mfg. Co., The, Electronics & Avionics Div.
Espey Mfg. & Electronics Corp., 2
Falstrom Co., 2, 3
Garrett Corp., The, 2, 3
Garrett Mfg., Ltd., Sub. The Garrett Corp., 2
General Dynamics/Convair, 1, 2, 3
Gibbs Mfg. & Research Corp., 2
Gilmore Industries, Inc., 2
Goodyear Aerospace Corp., 2, 3
Guardline Controls, 2
Hamilton Standard Div., United Aircraft Corp.
Hansen-Lynn Co., Inc., 1, 3
Hathaway Instruments, Inc., 2
Hawker Siddeley Aviation, 2
Hewlett-Packard Co., Dymec Div., 2
Hoffman Electronics Corp., Military Products Div., 1, 2, 3
Honeywell, Military Products Group, 1, 2, 3, 4
Hoover Co., The, Electronics Div., 2
Hughes Aircraft Co., Ground Systems Group, 2
A. Imhof, Ltd., Ashley Works, 2
Ingersoll Products, Div. Borg-Warner Corp., 2
Instrument Corp. of Florida, 2
Instruments for Industry, Inc., 1, 2
Intercontinental Electronics Corp., 2
International Business Machines Corp., Federal Systems Div., 2, 3
International Electronic Service S.A., 2
International Tel. & Tel. Corp., ITT Federal Laboratories Div., 2
Irving Air Chute Co., Inc., 2
Kaman Aircraft Corp., The, 1, 2
Walter Kidde & Co., Inc., 2
Kollsman Instrument Corp., Sub. Standard Kollsman Industries, Inc., 1, 2, 3
Lane Industries, Electronics Div., 1, 2
Langevin Div., Sonotec, Inc., 2
LAVELLE AIRCRAFT CORP., 2. SEE ADV. P. 208
Lear Siegler, Inc., Astro Structures Div., 2
Lear Siegler, Inc., Instrument Div., 1, 2, 3
Lear Siegler Service, Inc., Sub. Lear Siegler, Inc., 2
Ling-Temco-Vought, Inc., 1, 2, 3
Lockheed Aircraft Corp., 1, 2, 3
Magnesium Aerospace Products, 2, 3
MARTIN CO., DIV. MARTIN-MARIETTA CORP., 1, 2, 3. SEE ADV. P. 224
Maxson Electronics Div., 2
McDONNELL AIRCRAFT CORP., 1, 2, 3. SEE ADV. P. 230
McKiernan-Terry, Div. of Litton Industries, 2
Meriam Instrument Co., The, 1, 2, 3
Milgo Electronic Corp., 2
Missouri Research Laboratories, 2, 3
Morfax, Ltd., 2
M. Neushul Co., Inc., 2
Non-Linear Systems, Inc., 2
North American Aviation, Inc., Los Angeles Div.
North Electric Co., 2
Northrop Corp., Norair Div., 1, 2, 3
Notifier Corp./Notifier Engineering, Inc., 2
On Mark Engineering Co., 1
Ralph M. Parsons Co., The, 2
Ralph M. Parsons Co., Electronics Div., 2
Philco Corp., Western Development Laboratories, 2, 3
Piasecki Aircraft Corp., 1, 2
Plastic Age Sales, Inc., 2
Premier Metal Products Co., Inc.
REF Dynamics Corp.
Radio Corp. of America, 2, 3
RADIOTRONICS, INC., 2. SEE ADV. P. 214
Redifon, Ltd., Flight Simulator Div., 2
Republic Aviation Corp., 1, 2, 3
Republic Electronic Industries Corp., 2
Research, Inc., 2
Rimak Electronics, Inc., 1, 2
Sabema Corp.
Sargent Fletcher Co.
Scans Associates, Inc., 1, 3
Singer Metrics Div., The Singer Co., 2
Skydyne, Inc.
Societe d'Applications Generales d'Electricite et de Mecanique (SAGEM), 2
Space Corp., 2
Space General Corp., 2, 3
Sparton Corp., Sparton Electronics Div., 2
Spencer Display Co., Div. General Indicator Corp.
Sperry Gyroscope Co., Div. Sperry Rand Corp., 1, 2, 3
Sperry Microwave Electronics Co., Div. Sperry Rand Corp., 2
Sperry Utah Div., Sperry Rand Corp., 2
Stromberg Carlson, Div. General Dynamics Corp., 2
Sylvania Electronic Systems, Div. Sylvania Electric Products Inc., 2
Talley Corp.
Tamar Electronics, Inc., 2
Tasker Instruments Corp., 2
Telectro Industries Corp., 2
Theta Instrument Corp., 2
Thompson Ramo Wooldridge, Inc., 2
Tracerlab Div., Laboratory for Electronics, Inc.
Trio Laboratories, Inc., 2
Twin Industries Corp., Aerospace Div., 1, 2
UMC Electronics Co., United Mfg. Co. Sub., 2
United Electrodynamics, Inc., 2
U. S. Controls, Inc., 2, 3
Universal Match Corp., Unidynamics Div., 2
Vacco Valve Co., 1, 2, 3
Virginia Electronics Co., Inc., 2
Washington Aluminum Co., Inc., 1, 2, 3
Westinghouse Electric Corp., Air Arm Div., 1, 3
Westinghouse Electric Corp., Electronics Div., 2
Westland Aircraft, Ltd., 2
Wickes Industries, Inc., 2
Wilcox Electric Co., Inc., 2
Winder Aircraft Corp., 1, 2, 3

Constant Speed Equipment

AIRESEARCH MFG. CO., DIV. THE GARRETT CORP. SEE ADV. P. 28
Allis Chalmers Mfg. Co.
Dowty Group, Ltd.
Fairchild Stratos Corp., Stratos Div.
Garwin, Inc.
General Electric Co., Aircraft Accessory Turbine Dept.
General Precision Inc., Aerospace Group (Kearfott Div., Systems Div., Research Center)
Gyrex Corp., The
H. M. Hobson, Ltd.
Kollmorgen Corp.
LEAR SIEGLER, INC., POWER EQUIPMENT DIV. SEE ADV. P. 94, 95
Lockheed Aircraft Corp.
Lycoming Div., Avco Corp.
F. B. Maclaren Co., Inc.
Power-Tronic Systems, Inc.
Rotax, Ltd.
W. H. Sanders Electronics, Ltd.
Sundstrand Aviation-Denver
Sundstrand Corp., Sundstrand Aviation Div.
Szemco, Inc.
Tapco Div., Thompson Ramo Wooldridge, Inc.
Varo, Inc.
Vickers, Inc., Div. Sperry Rand Corp.
Vickers, Inc., Electric Products Div.
Vickers, Inc. Marine & Ordnance Dept., Div. Sperry Rand Corp.
Welin Davit & Boat Div., Continental Copper & Steel Ind., Inc.
Westinghouse Electric Corp.
Westinghouse Electric Corp., Aerospace Electrical Dept.

Construction Vehicles

Allis Chalmers Mfg. Co.
Blaw-Knox Co.
CATERPILLAR TRACTOR CO., DEFENSE PRODUCTS DEPT. SEE ADV. P. 22
Caterpillar Tractor Co., Engine Div.
FMC Corp., Ordnance Div.
Pettibone-Mulliken Corp.
Sicard, Inc.
Westinghouse Air Brake Co.
Westinghouse Electric Corp., Systems Management Dept.

Contact Materials

J. Bishop Co., Platinum Works
Brush Beryllium Co., The
Cannon Electric (G. B.) Ltd.
Carbone Corp., The
Engelhard Industries, Inc.
Engelhard Industries, Inc., Makepeace Div.
Fansteel Metallurgical Corp.
Gibson Electric Co.
Johnson, Matthey & Mallory, Ltd.
Kwikset Powdered Metal Products, Kwikset Div., American Hardware
J. M. Ney Co., The
Superior Carbon Products, Inc.
Sweet Industrial, Div. of EMA
Westinghouse Electric Corp.

Contacts, Electrical

1. Precious metal, 2. Slip ring

AMP, INC., 1. SEE ADV. P. 99, 100, 101, 102
Airborn Connectors, Div. Airborn, Inc., 1
Amphenol-Borg Electronics Corp. Amphenol Connector Div., 1
J. Bishop & Co., Platinum Works, 1
Bram Metallurgical Chemical Co.
Cannon Electric (G. B.), Ltd., 1
Carbone Corp., The, 2
Hugh H. Eby Co.
Electro-Miniatures Corp., 2
Electro-Tec Corp., 1, 2
Engelhard Industries, Inc., 1, 2
Engelhard Industries, Inc., Makepeace Div., 1, 2
Epoxy Products, Inc., 1
Fansteel Metallurgical Corp., 1
General Devices, Inc., 1, 2
Gibson Electric Co.
Gorn Electronics, Div. Gorn Electric Co., 1
Gray & Huleguard, Inc., 1
Helwig Carbon Products, Inc., 1
Irving Air Chute Co., Inc., 1
Joclin Mfg. Co., 2
Johnson, Matthey & Mallory, Ltd., 1, 2
King Electric Co., Inc.
P. R. Mallory & Co., Inc., 1, 2
Micro Products Corp., 1
National Connector Corp., 1
J. M. Ney Co., The, 1, 2
North Electric Co., 1
G. T. Schjeldahl Co., 1
Skyron Corp., 1
Slip Ring Co. of America, 1, 2
Stackpole Carbon Co., 1, 2



Air Force Titan III-C Gets

A PRECISION RING OF HIGH RELIABILITY

D6AC ROCKET MOTOR CASING RING DESIGNED FOR MILLION POUND THRUST

When Air Force Titan III-C blasts off for outer space, it will be powered by United Technology Center's two 120 inch O.D. segmented, solid propellant motors—each with a million pounds of thrust.

These rings made of Midvac Steel to specifications of the Curtiss-Wright Corporation, are a critical part of the Titan's rocket motor casings. Made of D6AC from a 40" ingot melted by Midvac consumable electrode process, the rings are ⅜" thick, precision machined to a .125 RMS finish. Diameter tolerance is .010" to .030".

Even bigger ingots of these ultra clean steels—up to 60 inches in diameter and weighing 110,000 pounds—are now available from Midvale's big new furnace. Now larger rocket motor components, forgings for nuclear parts, turbine shafts and other large parts are possible with this new M-H facility. Check the new capabilities in design and performance by writing for the Midvac Steel data book—today.

MIDVALE-HEPPENSTALL COMPANY
NICETOWN, PHILADELPHIA, PA.
Subsidiary of Heppenstall Company, Pittsburgh, Pa.

Midvac Steels

VACUUM AND CONSUMABLE ELECTRODE STEELS • BACK-UP ROLL SLEEVES • FORGED STEEL ROLLS • FORGINGS
RINGS • PRESSURE VESSELS • INDUSTRIAL KNIVES • DIE BLOCKS • MATERIALS HANDLING EQUIPMENT

Circle Number 130 on Reader-Service Card

A New Galaxy—



New Type IMM 648-1
Shown Actual Size

—of "MAG MOD" MICRO MAGNETIC MODULATORS

1952-1962...weight reduced from 5 ounces to 0.1 ounce!

The product of 2 years of intensive development work, new completely microminiaturized magnetic modulators feature an essentially drift-free circuit with superior phase and gain stability over wide environmental ranges. All the ruggedness, dependability, wide dynamic range and stability that are characteristic of the larger magnetic modulators are engineered into this new magnetic circuit. "MICRO MAG MODS" are shock and vibration proof, provide the ultimate in reliability and unlimited life.

Absolute Reliability in Micro Magnetics

An entire circuit module compensated for phase, gain and zero drift over entire temperature range.

- 0.1 Cubic Inch Volume
- 0.1 Ounces in Weight
- Infinite Standby and Service Life
- Low Milliwatt Power Consumption
- High Shock and Vibration Resistance

GENERAL MAGNETICS • INC

135 BLOOMFIELD AVENUE
BLOOMFIELD, NEW JERSEY

Turn to Reverse Side for Specifications and Data—



There is No Substitute for Reliability

New!

"MICRO MAG MOD"® MAGNETIC MODULATORS

–provide repeatable data over years of continuous, unattended operation!

"MAG MODS" provide four quadrant operation, extreme stability with negligible change of phase, gain and zero position over a wide temperature range. Design is simple, lightweight, rugged with no vacuum tubes, semiconductors or moving parts to limit life. "MAG MODS" offer infinite design possibilities and impedance levels, and are adaptable for algebraic addition, subtraction, multiplying, dividing, raising to a power and vector summing.

ADVANTAGES:

- Electrical zero point and gain, repeatability and stability over entire service life
- Extremely broad bandwidth
- Carrier frequencies as high as 1 megacycle
- Input signal current resolution better than 0.01 μa
- Absolute reliability—unlimited life
- High shock and vibration proof
- Low milliwatt power consumption



Micro Magnetic Modulator Type IMM-655-2



Micro Magnetic Modulator Type IMM-648-1

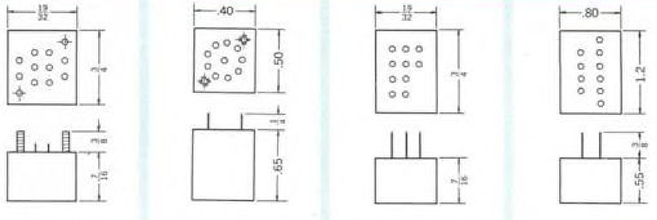


Micro Magnetic Modulator Type IMM-664-1



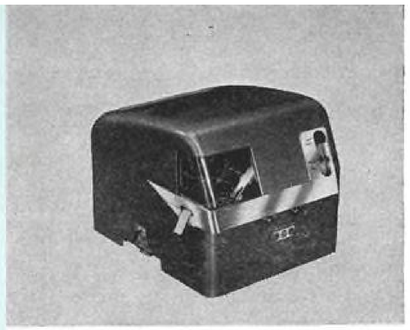
Micro Magnetic Modulator Type IMM-680-1

TYPE NUMBER	IMM-655-2	IMM-648-1	IMM-664-1	IMM-680-1
Reference Carrier Voltage and Frequency	3 V @ 400 cps	2 V @ 2 KC	10V @ 60 KC	115 V @ 400 cps
Input Control Signal Range	0 to ±100 μa DC	0 to ±300 μa DC	0 to ±100 μa DC	0 to ±10 μa DC
DC Resist. of Input DC Signal Winding	3 K ohms	1400 ohms	90 ohms	20 K ohms
AM Phase Reversing AC Output Range	0 to 0.8 V RMS @ 400 cps	0 to 1.0 V RMS @ 2 KC	0 to 200 mv RMS @ 60 KC	0 to 30 mv RMS @ 400 cps
Differential Gain RMS mv AC Output/μa DC Signal Input	7 mv/μa	4 mv/μa	2 mv/μa	5 mv/μa
AC Output Null (Noise Level) mv RMS	5 mv RMS Max.	5 mv RMS Max.	10 mv RMS Max.	.100 μv RMS Max.
Output Impedance	14 K ohms	1000 ohms	11 K ohms	Approx. 150 ohms
External Load	100 K ohms	5 K ohms	50 K ohms	100 ohms
Excitation (Carrier Winding) Impedance	3 K ohms	1700 ohms	750 ohms	90 to 100 K ohms
Zero Drift over Temp. Range Referred to DC Input Terminals	±0.1 μa Max.	0.5 μa Max.	—	0.05 μa Max.
Hysteresis in % of Max. Input DC Signal	0.2% Max.	0.2% Max.	0.5% Max.	0.1% Max.
% Harmonic Dist. in Output Product Wave	15%	10% to 15%	5%	20%
Temperature Range	–55°C to +125°C	–55°C to +125°C	–55°C to +125°C	–55°C to +125°C
Frequency Response	5 K Series, 108 cps	Over 200 cps	Over 5 KC	Over 100 cps
Overall Dimensions (in Inches)	1 9/32 x 3/4 x 7/16	0.4 x 0.5 x 0.65	1 9/32 x 3/4 x 7/16	.80 x 1.2 x .55
Type of Mounting	Two 2-56 Studs	Two 0-80 Inserts	Printed Circuit Board 1/10th Grid Plug-in	Two 4-40 Studs
Approximate Weight (in Ounces)	0.2	0.1	0.2	0.2

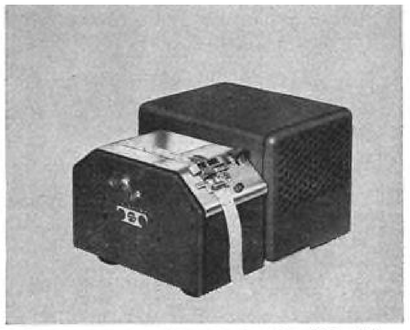


GENERAL MAGNETICS • INC
135 BLOOMFIELD AVENUE
BLOOMFIELD, NEW JERSEY

Catalogs available on Micro Magnetic Modulators, Standard Magnetic Modulators, Miniaturized Multiplying Modulators, Transistor Oscillators. Call or write for your copies, or ask to have a GENERAL MAGNETICS representative contact you for consultation on specific applications.



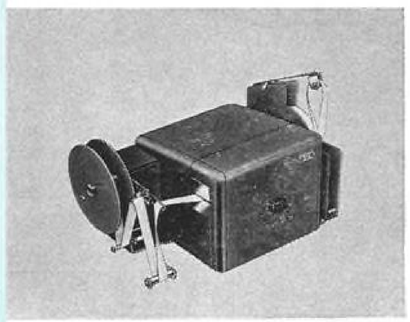
1 Printing Tape Punch (LPR Set), Serial Input, 10 char/sec.



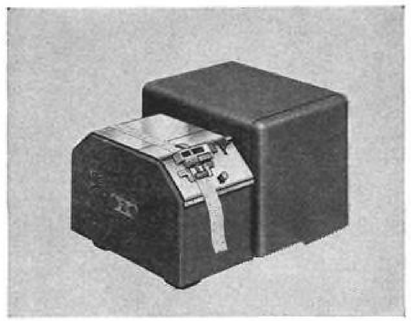
2 Tape Reader (LXD Set), Serial and Parallel Output, 10 char/sec.



3 Tape Reader (LBXD Set), Serial and Parallel Output; or as Signal Conversion Unit, Parallel Input, Serial output, 10 char/sec.



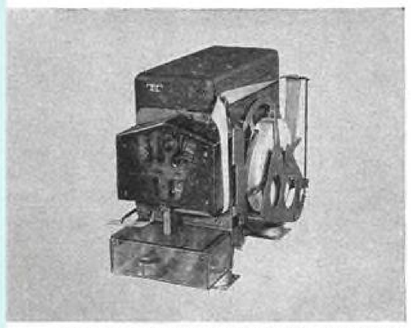
4 Tape Punch (LARP Set), Parallel Input, 20 char/sec.



5 Tape Reader (LX Set), Parallel Output, 20 char/sec.



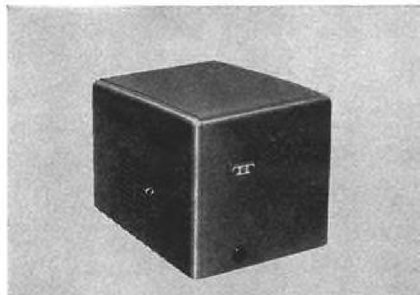
6 Keyboard Tape Punch (LKPE Set), Manual tape preparation.



7 Tape Punch (BRPE Set), Parallel Input, 63 or 110 char/sec.



8 Tape Reader (CX Set), Parallel Output, 60 or 107 char/sec.



9 Signal Conversion Units: Serial-to-Parallel Converter (LRS Set, shown); Parallel-to-Serial Converter (LD Set). 10 char/sec.

Does your data system need punched tape?

If it does, check your specifications against these nine Teletype units.

Then check the price.

Frankly, we think you'll be amazed that equipment with these capabilities will cost you so little.

Choose from models that handle five, six, seven or eight-level tape. They range in speed from 10 char/sec. on the LPR Tape Punch (upper left) to 110 char/sec. on the BRPE Tape Punch (lower left).

Is it a combination set you want? In addition to the units shown, we have gang-mounted punches and readers, code and speed converters, even punch and relay sets. In fact, there are Teletype units available for almost any message and data communication need—whether your system is small and local . . . or large and country-wide.

For more details, contact: Teletype Corporation, Dept. 70N, 5555 Touhy Avenue, Skokie, Illinois.

This equipment is made for the Bell System and others who require dependable communications at the lowest possible cost.

TELETYPE® CORPORATION SUBSIDIARY OF Western Electric Company INC.

Circle Number 140 on Reader-Service Card

Products Research Co.
Raytheon Co., Microwave & Power Tube Div.
Redman Electronics Corp.
Rixon Electronics, Inc.
Shallcross Mfg. Co.
Sparton Corp., Sparton Electronics Div.
Sperry Gyroscope Co., Div. Sperry Rand Corp.
Sperry Microwave Electronics Co., Div. Sperry Rand Corp.
Sprague Electric Co.
Systems Design, Inc.
Tektronix, Inc.
Templet Industries, Inc.
Tempo Instruments, Inc.
United Transformer Corp.
Valor Instruments, Inc.
Waveline, Inc.
Westinghouse Electric Corp.
Westinghouse Electric Corp., Air Arm Div.
Westinghouse Electric Corp., Electronics Div.
Whiteley Electrical Radio Co., Ltd.

Delays

Adtrol Electronics, Inc.
AGASTAT Timing Instruments, Elastic Stop Nut Corp. of America
Amcel Propulsion Co., Div. Celanese Corp. of America
Autronics Corp.
Dynamic Controls Corp.
ESC Electronics Corp.
Electronic Products Corp.
G-V Controls, Inc.
General Electric Co., Light Military Electronics Dept.
Hercules Powder Co.
Hurletron, Inc., Hurletron Control Products Div.
Industrial Timer Corp.
Irving Air Chute of Great Britain, Ltd.
Jay-El Products, Inc.
Jet Research Center, Inc.
Leach Corp.
North Electric Co.
Stromberg Carlson, Div. General Dynamics Corp.
Systems Design, Inc.
Tempo Instruments, Inc.
U. S. Flare-National Northern Div., Atlantic Research Corp.
Universal Match Corp., Unidynamics Div.
Wheaton Engineering, Div. Hurletron, Inc.

Demagnetizing Equipment

Aero Precision Industries, Inc.
Ampex Corp.
Amplifier Corp. of America
Barnes & Reinecke, Inc.
Bux-Shrader Magnetic Products
Canadian Research Institute
Electronic Brazing Co.
Fisher Engineering, Inc.
General Kinetics, Inc.
Ideal Industries, Inc.
International Tel. & Tel. Corp., ITT Federal Laboratories Div.
Irwin Laboratories, Inc.
Kahn & Co., Inc.
Magnaflux Corp.
Martindale Electric Co.
Microtran Co.
Permag Pacific Corp.
Qutronic Transformer Corp.
Radio Frequency Laboratories, Inc.
Sunbeam Equipment Corp.

De-mineralizing Equipment

American Sterilizer Co.
Crystal Research Labs., Inc.
Ionics, Inc.

Demodulators, Electronic

ACEC
ACF Industries, Inc.
Advanced Measurement Instruments, Inc.
Aero Geo Astro Corp.
Anzac Electronics, Inc.
Barnes Engineering Co.
Bendix Corp., The, Bendix Radio Div.
Boonshaft & Fuchs, Inc.
Canadian Curtiss-Wright, Ltd.
Crescent Engineering & Research Co.
Data Control Systems, Inc.
Dresser Electronics, HST Div.
Dynatronics, Inc.
Electro Mechanisms, Ltd.
Electronic Systems, Div. Antenna Systems, Inc.
Ensco, Inc.
Fiat, S.P. A., Divisione Aviazione
General Dynamics/Electronics—Rochester
General Instrument Corp., Defense & Engineering Products Group, Radio Recepter Div.
General Precision, Inc., Aerospace Group (Kearfott Div., Systems Div., Research Center)
Gulf Aerospace Corp.
Hathaway Instruments, Inc.
Hewlett-Packard Co.
Hoover Co., The, Electronics Div.
Houston Fearless Corp., Westwood Div.
Industrial Measurements Corp.
International Business Machines Corp., Federal Systems Div.
International Data Systems, Inc.
LEL, Inc.
Lear Siegler, Inc., Instrument Div.
F. B. MacLaren Co., Inc.
Matrix Research And Development Corp.
Muirhead Co., Ltd.
National Cash Register Co.
North Atlantic Industries, Inc.
Philco Corp., Sub. Ford Motor Co.
Piasecki Aircraft Corp.
Polyphase Instrument Co.
Power-Tronic Systems, Inc.
Princeton Applied Research Corp.
RHG Electronics Laboratory, Inc.
Radio Corp. of America
Rixon Electronics, Inc.
Robertshaw Controls Co., Aeronautical & Instrument Div.
Sanders Associates, Inc.
Siltronics, Inc.
Solid State Electronics Corp.
Spectran Electronics Corp.
Sperry Gyroscope Co., Div. Sperry Rand Corp.
Standard Products, Inc.
Systems Engineering Labs., Inc.
Taber Instrument Corp., Aero-Space Electronics Div.
Tamar Electronics, Inc.
Tele-Signal Corp.
M. Ten Bosch, Inc.
Theta Instrument Corp.
Torwico Electronics, Inc.
Vickers, Inc., Electric Products Div.
Vitro Corp. of America
Walkirt Co.
Weinschel Engineering Co., Inc.
Westinghouse Electric Corp., Air Arm Div.
Westinghouse Electric Corp., Electronics Div.
Wiancko Engineering Co., Div. Tamar Electronics, Inc.

Demonstrators

1. Electrical, 2. Electronic, 3. Mechanical

ARRA (Antenna & Radome Research Assoc.), 2
Astral Electronics, Inc., 1, 2, 3
Atkins & Merrill, Inc., 1, 2, 3
Budd Stanley Co., Inc., 2
Burtek, Inc., 1, 2, 3
G. F. Bush Associates
CSF-Compagnie Generale de Telegraphie Sans Fil, 2
Canadian Research Institute, 1, 2, 3
Chrysler Corp., Defense Space Group, 1, 2, 3
Chrysler Corp., Space Div., 1, 2, 3
Dynamic Controls Corp., 1, 2, 3
Elden Co., Inc., The, 1, 2, 3
Electronic Products Corp., 2
Electronics Development Corp.
Garrett Mfg., Ltd., Sub. The Garrett Corp., 2, 3
General Precision, Inc., 1, 2, 3
Goodyear Aerospace Corp., 2
Hathaway Instruments, Inc., 2
Honeywell, Military Products Group, 1, 2
Houston Engineering Research Corp., 1, 2, 3
Hughes Electronics Co., 1, 2
Intercontinental Electronics Corp., 2
Ling-Temco-Vought, Inc., 1, 2, 3
McDONNELL AIRCRAFT CORP., 2. SEE ADV. P. 230
North Electric Co., 1, 2, 3
Power-Tronic Systems, Inc., 1, 2, 3
Schaffer Air Industries, Inc., 1, 3
Singer Metrics, Div. The Singer Co., 2
Sperry Utah Div., Sperry Rand Corp., 2
Tasker Instruments Corp., 2
Tektronix, Inc., 2
Telkor, Inc., 1, 2
Topper Mfg. Co., Inc., 1, 2, 3
Varo, Inc.
Viewlex, Inc., 1, 2, 3
Westinghouse Electric Corp., 1, 3
Westinghouse Electric Corp., Air Arm Div., 2
Westinghouse Electric Corp., Electronics Div., 1, 2
Westinghouse Electric Corp., Ordnance Div., 2
Weston Instruments & Electronics, Div. Daystrom, Inc., 1, 2

Densitometers

ACEC
Automation Products, Inc.
Baird-Atomic, Inc.
Bar-Ray Products, Inc.
Bendix Corp., The, Pioneer-Central Div.
Canadian Research Institute
Conductron Corp.
Electro Physics Co.
B. K. Elliott Co.
Farrand Optical Co., Inc.
Franklin Systems, Inc.
Giannini Controls Corp.
Hogan Faximile Corp., Sub. Telautograph Corp.
Intectron, Inc.
Kaman Nuclear
Liquidometer Corp., The
David W. Mann Co., Div. Geophysics Corp. of America
Newark Controls Co.
Photographic Applications Co.
Princeton Applied Research Corp.
R. B. Pullin & Co., Ltd.
Servomechanisms, Inc.
Sonobond Corp., Sub. Aeroprojects, Inc.
Standard Products, Inc.

Desiccating Equipment

Bio-Rad Laboratories
Bowser-Briggs Filtration Div., Bowser, Inc.
Electro Chemical Co.
Great Lakes Mfg. Corp.
C. I. Hayes, Inc.
Humidial Co.
Hymatic Engineering Co., Ltd., The
Kahn & Co., Inc.
Robbins Aviation
Stewart Warner Corp., South Wind Div.
Swiss Electro Instruments, Div. Pastushin Industries, Inc.
Universal Dynamics Corp.
Westinghouse Electric Corp.

Destruct Systems

Advanced Technology Laboratories, Div. American-Standard
Aerojet-General Corp., Corporate Offices
Aerolab Development Co., Sub. Marshall Industries
Aircraft And Missile Consultants
Amcel Propulsion Co., Div. Celanese Corp. of America
Astropower, Inc. Sub. Douglas Aircraft Co., Inc.
Babcock Electronics Corp.
Beckman & Whitley, Inc.
Bulova Systems And Instruments Div. (incl. Bulova R & D Laboratories), Bulova Watch Co., Inc.
Chromalloy Corp., Propellex Div.
Cubic Corp.
Douglas Aircraft Co., Inc., Missile & Space Systems Div.
General Laboratory Associates, Inc.
Goodyear Aerospace Corp.
Hercules Powder Co.
Holex, Inc.
Jet Research Center, Inc.
Ledex, Inc.
Wallace O. Leonard, Inc.
Lockheed Aircraft Corp.
McCormick Selph Associates, Inc.
Prosser Industries, Inc.
Quantic Industries, Inc., Pelmac Div.
R S Electronics Corp.
Research Services
Rocket Power, Inc.
Space Technology Laboratories, Inc.
Special Devices, Inc.
Stellardyne Laboratories, Inc.
Talley Industries, Inc.
Technical Oil Tool Corp.
THIOKOL CHEMICAL CORP. SEE ADV. P. 36
Thiokol Chemical Corp., Wasatch Div.
Thompson Ramo Wooldridge, Inc., RW Div.
Universal Match Corp., Unidynamics Div.

Detectors

1. Crack, 2. Detonation, 3. Fire, 4. Friction, 5. Gas, combustible, 6. Gas, toxic, 7. Ice, 8. Magnetic chip, 9. Radiation, 10. Smoke, 11. Vacuum leak, 12. Vibration

Acoustica Associates, Inc., 12
Advanced Technology Laboratories, Div. American-Standard, 3, 9
Aero Vac Corp., 11
Aerojet General Corp., Corporate Offices, 6, 9
AIRESEARCH MFG. CO. DIV., THE GARRETT CORP., 7. SEE ADV. P. 28
American Data Machines, 3
American District Telegraph Co., 3, 10
American Gas & Chemical, Inc., 1, 2, 3, 5, 6, 11
American LaFrance Div., Sterling Precision Corp., 3
Amperex Electronic Corp., 9
Avimo, Ltd., 1
Barnes Engineering Co., 3, 5, 6, 9
Barnes Engineering Co., Defense & Space Div., 9
Beckman Instruments, Inc., Scientific & Process Instruments Div., 5, 6, 9, 10, 11
Beckman Instruments, Inc., Systems Div.
Bendix Corp., The, Bendix Pacific Div., 5
Bendix Corp., The, Bendix Research Laboratories, 6, 11
Bendix Corp., The, Eclipse-Pioneer Div., 6
Block Engineers, Inc., 9
Brent Chemical Products, Ltd., 1
E. W. Brilmayer Laboratories, Inc.
Bristol Co., The, 5
British Aircraft Corp., 3
Budd Co., Instruments Div., 1, 9
Bulova Systems And Instruments Div. (incl. Bulova R & D Laboratories), Bulova Watch Co., Inc., 9
G. F. Bush Associates, 5, 6, 9, 11, 12
Bux-Shrader Magnetic Products, 8
C-O Two Fire Equipment of Canada, 3, 10
CSF-Compagnie Generale de Telegraphie Sans Fil, 3, 9
Canadian Bristol Aerojet, Ltd., 9
Canadian Curtiss-Wright Ltd., 1, 4
Canadian Research Institute, 9, 10, 12
Capehart Corp., 9
Cardox Div., Chemetron Corp., 3, 10
Cleveland Metal Specialties Co.
Consolidated Electrodynamics Corp., 11, 12
CONSOLIDATED SYSTEMS CORP., 5. SEE ADV. P. 212
Cook Electric Co., Technological Center Div., 5, 6, 9, 10
Cook Electric Co., Wirecom Div., 7
Davis Emergency Equipment Co., Inc., 5, 6
Del Electronics Corp., 6
Delcon Corp., 4, 5, 6, 11
J. W. Dice Co., 1
E. I. Doucette Associates, Inc., 5, 6, 11
Dynalectron Corp., 6, 9
Eastman Kodak Co., 3
Edgerton, Germeshausen, Grier, Inc., 2, 9
Thomas A. Edison Industries, Instrument Div., 3
Eitel-McCullough, Inc., 11
Ekco Electronics, Ltd., 9
Electro Mechanisms, Ltd., 12
Electro Nuclear Laboratories, Inc., 9
Electro-Neutronics
Electro-Optical Systems, Inc., 9
Electrospace Corp., 9
Electro-Technical Labs., Div. Mandrel Industries, Inc., 12
Elfion Instruments, 11
Epic, Inc., 12
Erdco Engineering Corp., 5, 6
Farrand Optical Co., Inc., 9
Fenwal, Inc., 3, 10
Franklin Systems, Inc., 9
Fredericks Co., The, Vacuum Instrument Div., 11
General Electric Co., Light Military Electronics Dept.
General Electric Co., Vallecitos Atomic Laboratory, 9
General Nuclear Corp., 9
General Radio Co., 12
Geophysics Corp. of America, Physics Research Div., 6, 9, 11
B. F. Goodrich Aerospace & Defense Div., B. F. Goodrich Co., 7
Graviner, Inc., 3
Gulf Aerospace Corp., 9
Gulton Industries, Inc., 1, 5, 6, 12
Harshaw Chemical Co., The, 9
Hendrey Relays, Ltd., 6
Holley Carburetor Co., 7
Honeywell, Military Products Group, 2, 3, 5, 6, 7
Hughes Aircraft Co., 9
Industrial Instruments, Inc., 6
Inertia Switch, Inc., 12
Infrared Industries, Inc., 3, 9
Intercontinental Electronics Corp., 9
International Research & Development Corp., 12
International Tel. & Tel. Corp.
Isomet Corp., 9
Johnson-Williams, Inc., 5, 7
Kaman Nuclear, 9
Walter Kidde & Co., Inc., 3, 10
Walter Kidde & Co., Inc., Alarms Div., 3
Walter Kidde Co., Inc., Industrial And Marine Div., 10
Walter Kidde & Co. of Canada, Ltd., 3, 10
Korfund Dynamics Corp., 11, 12
Laboratory For Electronics, Inc., 6, 9
Landsverk Electrometer Co., 9
Leesona Moos Laboratories, Div. Leesona Corp., 5, 6
LISLE CORP., 8. SEE ADV. P. 250
Lockheed Aircraft Corp., 1, 9
MB Electronics, Div. Textron, Inc., 12
MEG Products, Div. Mandrel Industries, Inc., 2, 12
Magna Corp., Research & Development Div., 6
Magnaflux Corp., 1
J. W. Marchetti, Inc., 2
Mast Development Co., Inc., 6
Menlo Research Laboratory, 9
Metal Treating Equipment Exchange, Inc., 3
Mid-Eastern Electronics, Inc., 11
Mine Safety Appliances Co., 5, 6
Moran Instrument Corp., 9
NRC Equipment Corp., 11
Newark Controls Co., 11
Louis Newmark, Ltd., 5
Northrop Corp., 1
Notifier Corp./Notifier Engineering, Inc., 3, 10
Nuclear Corp. of America, Nuclear Div., 9
Nuclear Enterprises, Ltd., 9
Nuclear Measurements Corp., 9
Pall Corp., 5, 6, 11
Perkin-Elmer Corp.
Philco Corp., Sub. Ford Motor Co., 9
Photobell Co., Inc., 10
Physics International Co., 9
Presentey Engineering Products, Ltd., 10
Pyrene Co., Ltd., The, 3, 10
Pyrene Mfg. Co. of Canada, Ltd., 3, 10
Pyrotector, Inc., 3, 10
Radio Corp. of America, 6, 9
Radionics, Inc., 9
Raytheon Canada, Ltd., 5
Razdow Laboratories, Inc., 12



Landing strip for a supersonic fighter

Powered by the Bristol Siddeley BS 100 vectored thrust engine, the Hawker Siddeley P 1154 strike aircraft combines supersonic performance with vertical take-off and land ability. This aircraft is now being developed as a Hunter and Royal Navy Sea Vixen replacement.

The choice of the BS 100 for the P 1154 follows closely on the successful trials of another Bristol Siddeley powered V/STOL aircraft–the Hawker Siddeley P 1127. The P 1127, powered by the Pegasus vectored thrust engine, has been flying for more than three years and was the world's first V/STOL strike aircraft. With more than eight years development experience in vectored thrust engines, Bristol Siddeley are world leaders in this field.

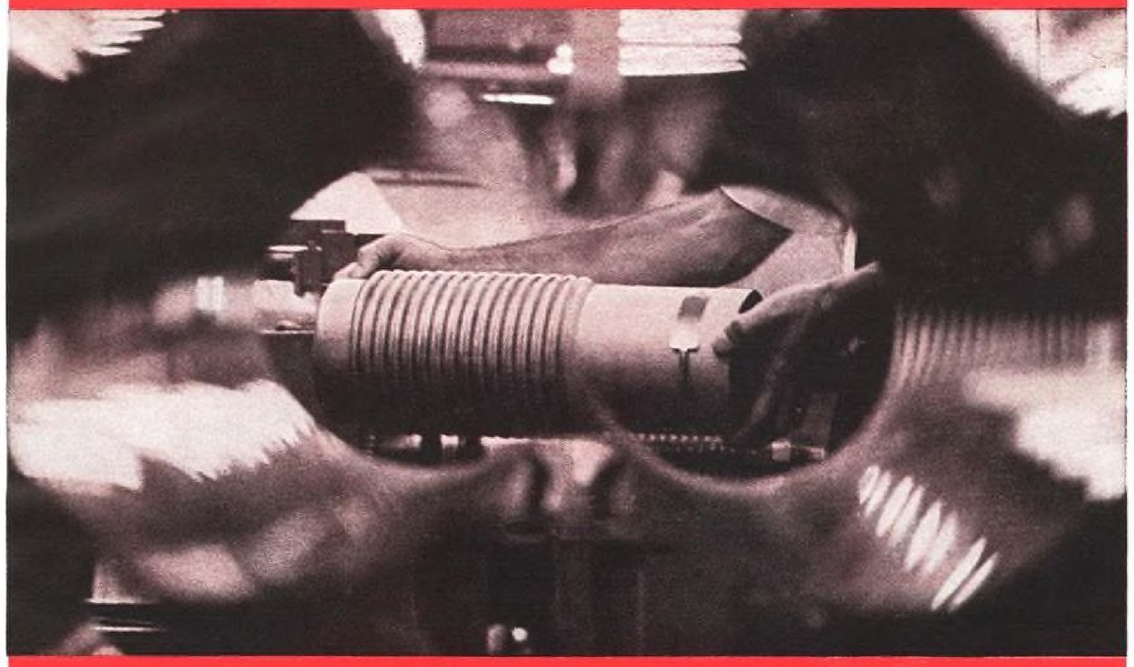
Bristol Siddeley Engines Limited. Aero-Engine Division: PO Box 3, Filton, Bristol, England.

BRISTOL SIDDELEY
SUPPLY THE POWER

at Arrowhead you get

THE CAPACITY TO CREATE...THE SKILL TO PRODUCE

Arrowhead's "Programmed Capability" makes available to you a unique organization of imaginative specialists, molded into an integrated team with a remarkable sense of project responsibility ■ Housed in a new engineered facility, present project activities include unusual space-age materials engineered into systems with exotic configurations and sizes (50 foot Saturn fuel lines) as well as critical ducting and fluid transfer systems for both military and commercial aircraft ■ Arrowhead has years of experience in producing Life Support Equipment, such as fuel suits, full-pressure suits and helmets ■ For ground operations or a lunar probe and return, Arrowhead's Human Factors Laboratory can be relied upon from research through precision performance ■ The new plant includes full-scale environmental testing equipment to insure unfailing service ■ A super-clean room is in operation 'round-the-clock. You are urged to utilize the unusual creativity and production skills of the Arrowhead specialists.



METALLIC & NON-METALLIC SYSTEMS FOR MILITARY & COMMERCIAL AIRCRAFT-MISSILES & AEROSPACE PROGRAMS



FLUID TRANSFER SYSTEMS
Arrowhead's "Integrated" engineering combines unrelated materials such as metal, rubber, plastics and fabric to save weight and provide functional superiority, complete reliability.

THERMAL PROTECTION
Advanced techniques and materials for extreme service include ablative and cryogenic systems, integral and blanket insulation, customized in substance and shape to exact specification.

LIFE SUPPORT EQUIPMENT
Space-age full-pressure suits and helmets for astronauts and ground support fuel suits, with two-way radio, provide safety and functional freedom for crewmen. Standard or custom.

NON-METALLIC STRUCTURES
Structural configurations use modern chemistries... foam, fiber glass, resins... and ranges from radomes, custom fuel cells, or instrument cases to a 50 ft. Saturn fuel line shipping case.

LOX CLEANING FACILITIES
Arrowhead's particulate matter control is available for custom service. Complete cycle ranges from a gray area, through super-clean procedures and vacuum packaging.

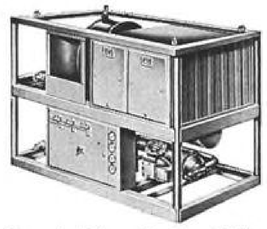
Space-age capability from Launch Pad to Recovery

FLUID TRANSFER SYSTEMS Flexible bellows and ducting components • THERMAL PROTECTION Extreme service insulation • LIFE SUPPORT EQUIPMENT Space Suits, fuel suits, helmets, and human factors equipment • NON-METALLIC STRUCTURES Plastic, rubber and fabric aerospace components • LOX CLEANING FACILITIES Aerospace clean-room.

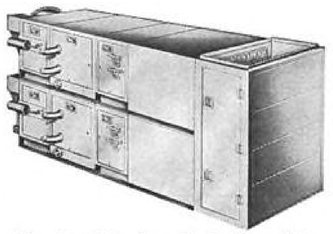
ARROWHEAD
Division of Federal-Mogul-Bower Bearings, Inc.
PRODUCTS
4415 KATELLA AVE. • LOS ALAMITOS, CALIF.
IN CANADA – RAILWAY & POWER EQUIPMENT LTD. IN EUROPE – FEDERAL-MOGUL, ANTWERP, BELGIUM

Circle Number 145 on Reader-Service Card

FROM AAF ENVIRONICS PRODUCTS OF ENVIRONMENT CONTROL PROGRESS



Packaged Brine Cooler. Self-contained unit incorporates refrigeration compressor, brine chiller, all associated components, controls. Cooling output, 67,000 BTU/hr. Refr. effect, at 120° F. condensing temp.; and 100° F. ambient temp., 3000 ft. altitude.

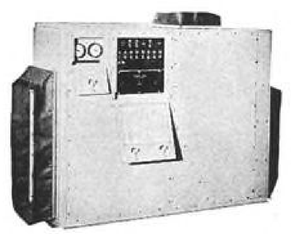


Air Conditioning Unit. Complete, modular constructed unit has supply fan, chilled brine supplied air cooling coil, air filter, automatic temp. control and alarm sensors. Fresh air filtration capable of removing 99.97% of all particulate matter over 0.3 microns in size.

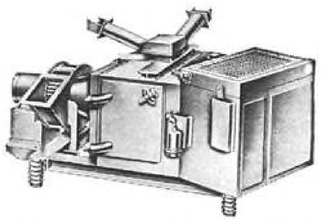
AAF Environics is the highly developed approach to environment control system engineering, production, delivery, and installation that created Minuteman's integral environmental system. It has also helped support Atlas, Nike Zeus, the Century Jets, and other weapons and command systems. Shown here are a number of original units of such systems, available for your application. More important, one or more may embody a vital head-start on your own environmental engineering requirements. Ask for Bulletin D-164 and assistance on any problem. *Defense Products Group, American Air Filter Co., Inc., 1270 N. Price Road, St. Louis, Missouri.*



Emergency Cooling Unit. Contains DC-powered vaneaxial fan, DC-powered circulating pump, chilled water supplied air cooling coil, an AC-powered normal-service water circulating pump. Automatic controls for each component. Will withstand shock load in any direction.



Air Conditioner Unit. Provides fully modulated conditioned, filtered air supply with 3-stage cooling. 3-stage heating. Integral, finned, strip-type, electric resistance heaters. Cooling output: 42,000 BTU/hr., rated at + 125° F. Heating output: 51,000 BTU/hr.



Air Conditioning Unit. Complete, modular constructed unit contains supply fan, chilled brine supplied air cooling coil, air filter, air flow control dampers, automatic temp. control and alarm sensors. Designed to withstand shock load in any direction.



Air Conditioner CH-100A. Has both automatic and manual controls; integral and remote controls. Fully modulated conditioned air supply with 3-stage cooling, 3-stage heating. Cooling output: 30,000 BTU/hr. rated at + 125° F. Heating output: 51,000 BTU/hr.



Explosion-proof Portable Heater. Designed to meet MIL-E-4970 Environmental and MIL-H-27507 performance. Delivers heated air while operating within hazardous atmosphere. Triple over-riding temperature limit controls. Unit grounded against static electrical build-up.



Explosion-Proof Radiant Heater. For personnel in extremely hazardous atmospheres and locations. Five separate safety devices. Rated 2.25 KW input adjustable to 1.5 and .75 KW. Adjustable angle. Removable from stand. Easily wheeled by one man. Heater alone weighs 75 lbs.

AAF ENGINEERED ENVIRONMENT SYSTEMS

HEATING • VENTILATING • AIR FILTERING • REFRIGERATION • HUMIDITY CONTROL • PURIFICATION

Circle Number 148 on Reader-Service Card

Flexaust Co., 3
Flexco, Inc., 3, 4
Flexible Metal Hose Mfg. Co., 1, 2
Flexiple Tubing Corp., 3
Flexiliner Corp., 3
Focke Wulf G.m.b.H., 2
John J. Foster Mfg. Co., 2
Garrett Corp., The, 3
Garrett Corp., The, Air Cruisers Div., 3
Gates Rubber Co., The, 3
General Development Corp., 3
General Wire and Cable Co., Ltd., 3
Gentz Industries, Inc., 1, 2
Goodyear Tire & Rubber Co., Aviation Products Div., 3
Hanlon & Wilson Co., 1, 2, 3, 4
Haveg Industries, Inc., 4
Hoover Aircraft Products Co., 3
Irving Air Chute Co., Inc., 2
Jervis Corp., 2
Johnson Metal Hose, Inc., 1
Kellett Aircraft Corp., 2
Kirkhill Rubber Co., 3, 4
Korfund Dynamics Corp., 2
Lawrence Aviation Industries, Inc., 2
Lockheed Aircraft Corp., 1, 2
Luzerne Rubber Co., The, 4
McGregor Mfg. Corp., 1, 2
Meco, Inc., 1, 2
Metal Bellows Corp., 1
Morfax, Ltd., 1, 2
National Utilities Corp., 1, 2
Nelson Electric Mfg. Co., 2
Parts Mfg. Associates, Inc., 2
Plastic Age Sales, Inc., 4
H. K. Porter Co., Inc., Thermoid Div., 3
H. K. Porter Co., Inc., Thermoid Div., Chanute Works, 3, 4
Power Auxiliaries, Ltd., 1
PYLE-NATIONAL CO., THE, 3. SEE ADV. P. 35
REF Dynamics Corp., 4
Raybestos-Manhattan, Inc., Plastic Products Div., 3
Rohr Corp., 1, 2, 3, 4
Rowland Products, Inc., 4
Roylyn, Inc., 3
Scheidl Mfg. Co., Inc., 3, 4
Servicair Co., 1
W. S. Shamban & Co., 3, 4
Shawnee Industries, Inc., 1, 2
Silicone Insulation, Inc., 4
Skydyne, Inc., 4
Solar, Sub. International Harvester Co., 1, 2
Southern Plastics Co., 3, 4
Southwest Products Co., 1
Space Equipment Corp., 3, 4
Space-Flex Corp., 3, 4
Stainless Steel Products, Inc., 1, 2
STANDARD-THOMSON CORP., AIRCRAFT DIV., 1, 2. SEE ADV. P. 214
Stellardyne Laboratories, Inc., 1, 2
E. C. Styberg Engineering Co., Inc., 2
Superior Spinning & Stamping Co., 2
Swedlow, Inc., 1
Taylor Electric, Inc., 4
Teddington Aircraft Controls, Ltd., 1
Telecomputing Corp., 3
H. I. Thompson Fiber Glass Co., 1, 3
Tiltman Langley, Ltd., 2
Titeflex, Inc., 3
Topper Mfg. Co., Inc., 3, 4
Twin Industries Corp., Aerospace Div., 2, 4
United Flexible Metallic Tubing Canada, Ltd., 1
VIRON DIV., GEOPHYSICS CORP. OF AMERICA, 3. SEE ADV. P. 262
Winder Aircraft Corp., 4
Zippertubing Co., The, 3

Dynamometers

B & F Instruments, Inc.
Clayton Mfg. Co.
Cox Instruments, Div. Lynch Corp.
W. C. Dillon & Co.
Douglas Aircraft Co., Inc.
Engineering Specialties
Garwin, Inc.
General Electric Co., Direct Current Motor & Generator Dept.
General Electro-Mechanical Corp.
Hickok Electrical Instrument Co., The
Hunter Spring, Div. Ametek, Inc.
Industrial Engineering Co.
C. E. Johansson Gage Co., Swedish Gage Co. Affiliate
Kahn & Co., Inc.
Lear Siegler, Inc., Instrument Div.
Leeds & Northrup Co.
Magtrol, Inc.
Metcut Research Associates, Inc.
Newton Brothers Derby, Ltd.
Task Corp.
Thermech Engineering Corp.
Vortec Products Co., Div. Douglas Aircraft Co.
Westinghouse Electric Corp.
Weston Instruments & Electronics Co., Div. Daystrom, Inc.

Dynamotors

Aviation Electric, Ltd.
Bendix Corp., The, Montrose Div.
Carter Motor Co.
Heinz Mueller Engineering Co., Inc.
Indiana General Corp., Electro Mechanical Div.
Lear Siegler, Inc., Instrument Div.
LEAR SIEGLER, INC., POWER EQUIPMENT DIV. SEE ADV. P. 94, 95
Leland Airborne Products, American Machine & Foundry Co.
Newton Brothers Derby, Ltd.
Small Motors, Inc.
Talley Corp.
Task Corp.
Wincharger Corp.

Earphones

Aircraft Components, Inc.
Amplivox, Ltd.
Audiosears Corp.
Canadian Curtiss-Wright, Ltd.
DAVID CLARK CO., INC., SAFETY PRODUCTS DIV. SEE ADV. P. 218
Lionel Corp.
Permoflux Corp.
Photographic Applications Co.
Piezoelectric Div., Clevite Corp.
Remler Co.
Roanwell Corp.
Roflan Co., The
Sierra Engineering Co.
Standard Telephones & Cables, Ltd.
Telephonics, Div. of Instrument Systems Corp.
Telex, Inc., Telex Acoustic Products Div.

Ejection Systems

Aeronca Mfg. Corp.
Aeronca Mfg. Corp., Aerocal Div.
Aircraft Mechanics, Inc.
Amcel Propulsion Co., Div. Celanese Corp. of America.
Arnolt Corp.
Beckman & Whitley, Inc.
BREEZE CORPORATIONS, INC. SEE ADV. P. 277
BROOKS & PERKINS, INC. SEE ADV. P. 20
Canadian Flight Equipment (Cobourg), Ltd.
Chromalloy Corp., Propellex Div.
Cook Electric Co., Technological Center Div.
Douglas Aircraft Co., Inc.
Dynalectron Corp.
Espey Mfg. & Electronics Corp.
Goodyear Aerospace Corp.
Hupp Corp., Hupp Aviation Div.
Irving Air Chute Co., Inc.
Jet Research Center, Inc.
Wallace O. Leonard, Inc.
Ling-Temco-Vought, Inc.
Lockheed Aircraft Corp.
Lundy Electronics & Systems, Inc.
M. L. Aviation Co., Ltd.
MARTIN CO., DIV. MARTIN-MARIETTA CORP. SEE ADV. P. 224
Martin Baker Aircraft Co.
MCDONNELL AIRCRAFT CORP. SEE ADV. P. 230
Northrop Corp.
Northrop Corp., Norair Div.
Ordnance Engineering Associates, Inc.
Republic Aviation Corp.
Rocket Power, Inc.
Sabema Corp.
Space Ordnance Systems, Inc.
Standard Armament, Inc.
Sud Aviation.
Talley Corp.
Talley Industries, Inc.
Tavco, Inc.
Thiokol Chemical Corp., Rocket Operations Center.
Universal Match Corp., Unidynamics Div.
VIRON DIV., GEOPHYSICS CORP. OF AMERICA. SEE ADV. P. 262
Weber Aircraft Corp.
Westinghouse Electric Corp.
E. B. Wiggin Oil Tool Co., Inc.

Elastomers

Acushnet Process Co.
Barry Wright Corp., Barry Controls Div.
G. F. Bush Associates
CPR International Corp.
R. E. Darling Co., Inc.
Dow Chemical Co., The, Dow Metal Products Co., Div.
Dow Corning Corp.
E. I. duPont de Nemours & Co., Inc.
Electrada Corp., The, Stillman Div.
Fabric Research Laboratories, Inc.
Firestone Tire & Rubber Co.
Garlock, Inc.
GENERAL ELECTRIC CO., SILICONE PRODUCTS DEPT. SEE ADV. P. 21
General Tire & Rubber Co., Government & Aviation Div.
Goodyear Aerospace Corp.
Hysol Corp.
Korfund Dynamics Corp.
Mechanical Rubber Products Co.
Minnesota Mining & Mfg. Co., New Product Liaison
Narmco Research & Development, Div., Telecomputing Corp.
Pennsylvania Industrial Chemical Corp.
Plastic & Rubber Products Co.
Products Research Co.
Raybestos-Manhattan, Inc., Plastic Products Div.
Skytronics, Inc.
THIOKOL CHEMICAL CORP. SEE ADV. P. 36
Thiokol Chemical Corp., Trenton Div.
Tufcrete Co., Inc.
Union Carbide Corp., Silicones Div.
Wilbur & Williams Co., Inc., The

Electrical Discharge Equipment

Cincinnati Milling and Grinding Machines, Inc.
Edgerton, Germeshausen, Grier, Inc.
Flexible Metal Hose Mfg. Co.
Hickok Electrical Instrument Co., The
C. E. Johansson Gage Co., Swedish Gage Co. Affiliate
P. R. Mallory & Co., Inc.
McGraw-Edison Co., Line Material Industries.
Metcut Research Associates, Inc.
Muirhead Instruments, Inc.
Rhodes & Bloxsom.
Transformer Specialty Co.
Westinghouse Electric Corp.

Electrodes

Air Reduction Canada, Ltd.
Air Reduction Co., Inc.
Ajax Electric Co.
All State Welding Alloys Co., Inc.
Astra, Inc.
Beckman Instruments, Inc., Scientific & Process Instruments Div.
J. Bishop & Co., Platinum Works.
Canadian Liquid Air Co., Ltd.
Carbone Corp., The
Engelhard Industries, Inc.
High Temperature Materials, Inc.
A. F. Holden Co., The
Hughes Aircraft Co.
Hughes Aircraft Co., Vacuum Tube Products Div.
Huntington Alloy Products Div., The International Nickel Co.
Ionics, Inc.
Jarvis Mfg. Corp.
Johnson, Matthey & Mallory, Ltd.
McKay Co., The
MOTOR GENERATOR CORP. (HOBART BROS. AFF). SEE ADV. P. 269
New England Aircraft Products Co.
Sippican Corp.
Steel Co. of Canada, Ltd., The
Thor Ceramics.
Tri-D Corp.
Westinghouse Electric Corp.

Electrodialysis

Garrett Corp., The
Ionics, Inc.

Electroforming

Allied Research Products, Inc.
Barogenics, Inc.
Bart Mfg. Corp.
Electroforms, Inc.
Electro-Optical Systems, Inc.
General Electronic Laboratories, Inc.
Physical Electronics Labs.
Republic Aviation Corp.
Selectrons, Ltd.
Steel Improvement & Forge Co.
Sylvania Electric Products, Inc., Electronic Tube Div.
Value Engineering Co.

Electroluminescent Equipment

Avco Corp., Electronics Div.
Belock Instrument Corp.
Bendix Corp., The, Eclipse-Pioneer Div.
Bendix Corp., The, Space Navigation Program
Canrad Precision Industries, Inc.
Electro Nuclear Laboratories, Inc.
Felsenthal Instruments Co.
Ferranti Electric, Inc.
Garrett Corp., The
General Dynamics/Electronics-San Diego
General Precision, Inc., Aerospace Group (Kearfott Div., Systems Div., Research Center)
General Precision, Inc., Information Systems Group (Librascope Div.)
International Business Machines Corp., Federal Systems Div.
Lear Siegler, Inc., Instrument Div.
Lockheed Aircraft Corp.
Mini-Tool Technical Industries, Inc.
Molectro Corp.
D. Napier & Son, Ltd.
National Cash Register Co.
Radio Corp. of America
Radium Dial Corp.
Semi-Elements, Inc.
Sierracin Corp.
Sylvania Electric Products, Inc., Home & Commercial Electronics Div.
Sylvania Electric Products, Inc., Special Products Div.
Sylvania Electronic Systems, Div. Sylvania Electric Products, Inc.
Thorn Electrical Industries, Ltd., Special Products Div.
Westinghouse Electric Corp.
Weston Instruments & Electronics, Div. Daystrom, Inc.
Zep Aero

Electron Beam Equipment

Aero Vac Corp.
Air Reduction Co., Inc.
Allis-Chalmers Mfg. Co.
Alloyd Electronics Corp.
E. W. Bliss Co.
Braddock, Dunn & McDonald, Inc.
CELCO (Constantine Engineering Laboratories Co.)
CSF-Compagnie Generale de Telegraphie Sans Fil
California Magnetic Control Corp.
Consolidated Vacuum Corp.
Du Mont Laboratories, Div. Fairchild Camera & Instrument Corp.
Elion Instruments
Giannini Controls Corp.
Goodrich-High Voltage Astronautics
Hamilton Standard Div., United Aircraft Corp.
Hughes Aircraft Co., Ground Systems Group
International Business Machines Corp., Federal Systems Div.
Kaman Nuclear
Manson Laboratories, Inc.
National Research Corp., Research Div.
Physical Electronics Labs.
Radio Corp. of America
Satec Corp.
Sciaky Electric Welding Machines, Ltd.
Sciaky S. A.
Semi-Elements, Inc.
Societe Alsacienne De Constructions Mecaniques, Dept. Energie Nucleaire, Telecommunications-Electronique
Sperry Gyroscope Co., Div. Sperry Rand Corp.
Sylvania Electronic Systems, Div. Sylvania Electric Products, Inc.
Tektronix, Inc.
Vactek, Inc., Sub. Geophysics Corp. of America
Woodwelding, Inc., Cavitron Wood Welder Mfg. Div.

Electronic Countermeasures Equipment

1. Airborne/Spaceborne, 2. Ground /Ship-Based

ACEC, 2
ARRA (Antenna & Radome Research Assoc.), 1, 2
Adams-Russell Co., Inc., 1
Adler Electronics, Inc.
Advanced Development Laboratories, Inc., 1, 2
Aero Geo Astro Corp., 1, 2
Aerojet-General Corp., Corporate Offices, 1, 2
Aeronca Mfg. Corp., Aerocal Div., 1
Aeronutronic Div., Philco Corp., Sub Ford Motor Co., 1
Airborne Instruments Laboratory, Div. Cutler-Hammer, Inc., 1, 2
American Avionics, Inc., Div. Astro-Science Corp., 2
American Bosch Arma Corp.
American Electronics Labs., Inc., 1, 2
Antenna & Radome Research Associates, 1, 2
Antenna Systems, Inc., 2
Applied Technology, Inc., 1, 2
Babcock Electronics Corp., 1, 2
Barnes & Reinecke, Inc., 2
Bell Aerosystems Co., Tucson Research Laboratory, 1, 2
Bendix Corp., The York Div., 1
CSF-Compagnie Generale de Telegraphie Sans Fil, 1, 2
Canadian Arsenals, Ltd., 1, 2
Canadian-Westinghouse Co., Ltd., Electronics Div., 1, 2
Capehart Corp., 1, 2
Cardion Electronics, Inc., 2
Collins Radio Co.
Conductron Corp.
Cook Electric Co., Technological Center Div., 1, 2
A. C. Cossor, Ltd., Cossor Electronics, Ltd., 2
Dalmo Victor Co., Textron, Inc., 1, 2
Dare, Inc., 1
Decitron Electronics Corp., 1, 2
Defense Electronics, Inc., 1, 2
Dorne & Margolin, Inc., 1, 2
Du Mont Laboratories, Div. Fairchild Camera & Instrument Corp., 1
Electronic Communications, Inc., 1, 2
Electronic Specialty Co., 1, 2
Electronic Systems, Div. Antenna Systems, Inc., 2
Electronics Systems, Inc., 1, 2
Emerson Electric Mfg. Co., The, Electronics & Avionics Div.
Fairchild Space and Defense Systems, Div. Fairchild Camera and Instrument Corp., 1, 2
Fairchild Stratos Corp.
Federal Scientific Corp., 1, 2
Ferranti, Ltd., Edinburgh Div., 1
Garrett Corp., The, 1

ASTRODATA

TELEMETRY SYSTEMS

PCM GROUND TELEMETRY STATION — PCM/Video quick-look ground station for missile checkout, launch and tracking; system consists of PCM simulator, synchronizer, decommutator on DAC's provides outputs to oscillographic recorders.

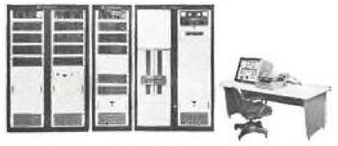


TELEMETRY DATA REDUCTION SYSTEM — PAM-FM, PDM-FM and FM-FM on-line computer system for reduction of Air Force project telemetry tapes at university research department.

NUCLEAR ROCKET DEVELOPMENT TEST SYSTEM—On-line computer PAM decommutation system accepts data in real time or from magnetic tape playback. Synchronization is maintained in presence of up to 20% pulse rate change in one channel interval. Noise pulses are rejected by signal-energy content comparison.

COMPUTER INTEGRATED SYSTEMS

HIGH SPEED DATA CONVERSION SYSTEM —High speed system multiplexes analog information and feeds digitized data at a 20 kc rate direct to a high speed digital computer.



COMPUTER CENTERED SATELLITE COMMAND AND CONTROL SYSTEM—Remote-telescope control system communicates with, acquires data from, and controls remotely located telescope. Telescope eventually will be placed in stable orbit.

AUTOMATIC CHECKOUT SYSTEMS



DEEP SPACE PROBE COMMAND SYSTEM—Ground command subsystem for deep space probes accepts computer-originated commands for satellites, checks, rejects incorrect commands, simulates transmission, verifies data, and prepares correct tapes for subsequent transmission.

MISSILE AUTOMATIC CHECKOUT SYSTEM —General Purpose Programmer and Programmed ADC for controlling stimuli and on-off input sequence to missile system undergoing automatic checkout test.

DATA ACQUISITION SYSTEMS

STRUCTURAL STATIC TEST SYSTEM — Mobile 200-channel data acquisition system records strain gage outputs on incremental magnetic tape recorder and high speed printer.



HYPERSONIC WIND TUNNEL DATA ACQUISITION SYSTEM—Wind tunnel data acquisition system acquires data under computer control from 3 wind tunnel sites . . . **total system error 1.25 microvolts on most sensitive scale.**

TIMING SYSTEMS

Astrodata time code equipment has been used throughout current space programs at Cape Canaveral, Pacific Missile Range and tracking stations around the world. Standard time code generators, tape search units and terminal units provide systems engineers with a high degree of flexibility ranging from simple and economical through extremely sophisticated systems.

The modular design approach permits tailoring systems to specific requirements using standard modules. In addition to the production and engineering economies obtained, users can re-assemble and update systems at little added cost when progressing from one program to another.



Astrodata timing equipment for White Sands Missile Range, the world's most heavily instrumented test range, will provide time references for Apollo and Gemini manned spacecraft programs.

Standard Time Code Generating Systems models provide up to 8 serial time codes simultaneously . . . standard pulse rates . . . decimal display and/or binary display . . . stability to 1 part in 10^8.

Standard Time Code Translator Systems include models to translate all serial time codes to decimal display, parallel BCD output . . . translate serial time code, provide parallel output and display consistent with input code format.

Standard Terminating Systems include models to operate as translator and/or generator, maintain output on loss of input signal . . . to provide basic modules for all terminal function assemblies such as terminal, signal conditioning or conversion functions.

STANDARD INSTRUMENTS

NANOVOLT AMPLIFIER, METER, INTEGRATOR

Nanovolt Amplifier
Model 120
Gains: from 200 to 10^6
Noise level referred to input: 0.05 μv p-p from 1 cpm to 1cps; 0.25 μv p-p from lcpm to 20cps



Nanavoltmeter
Model 121
Full scale ranges: from ± 0.1 μv to ± 100 mv
Accuracy: $\pm 3\%$ of full scale, all ranges

Nanovolt Integrator Model 122
Ultrasensitive dc amplifier
Open loop gain: 50 million
Bandwidth: dc to 100kc

SOLID STATE AMPLIFIERS

Wideband Differential Amplifier Model 885
Bandwidth to 5 kc gains to 1000
Noise less than 2 μv p-p referred to input

100-Volt Operational Amplifier Model 117
Output: ± 50 ma. Open loop gain greater than 10^8. Frequency Response: flat within 0.1% dc to 2 kc within 3 db dc to 200 kc

Galvanometer Drivers Series 130
Output Currents to 100 ma
Output Voltages to ± 10 vdc or peak ac

Differential Amplifier Model 880
Bandwidth: dc to 100 cps Gains to 1000
Low Noise: less than 1 μv rms

Chopper-Stabilized Operational Amplifier Model 112
Bandwidth: dc to 250 kc
Gain at least 10^7 at dc

SOLID STATE ADC's and MULTIPLEXERS



Series 3000 ADC's
1088 Standard models
Accuracies to 0.01%
Conversion speeds to 30,000/sec.

High Level Multiplexer Model 951-100
Inputs per card: 4 two-wire
Input voltage: ± 5 volts
Switching Time: < 5 μsec

Low Level Multiplexer Model 952
Input voltage (full scale): ± 10 mv
Switching Rate: 0 to 20 kc
Crosstalk: less than 0.005%

Write for Systems Experience brochure giving more complete descriptions of Astrodata systems.

ASTRODATA INC.
240 East Palais Road • Anaheim, California

Circle Number 150 in Reader-Service Card

STOP pump wear?
ELIMINATE valve erosion?

Here's how...

Costly wear in pumps, valves and other hydraulic, fuel and lube system parts is not inevitable. Even though wear is still unavoidable during break-in while rough edges are being worn down, there is no need for it to continue merely because the metal surfaces slide over each other.

New studies by PALL and scientists at leading aerospace and industrial facilities have proven that the cause for continued wear is extremely fine contaminants circulating in the fluid. Too small to be seen by the naked eye, these less than 5-micron (0.0002") diameter particles act as a lapping compound and grind away at the surfaces by getting between the moving parts.

Naturally, these ultra-fine particles pass right thru the 10-micron nominal (absolute 25-micron) filters used in most systems. Most of them even go thru the nominal 1.5-micron (absolute 15-micron) filters found in a few of the latest systems. While these filters prevent passage of the large particles that might cause a catastrophic failure, they do little to control the wear caused by less than 5-micron contaminants.

Now there is an exclusive 3-micron absolute filter developed to continuously remove "lapping" size range particles, reducing wear and erosion to a negligible amount. Based on an epoxy impregnated and coated paper filter medium called ULTIPOR.9, these disposable and relatively inexpensive filters are available for a wide range of system requirements.



PALL 3-MICRON ABSOLUTE FILTERS

■ Sized to AN6235-4A (1¾" dia. x 4½" long). ■ Both 2-stage & 1-stage filters fit into a standard MS28720-12 housing. ■ Absolute 3-micron particle removal per MIL-F27656A(USAF). ■ Absolute 1-micron rating using standard APM-F-9 glass beads. ■ Available off-the-shelf, with or without housing. ■ Zero media migration. ■ Disposable. ■ Low cost.

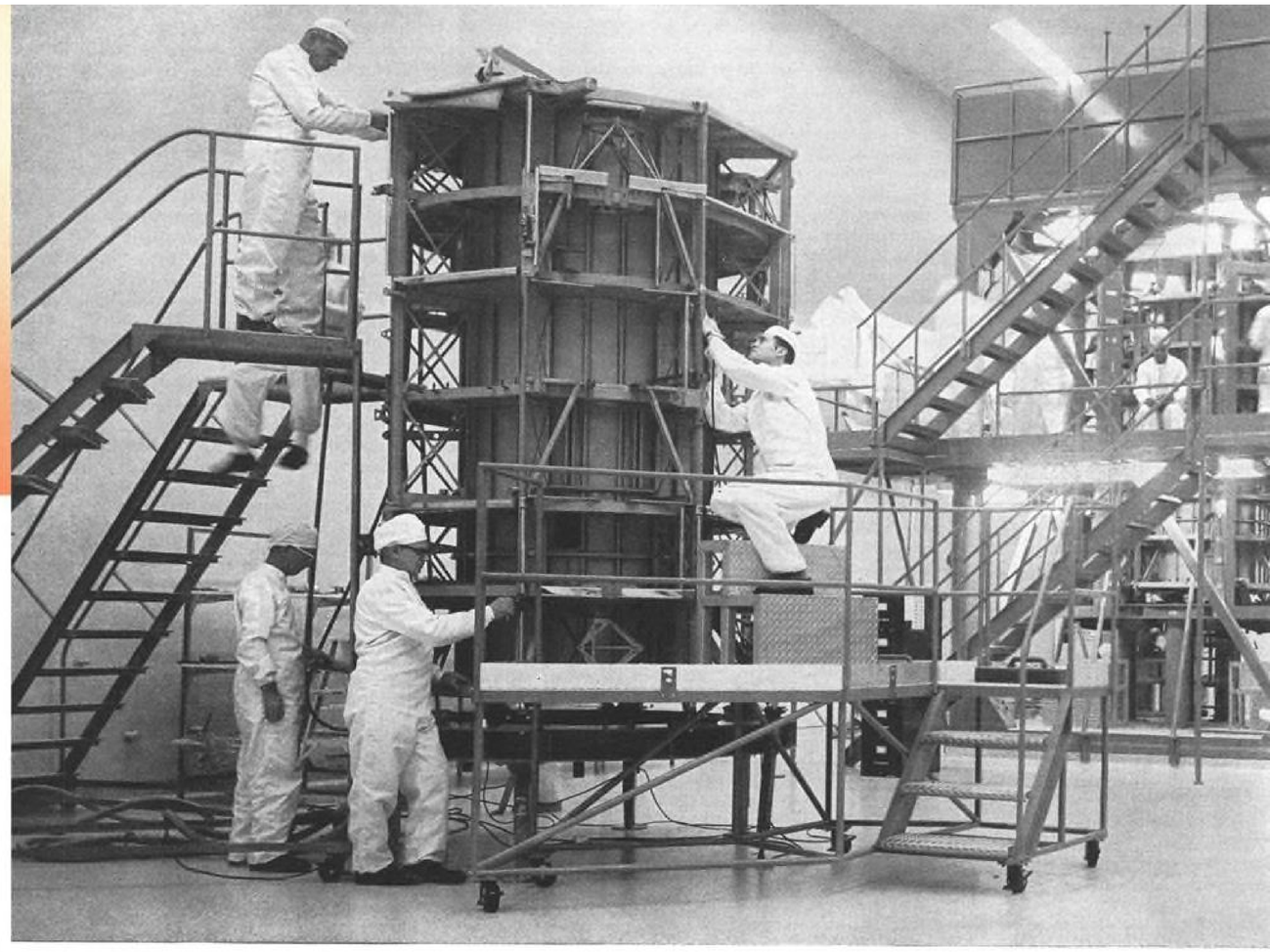
Send for complete technical literature today.

AIRCRAFT POROUS MEDIA, INC.

PALL — *A SUBSIDIARY OF PALL CORPORATION*

GLEN COVE, L. I., N. Y. • (516) OR 1-4000 • TWX: 516-671-6272 • WU TELEX: 01-26329

Circle Number 157 on Reader-Service Card



Multi-Mission Satellite

Already scheduled for four major missions, the OAO can be adapted to others with minimum change

The Orbiting Astronomical Observatory spacecraft will accurately point—within one minute of arc—a 1000-pound pay load almost four feet in diameter and more than nine feet long. Its pointing stability on a star can be held to one-tenth second of arc—long enough to acquire, store, and transmit data as commanded from the ground. This fully integrated, flexible system is designed, built and tested by Grumman for NASA's Goddard Space Flight Center. Because of the versatility of the system, the OAO spacecraft can be adapted to other space missions with minimum change. The design, development and integration of advanced space systems is a job that requires special skills and capabilities. Grumman has the manpower, the research and test facilities and the management team to administer the most complex space programs.

GRUMMAN AIRCRAFT ENGINEERING CORPORATION
Bethpage, Long Island, N.Y.



The OAO, largest and most precise unmanned satellite under development in the United States, takes final shape in Grumman's clean rooms. A carefully controlled, dust-free environment accompanies each OAO, from the time its smallest components are assembled until the final spacecraft is launched. The first OAO's will carry high-precision astronomical experiments as their pay loads and are designed to accomplish potential breakthroughs in knowledge that will be extremely significant.



AEROTEC

Capability

AIRCRAFT EQUIP. DIVISION	AEROTHERM DIVISION
• PRESSURE SWITCHES	• AIRCRAFT SEATING
• FLOW DEVICES	• AERO- CONTAINER
• LIQUID LEVEL DEVICES	• AERO- STRETCHER
• DISCONNECTS	• AERO-HARNESS

AEROTEC INDUSTRIES, INC.

AIRCRAFT EQUIPMENT DIVISION • GREENWICH, CONNECTICUT
AEROTHERM DIVISION • BANTAM, CONNECTICUT

Circle Number 163 on Reader-Service Card

CECO

SMALL ENGINE FUEL CONTROLS AND PUMPS

...have earned* their reputation in

HELICOPTERS
DRONES
SURVEILLANCE and
VTOL AIRCRAFT

*Earned through unusual quality and uniform dependability. They're important reasons why CECO small engine fuel controls and pumps are specified by leading manufacturers of gas turbines.

CECO's simple, reliable, lightweight, low-cost fuel *systems* are exemplified by the TA and MC series of jet engine main fuel controls.

The TA-1, proved in service on Lycoming's T-53, incorporates a dual element main fuel supply pump, free power turbine governor, automatic altitude and temperature compensation, and integral emergency fuel metering system.

The MC-16, powering the Ryan Firebee drone, combines the pumping and controlling functions in one compact unit.

And CECO main fuel *pumps* have earned their reputation by dependable performance on the General Electric J-85 and the Pratt & Whitney Aircraft J-60 gas turbines.

Put CECO's specialized developmental and manufacturing experience to work for you. Remember, *control is our business.*

CHANDLER EVANS CORPORATION • WEST HARTFORD 1, CONNECTICUT
Major Industrial Component of Fairbanks Whitney Corp.

CECO ® SYSTEMS CONTROLS

GAS TURBINE FUEL CONTROLS/PUMPS • MISSILE CONTROL SYSTEMS/SERVOS • AIRCRAFT/ENGINE ACCESSORIES

Circle Number 164 on Reader-Service Card



—with Aerospace Precision

Kaupp precision metal forming machines, combined with ultra-modern techniques and quality control equipment, assure adherence to close tolerances on instrument cases, weldments, covers and special shapes. Consult Kaupp on military and commercial components, long or short production runs in light, medium or heavy gauges. Highest inspection standards result in metal parts of highest accuracy in a wide range of metals.



metal forming "assist"

KAUPP...Metal Craftsmen since 1924

Fast Service for Designers and Development Engineers – KAUPP has solved many unusual metal forming problems involving both military and commercial metal components. In many instances design changes, suggested by our engineers, have resulted in important savings in time and money. KAUPP'S wide experience, ranging from parts for electrical appliances to guided missiles, is at your service.

See reverse side for complete data . . .

Kaupp metal forming facilities

—for the design and production of METAL PARTS

HYDROFORMING
KAUPP offers special service to design and development engineers with simpler tooling, faster set-ups and improved quality. Hydroforming combines economical unit cost with fast delivery.

DEEP DRAWING
From carbon steel to "space age" alloys, KAUPP technicians have the knowledge of metals, and the equipment necessary, to hold work to closest tolerances and maintain uniformity throughout production.

SPECIALS
Specify KAUPP for unusual components for rockets, missiles, aircraft and radar. Complete service includes piercing, notching, embossing, annealing, spotwelding and fabricating.

SPINNING
Minimum tooling requirements save time and money on development pieces, sample parts and short production runs. KAUPP offers years of experience in this method of metal forming.

PROTOTYPES
KAUPP "know how" solves unusual design problems. Our engineering department is fully conversant with the problems involved in producing unusual shapes and sizes to exact requirements.

TOOL MAKING
One of the industry's most modern tool and die departments is maintained by KAUPP to assure the efficient production of all dies, punches, jigs and fixtures. There are practically no delays waiting for tools.

WELDING
KAUPP produces weldments and sub-assemblies for military electronics, nucleonics and experimental parts for research and development work throughout general industry.

Precision Metal Forming Equipment for Fast Prototype/Production Service

Selected raw materials and expert metal craftsmanship combine to produce high accuracy metal components at economical cost. KAUPP engineers are thoroughly familiar with the techniques required for forming modern alloys. KAUPP precision metal parts are used in electronics, nucleonics, chemical processing and governmental space and research projects.

MU METAL	TITANIUM
BRASS	CARBON STEEL
INCONEL	MULTIMET*
ALUMINUM	HAYNES* No. 25
COPPER	STAINLESS STEEL
SILVER	HASTELLOY* X
NICKEL	MAGNESIUM
NIMONIC	WASPALLOY

Our engineers will recommend the best method of production for your specific components. Estimates on your metal parts will be supplied on receipt of your blueprints or specifications.

*Union Carbide Corporation Trademarks

HYDROFORMS
1 8" PRESS 1 12" PRESS
2 19" PRESSES

PRESSES
1 BLISS NO. 4A SINGLE CRANK DOUBLE ACTION
1 BLISS NO. S-100—100 TON 10" STROKE PNEUMATIC CUSHION 15 TON
1 BLISS NO. 305 90 TON 10" STROKE PNEUMATIC CUSHION 15 TON
3 NIAGARA NO. H 3 ½A—45 TON
2 NIAGARA NO. H 2 ½—25 TON
1 BLISS NO. 20B—32 TON
3 BLISS NO. 18 HORN
2 BLISS NO. 18 INCLINABLE
3 BLISS NO. 18C INCLINABLE
1 CONSOLIDATED NO. 72 PNEUMATIC CUSHION—5 TON
1 LOSHBOUGH & JORDAN NO. 2 SPECIAL
1 LOSHBOUGH & JORDAN NO. 3 SPECIAL
1 ZEH & HANNEMAN NO. 4
1 ZEH & HANNEMAN NO. 2 INCLINABLE

SPINNING LATHES
1 HAAG GAP LATHE 26 to 48
1 GRABO GAP LATHE 24 to 60
1 PRYBIL LATHE 26
1 GRABO LATHE 26
1 HAAG LATHE 22
3 GRABO LATHES 22
1 GRABO LATHE 16

LATHES
1 MONARCH—12 x 30
1 MONARCH—16 x 54
2 LE BLOND—17 x 54
1 SOUTH BEND—14 x 36
2 SOUTH BEND—10 x 36
2 SOUTH BEND—9 x 36
1 CINCINNATI—26 x 60
1 LE BLOND—22 x 48

MILLING MACHINES
1 MILWAUKEE RAM HD. 5 HP
1 MILWAUKEE VERT. 2 HP
1 MILWAUKEE UNIV. 2 HP
1 HARDINGE PLAIN
2 BRIDGEPORT ½ HP
2 CINCINNATI TOOLMASTERS
3 BRIDGEPORT 1 HP
1 SIMMONS HORIZONTAL PRODUCTION

GRINDERS
1 CINCINNATI UNIVERSAL 14 x 36 INTERNAL EXTERNAL HYDRAULIC
2 BROWN & SHARPE NO. 5 6 x 12 x 18 SURFACE
1 THOMPSON—6 x 12 x 18 SURFACE HYDRAULIC
1 REID—6 x 12 x 18 SURFACE
1 NEVEN BENCH GRINDER COMPLETE WITH DIAMOND WHEEL
1 MONOSET TOOL & CUTTER GRINDER

SAWS
1 GROB BAND FILING FAB NO. 18
2 GROB BAND DIE CUTTING
1 MARVEL POWER 6 x 8
1 MARVEL POWER 10

JIG BORER
1 PRATT & WHITNEY 1 ½B

SHEARS
1 NIAGARA SQUARING SHEAR 6'
1 NIAGARA SQUARING SHEAR 4'
1 FOOT SHEAR 3'
1 NIAGARA POWER CIRCULAR SHEAR & FLANGER
3 NIAGARA POWER RING & CIRCULAR SHEAR
1 HAND CIRCULAR SHEAR

SPOT WELDERS
1 PEER 15 KVA & TIMER
1 EISLER 10 KVA & TIMER
1 TAYLOR WINFIELD 50 KVA

MISCELLANEOUS
1 GOULD & EBERHARDT UNIVERSAL SHAPER 14"
1 MULMAT HIGH SPEED SENSITIVE DRILL PRESS
1 LELAND GIFFORD 26" SINGLE SPINDLE PRESS
1 BUFFALO 16" DRILL PRESS
4 WALKER TURNER 14"
1 DROP HAMMER 200 LB.
2 ATLAS LATHES PROD. WORK TRIM
1 WALKER TURNER 10" TILTING ARBOR TABLE SAW
3 30" x 60" SURFACE PLATE & ANGLE COMPUTER

Call, write or wire for prompt service

C. B. KAUPP & SONS · INC

METAL CRAFTSMEN SINCE 1924

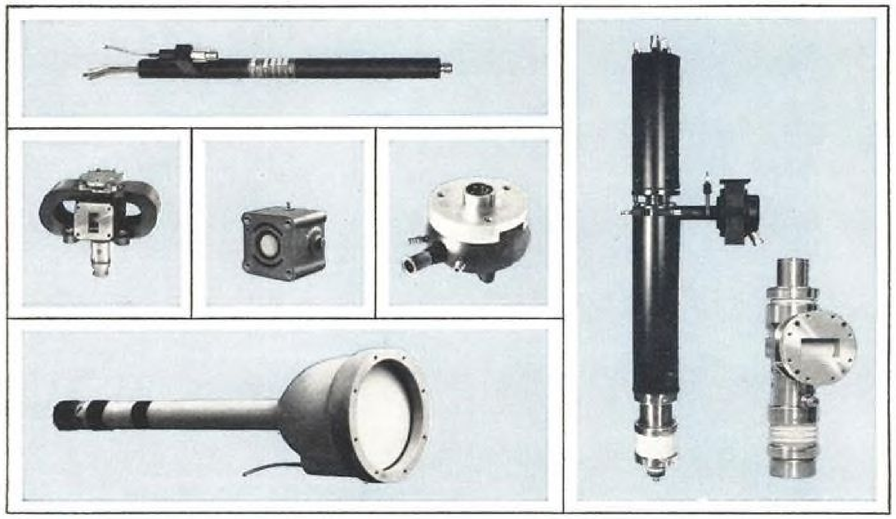
30 NEWARK WAY, MAPLEWOOD, N. J. — Telephone: POplar 1-4000 (Area Code 201)











Litton electron tubes, display devices, and accessory equipment. More than 500 electron tube types spanning the 1-meter-to-4-millimeter frequency spectrum and the milliwatts-to-megawatts power ouput range . . . more than 100 high-performance, high-resolution cathode ray tubes and CRT operational accessories . . . dozens of tube-related accessory equipments — all are part of the standard line at Litton. If one of them doesn't meet your specifications, we always have others in development. Should your needs be even more advanced, we stand ready to apply some of the finest minds, skills, instruments and facilities in the industry to the solution of your problem. Whatever your requirement in microwave tubes, display devices or accessory equipment, contact us at 960 Industrial Road, San Carlos, California, for full information.

Amplifier Klystrons — 400 to 11,000 Mcs • 20 Kw to greater than 30 Mw pulsed • 2 W to 75 Kw CW • fixed, tunable and broadband • solid beam, cathode pulsed, mod-anode, hollow beam, electrostatically focused, single and multiple beam models

Traveling Wave Tubes — 200 to 11,000 Mcs • 10 mW to 10 kw • small signal gains 33 to 70 db • light as 1.1 lb • pulse & CW • augmenter, beacon, ECM, white noise and intermediate power amplifier types

M-Type Backward Wave Oscillators — 500 to 11,000 Mcs • 100 to 500 W • voltage tunable • CW and pulse •liquid and conduction cooled

Magnetrons — 406 to 34,900 Mcs pulse • 350 to 10,475 Mcs CW • 100 W to 2 Mw pulse • 1.0 to 400 W CW • miniatures • high powers • white noise Barratron® types

Display Devices — Micropix® high-resolution cathode ray tubes • Printapix® types for electrostatic printing • Pipix® fiber optic direct film recording tubes • Composipix® character writing tubes • flying spot scanners • electronic printers • video amplifiers • power supplies • other CRT operational accessories

Millimeter Wave Tubes — 12 to 4 mm • 0.03 to 50 W • floating drift tube klystrons • reflex klystrons • magnetrons • monitor diodes

Switch Tubes — Injectron® high-power, beam switching types • 95% efficiency • fast rise times • low control power • collector voltages to 350 kVdc at 30 amps

Accessory Equipment — microwave power sources for use with magnetrons, M-BWO's, floating drift tube klystrons • 350 to 80,000 Mcs • 0.1 W to 2 kw peak • water loads • dry loads • TWT amplifiers • focus coil supplies • differential thermopiles • radiation shields • transitions • sockets • filament controllers • solid state TWT power supplies

Advanced Devices and Investigations — gaseous and solid-state lasers • electrostatically focused klystrons • Dematron® distributed emission crossed-field amplifier • Bimatron® injected beam crossed-field amplifier • Bidematron® high-gain, high-power amplifier • electron optics studies • ion propulsion • slow-wave structure studies • millimeter wave generation • low noise research • plasma physics • quantum electronics • solid-state devices • light amplifiers • neutron sources • ceramic-metal bonding

LITTON INDUSTRIES ELECTRON TUBE DIVISION

San Carlos, California — Canada: 25 Cityview Drive, Rexdale, Ontario — Europe: Box 110, Zurich 50, Switzerland

Circle Number 174 on Reader-Service Card



POWER BOOSTED MASTER BRAKE CYLINDERS—HYDRAULIC



SEQUENCE VALVES—HYDRAULIC OR PNEUMATIC



3-WAY SOLENOID SELECTOR VALVES—HYDRAULIC



4-WAY SOLENOID SELECTOR VALVES—HYDRAULIC



RESTRICTORS AND CHECK VALVES



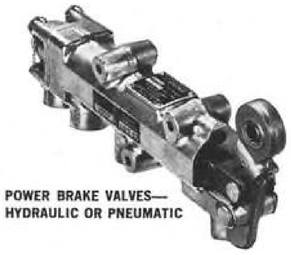
PITOT-STATIC TESTERS



CONTROLLABLE CHECK VALVES—HYDRAULIC



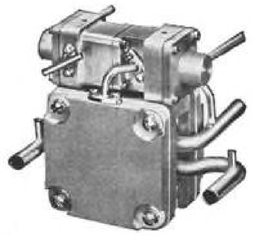
QUADRUPLE 3-WAY SOLENOID SELECTORS—PNEUMATIC OR HYDRAULIC



POWER BRAKE VALVES—HYDRAULIC OR PNEUMATIC



4-WAY SOLENOID SELECTOR VALVES—PNEUMATIC



AUTOPILOT SERVO AMPLIFIERS—PNEUMATIC

WANTED:

The one design engineer with a really tough valve problem

Perhaps *you're* our man. You are if you're up against a tough one. You are if you're looking for a hydraulic or pneumatic component that will meet ultra-critical performance specifications . . . one that will provide high-pressure, high-performance operation.

This is *our* business. Particularly in missiles, space vehicles, GSE and aircraft. We've specialized in it for 21 years. We've made precision a habit, with consistently fine results. We find out what you need, precisely. We engineer and manufacture to the need—precisely. The result is uncompromising dependability in solenoid selectors, brake controls, master brake cylinders, sequence valves, manual selectors, controllable checks, restrictors and check valves. These are just a few, standard and special.



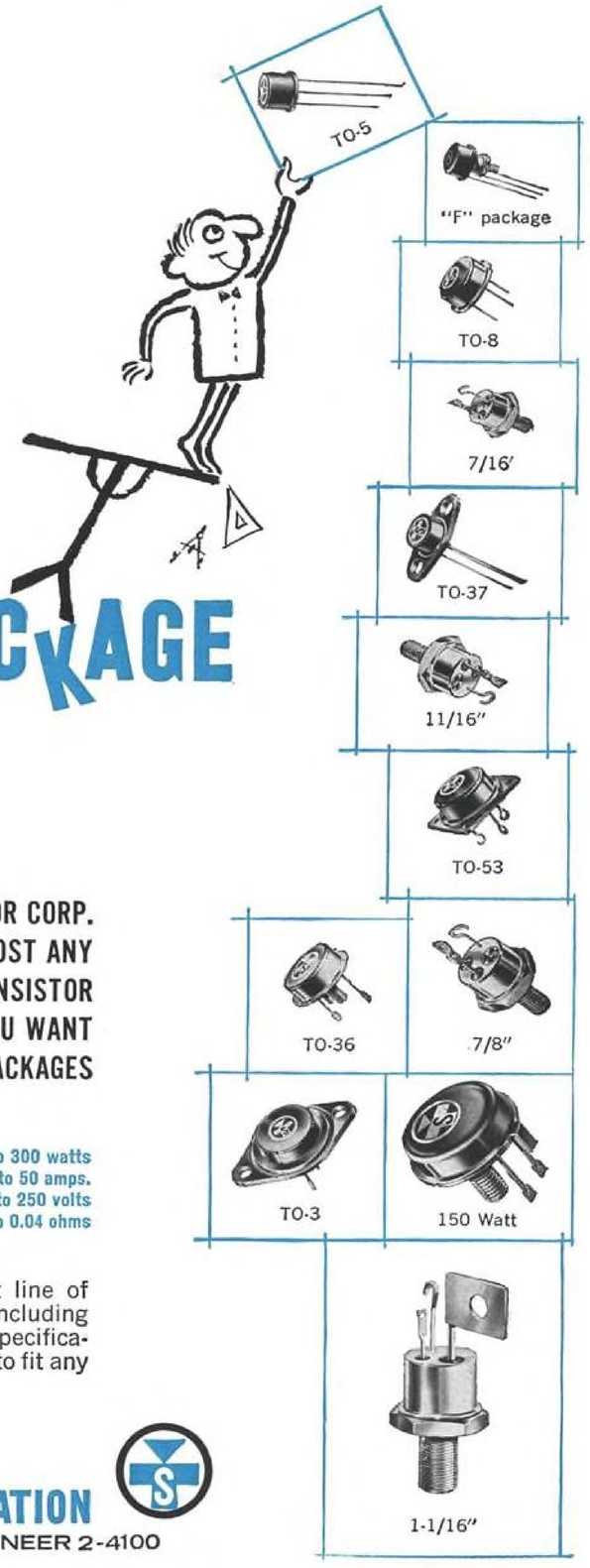
Now, where on earth . . . or in outer space . . . can you use the precision of Tactair Valves? We like to work on a personalized basis . . . face-to-face, engineer-to-engineer. If you want a fast start on that problem, just give us a call. BRoadway 5-1000. Or let us send you more details . . . our products, capabilities, the way we work. Please write Tactair Fluid Controls Corporation, Bridgeport, Pennsylvania.

CONTROL, SELECT, BRAKE, RESTRICT, CHECK...with **TACTAIR®**

FLUID CONTROLS CORP.
Formerly: Aircraft Products Co.

Circle Number 184 on Reader-Service Card

PICK YOUR PACKAGE



SILICON TRANSISTOR CORP. CAN MEET ALMOST ANY SILICON POWER TRANSISTOR SPEC YOU WANT IN THESE PACKAGES

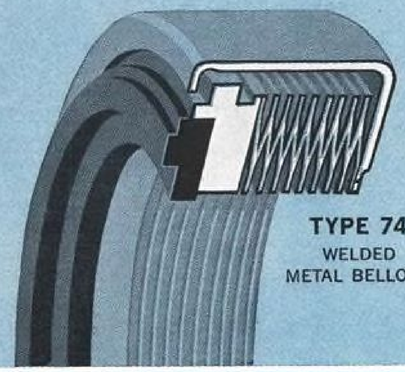
Pc up to 300 watts
Ic up to 50 amps.
Vce up to 250 volts
Vce (SAT) down to 0.04 ohms

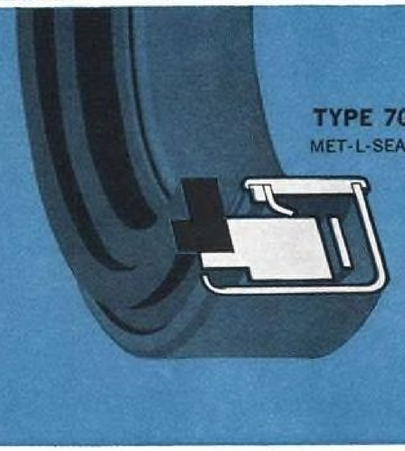
Supplementary to offering the broadest line of silicon power transistors in the industry, including the military types, STC will tailor your specifications, within the wide limits listed above, to fit any of the illustrated packages.

SILICON TRANSISTOR CORPORATION
CARLE PLACE, L. I., NEW YORK (516) PIONEER 2-4100

SEAL SELECTION SIMPLIFIED

Choose From Two All-Metal Shaft Seals For Aircraft, Missiles & Rockets.





*patents pending

When conditions are too severe for an elastomer seal simplify your task of selecting and specifying a shaft seal by simultaneously testing Gits' two all-metal designs. For a technical comparison send for Gits Technical Bulletin No. 9.

GITS
SHAFT SEALS



GITS BROS. MFG. CO., 1866 SO. KILBOURN AVE., CHICAGO 23, ILL.

☐ Please send GITS TECHNICAL BULLETIN NO. 9
☐ Please send GITS NEW SEAL DESIGN KIT

We have an application for_____

NAME_____

TITLE_____

COMPANY_____

ADDRESS_____

CITY_____ STATE_____

WORKING ON
Projects
INVOLVING
Antennas
AND ANTENNA EQUIPMENT?

Andrew can help you solve your problems in this specialized field of antennas and transmission lines. You are invited to write for catalogs in area of your interest.

Telemetry, Catalog T—Ground to air antenna systems for 25-3000 Mc, rotators and coaxial patch panels.

•

Hubloc Antennas, Catalog D—Setting new standards in large parabolic antenna design, sizes to 60 ft. dia. Technical data on antenna feeds, radomes, tower mounts.

•

Microwave, Catalog M—Parabolic antennas for use in 800 Mc to 12 Gc range with associated equipment; mounts, radomes, waveguides.

•

Heliax, Catalog H—Heliax, the flexible air dielectric copper cable in sizes up to 5" in 50, 75 and 100 ohms.

•

Transmission Lines, Catalog R—Rigid coaxial lines are available in sizes 7/8" to 14" in 50 ohm and other impedances. RF switches and other accessories available.

•

Fixed Station, Catalog F—Mobile radio service antennas, flexible foam Heliax cables for complete system installation.

•

Telescoping Masts, Catalog P—Offers a large selection of standard pneumatic masts for variable extended heights.

ANDREW

Andrew

P. O. Box 807 • Chicago, Illinois 60642
New York • Washington, D. C. • Boston • Dallas
Los Angeles • San Francisco • Toronto • Montreal

Nipples

Airaterra
A. M. Byers Co.
Carmac Aviation
Deutsch Co., Hydraulic Components Div.
Ladish Co.
Luzerne Rubber Co., The
Roylyn, Inc.
S.A.R.M.A., Societe Anonyme de Recherches de Mecanique Appliquee
Weatherhead Co. of Canada, Ltd.
E. B. Wiggin Oil Tool Co., Inc.

Nitrogen

Air Reduction Co., Inc.
Canadian Liquid Air Co., Ltd.
Cosmodyne Corp.
Linde Co., Div. Union Carbide Corp.
Liquid Carbonic Div., General Dynamics Corp.
Puritan Equipment, Inc., Aerospace Div.
Superior Air Products Co.

Nozzles

1. Exhaust, Gas Turbine Engines, 2. Exhaust, Reciprocating Engines, 3. Fuel, 4. Fuel Injection, Gas Turbine Engines, 5. Liquid, Air, Etc., 6. Rocket Motor

ACF Industries, Inc., 3, 4, 6
Advanced Dynamics, Inc., 6
Aero Precision Industries, Inc., 4
Aerolab Development Co., Sub. Marshall Industries, 6
Aeronca Mfg. Corp., Aerocal Div., 6
Aeronutronic Div., Philco Corp., Sub. Ford Motor Co., 6
Airaterra, 3
Aircraft Plating, Inc., 2
Airtek Dynamics, Inc., 5, 6
Altamil Corp., Defense Products Sales, 1, 2, 4, 6
Amcel Propulsion Co. Div., Celanese Corp. of America, 6
American Bosch Arma Corp., American Bosch Sales Div., 4
American Metal Products Co., 6
American Welding & Mfg. Co., 1, 2, 4, 6
Arde-Portland, Inc., 1, 5, 6
Astropower, Inc., Sub. Douglas Aircraft Co., Inc., 6
Atlantic Research Corp., 6
Ausco, Inc., 3
Avco Corp., Aerospace Structures Div., 6
Aviation Electric, Ltd., 3, 4
Bell Aerosystems Co., Div. Bell Aerospace Corp., A Textron Co., 6
Bendix Corp., The, Bendix Products Aerospace Div., 3, 6
Bendix Corp., The, Eclipse Machine Div., 4
Binks Mfg. Co., 5
J. Bishop & Co., Platinum Works, 3
BLACK, SIVALLS & BRYSON, INC., FILAMENT STRUCTURES DIV., 6. SEE ADV. P. 16
Blaw-Knox Co., 6
E. W. Bliss Co., 6
Bristol Aero-Industries, Inc., Winnipeg Div., 1, 6
BRUNSWICK CORP., DEFENSE PRODUCTS DIV., 6. SEE ADV. P. 31
Buckeye Iron & Brass Works, 3
Carbone Corp., The, 6
Carborundum Co., The, 6
J. C. Carter Co., The, 3
Cleveland Pneumatic Div., Pneumodynamics Corp., 6
Clevite Corp., Aerospace Div., 4, 6
Connecticut Hard Rubber Co., The, 6
Continental Motors Corp., Aircraft Engine Div., 3
Curtiss-Wright Corp., Wright Aeronautical Div., 1, 2, 6
R. E. Darlying Co., Inc., 6
Delavan Mfg. Co., 4, 5, 6
Douglas Aircraft Co., Inc., Missile & Space Systems Div., 1, 5, 6
Eddington Metal Specialty Co., 3, 4
Eldon Fiberglass Mfg. Co., Aerospace Div., 6
Eljay Corp., 6
Engineered Products Co., The, 3, 4, 5, 6
Ex-Cello-O Corp., 3, 4, 5, 6
Firestone Tire & Rubber Co., 6
FIRTH STERLING, INC., 6. SEE ADV. P. 124
Flight Equipment & Engineering Corp., 1, 2
Gasoilair Equipment Co., 3, 5
Gentz Industries, Inc., 1, 2
B. F. Goodrich Aerospace & Defense Div., B. F. Goodrich Co., 6
Goodyear Tire & Rubber Co., Aviation Product Div., 6
Great Lakes Carbon Corp., Graphite Products Div., 6
Hanlon & Wilson Co., 1, 2, 3, 4
Haveg Industries, Inc., 6
Hispano-Suiza, 1
HI-TEMP MATERIALS MACHINING CO., 6. SEE ADV. P. 211
Hupp Corp., Hupp Aviation Div., 6
Hymatic Engineering Co., Ltd., The, 1
IMC Magnetics Corp., Arizona Div., 4
Ingersoll Kalamazoo Div., Borg-Warner Corp., 6
Intercontinental Mfg. Co., Inc., Sub. The Lionel Corp., 6
International Electronic Research Corp., 6
Jervis Corp., 1, 2, 6
Kelsey-Hayes Co., 6
Kentucky Metals, Inc., 4
Ladish Co., 1
LAVELLE AIRCRAFT CORP., 1. SEE ADV. P. 208
Le Fiell Mfg. Co., 6
Lear Siegler, Inc., Astro Structures Div., 6
Lee Co., The, 4
Lunkenheimer Co., 5
Lycoming Div., Avco Corp., 6
Magnesium Aerospace Products, 6
Marquardt Corp., The, 6
McGregor Mfg. Corp., 1, 2, 3, 5, 6
Mektron, Div. California General, Inc., 1, 2, 3, 4, 5, 6
National Carbon Co. Div., Union Carbide Corp., 6
National Research Corp., Metals Div., 6
North American Aviation, Inc., Rocketdyne Div., 6
Northern Research & Engineering Corp., 1, 2, 3, 4, 5, 6
Northwest Aerospace Co., 6
Ordnance Engineering Associates, Inc., 6
Oregon Metallurgical Corp., 6
Ottico Meccanica Italiana OMI SPA, 3, 4
Parker-Hannifin Corp., Parker Aircraft Co. Div.
Plastic Age Sales, Inc., 6
H. K. Porter Co., Inc., Electrical Div., 6
Pressed Steel Tank Co., 6
Randall Engineering Corp.
Raybestos-Manhattan, Inc., Plastic Products Div., 6
Reaction Motors Div., Thiokol Chemical Corp., 6
Rohr Corp., 1, 2, 6
Royal Industries, Inc., Vard Div., 1, 6
Roylyn, Inc., 3, 5
SNECMA, 1, 4, 6
Schulz Tool & Mfg. Co., 3
Solar, Sub. International Harvester Co., 1, 2, 6
Space Equipment Corp., 6
Special Corp., The, 6
Spraying Systems Co., 5
Starkoole Carbon Co., 6
Stainless Steel Products, Inc., 1
Steel Improvement & Forge Co.
Sterer Engineering & Mfg. Co., 5
Studebaker Corp., CTL Div., 6
Swedlow, Inc., 1
Szemco, Inc., 1, 3, 4, 6
Talley Corp., 1, 6
Talley Industries, Inc., 6
Tapco Div., Thompson Ramo Wooldridge, Inc., 6
Taylor Corp., 6
Thiokol Chemical Corp., Rocket Operations Center, 6
Thiokol Chemical Corp., Wasatch Div., 6
Thomason Ramo Wooldridge, Inc., 3, 4, 6
Tri-D Corp., 6
Union Carbide Stellite Co., Div. Union Carbide Corp., 1, 4
U. S. STEEL CORP., 6. SEE ADV. P. 110, 111
United Technology Center Div., United Aircraft Corp., 6
Value Engineering Co., 6
Western Gear Corp., Precision Products Div., 6
Wyatt Industries, Inc., Plastic & Rubber Div., 6
Zirconium Corp. of America, 6

Nuts

1. Anchor, 2. Castellated, 3. Channel Assembled, 4. Coupling, 5. Lock, 6. Machine Screw, 7. Self-Locking, 8. Special, 9. Wing

Abbott Products, Inc., 8
Abscoa Industries, Inc., 1, 2, 5, 6, 7, 8
Accessories Manufacturers, Ltd., 8
Aircraft Components, Inc., 1, 2, 3, 5, 6, 7
Aircraft Materials, Ltd., 7, 9
Alisco Co., 5, 6, 7, 8
Allen Mfg. Co., The, Aerospace Special Products Div., 5, 7
Allmetal Screw Products Co., Inc., 1, 2, 3, 4, 5, 6, 7, 8, 9
ALUMINUM CO. OF AMERICA, 6, 8, 9. SEE ADV. P. 203, 204
American-Standard Products, Inc., 2, 4, 6, 8
Anti-Corrosive Metal Products, 1, 2, 3, 4, 5, 6, 7, 8, 9
Bancroft Industries (62), Ltd.
Barry Electric, Ltd., 7
Bethlehem Steel Co., 4, 6, 7, 8
Bland Burner Co., The, Precision Threaded Products Div., 8
Boots Aircraft Nut Corp., Div. Towsend Co., Sub. Textron, Inc., 1, 2, 3, 5, 7, 8
Calfax, Inc., 1, 8
Century Fasteners Corp.
Circon Component Corp., 6
Clevite Corp., Aerospace Div., 8
Clipper Gear & Machine Corp., 8
Collins Engineering Corp.
Continental Motors Corp., Aircraft Engine Div., 5, 6, 7
Cooper Industries, Inc., 1, 2, 6, 7
Delron Co., Inc. The 5, 7
Dominion Fasteners, Ltd., 1, 5, 7, 8
Elastic Stop Nut Corp. of America, Fastener Div., 1, 2, 3, 5, 6, 7, 8, 9
Ex-Cell-O Corp. of Canada, Ltd., 8
Federal Machine Co., Inc., 8
Fischer Special Mfg. Co., 6, 8
Freeman Co., The, 8
Geo. K. Garrett Co., Div. MSL Industries, Inc., 8
Greer Stop Nut Co., Inc., Sub. Kaynar Mfg. Co., Inc., 5, 7
Hardware Specialty Co., Inc.
Heli-Coil Corp., 1, 5, 6 7
Hi-Shear Corp., 8
Idaho-Maryland Industries, Inc., 1, 2, 3, 4, 5, 6, 7, 8, 9
Jaros Aircrafters, 1, 2, 3, 4, 5, 6, 7, 8, 9
Kaylock Div., Kaynar Mfg. Co., Inc., 1, 3, 5, 7, 8
Klincher Locknut Corp., 7
Kwikset Powdered Metal Products, Kwikset Div., American Hardware, 2, 7, 8
Lamson & Sessions Co., The, 1, 2, 5, 6, 7, 8
Leader Products Co., Ltd., 8
Liberty Engineering & Sales, 7
Luzerne Rubber Co., The, 8
Mercury Air Parts Co., Inc., 1, 2, 3, 4, 5, 6, 7, 8, 9
Micro Products Corp., 6
J. I. Morris Co., 6, 8
National Automatic Products Co., The, 2, 4, 6
National Lock Co., 5, 6
National Radio Co., Sub. National Co., 5, 6, 7
National Screw & Mfg. Co., The, 2, 6, 9
Niagara Screw & Bolt Co., Inc., 2, 5, 6, 7, 8, 9
North & Judd Mfg. Co., 9
Northwest Aerospace Co., 8
Notifier Corp/Notifier Engineering, Inc., 6
Nylok Corp., 5
Palnut Co., The, Div. United-Carr Fastener Corp., 5, 6, 7, 9
Qualified Air Components, 2, 4, 7, 9
Red Devil Mfg. Co., 8
Republic Steel Corp., 1, 2, 5, 6, 7, 8
Research Development Mfg., Inc., 8
Rosan, Inc., 6, 7, 8
Shakeproof Div., Illinois Tool Works, Inc., 4, 5, 6, 7, 8
Shur-Lok Corp., 5, 7, 8
Sido, Ltd., 6, 8
Wm. H. Snow Co., 8
Standard Locknut & Lockwasher, Inc., 2, 5, 6, 8
Standard Pressed Steel Co., 1, 2, 3, 4, 5, 6, 7, 8
Standard Screw Co., Chicago, Hartford, Western Divs., 2, 8
Steel Co. of Canada, Ltd., The, 1, 5, 6, 7, 9
Tinnerman Products, Inc., 1, 3, 5, 6, 7, 8
Unbrako Socket Screw Co., Ltd., 5, 7
United Carr Fastener Corp., Cinch-Monadnock Div., 1, 7, 8
Vlier Engineering Corp., 4, 6, 8
Voi Shan Mfg. Co., 1, 5, 7, 8
Waldom Electronics, Inc., 5, 6, 9
Waltham Precision Instrument Co., Electromechanical Div., 5, 7
E. B. Wiggin Oil Tool Co., Inc., 4
J. H. Williams & Co., 9
York Gears, Ltd., 8

"O" Rings

AGC, Inc.
Abscoa Industries, Inc.
Acushnet Process Co.
Aero-Stat Co., The
Airtron Div., Litton Industries, Inc.
Allmetal Screw Products Co., Inc.
American Aero Parts
ARROWHEAD PRODUCTS DIV., FEDERAL-MOGUL-BOWER BEARINGS, INC. SEE ADV. P. 145
Auburn Mfg. Co., The
BTR Industries, Inc., Engineering — Reinforced Plastics Divs.
Bacon Industries, Inc.
Bancroft Industries (62), Ltd.
Bells Asbestos & Engineering, Ltd.
Carmac Aviation
Chamberlain Aviation, Inc.
Chicago-Allis Mfg. Co.
Collins Engineering Corp.
Continental Motors Corp., Aircraft Engine Div.
Continental Rubber Works
Cooper Industries, Inc.
Crane Packing Co.
D.S.D. Mfg. Co., The
John L. Dore Co., Military Products Div.
Dowty Group, Ltd.
Electrada Corp., The, Stillman Div.
Electrospace Corp.
Emerson Plastics Corp.
Federal-Mogul-Bower Bearings, Inc., National Seal Div.
Fluorocarbon Co., The
Fluro Plastics, Inc., Div. Flexrock Co.
Garlock, Inc.
General Tire & Rubber Co., Government & Aviation Div.
Greene Tweed & Co.
Hardware Specialty Co., Inc.
Haveg Industries, Inc.
Hecht Rubber Co., Inc.
Hercules Powder Co.
E. F. Houghton Co.
Jaros Aircrafters
Johns-Manville
Koppers Co., Inc., Metal Products Div.
Leader Products Co., Ltd.
Linear, Inc.
Lucas Aircraft Supply Co.
Mini-Tool Technical Industries, Inc.
Moxness Products, Inc.
North American Aviation, Inc.
Parker Seal Co.
Plastic & Rubber Products Co.
Raybestos-Manhattan, Inc., Plastic Products Div.
Roberts-Toledo Rubber Co., The
Rubber-Teck, Inc.
Seals, Inc.
W. S. Shamban & Co.
Sierra Engineering Co.
Silicone Insulation, Inc.
Sparta Mfg. Co., Div. U. S. Cermaic Tile Co.
Standard Locknut & Lockwasher, Inc.
Stoner Rubber Co.
Tetrafluor, Inc.
Thermech Engineering Corp.
Ronald Trist & Co., Ltd.
Albert Trostel Packings, Ltd.
UNITED AIRCRAFT PRODUCTS, INC. SEE ADV. P. 4
Vactek Inc., Sub. Geophysics Corp. of America
Vernay Laboratories, Inc.
Vibraseal Corp.
E. B. Wiggin Oil Tool Co., Inc.

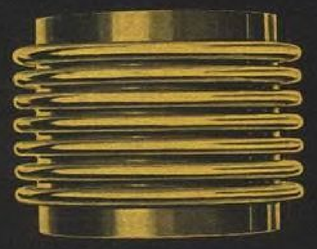
Oiling Equipment

Aro of Canada, Ltd.
Binks Mfg. Co.
Bowser-Briggs Filtration Div., Bowser, Inc.
Eynon Dakin Co.
GARSITE PRODUCTS, INC. SEE ADV. P. 244
Le Roi Div., Westinghouse Air Brake Co.
Lincoln Engineering Div., McNeill Machine & Engineering Co.
Nupla Mfg. Co., Div. New Plastic Corp.
Seamless Products Co., Inc.
Stewart-Warner Corp., Alemite Div.
Technical Development Co.
Trico Fuse Mfg. Co.
Wilkerson Corp.

Optical Equipment

Advanced Technology Laboratories Div., American-Standard
Aerojet Delft Corp.
American Astrophysics
American Optical Co.
Askania Werke, U. S. Branch Office
Autometric Corp., The
Avimo, Ltd.
Baird-Atomic, Inc.
Ball Bros. Research Corp.
Barnes Engineering Co., Instrument Div.
Beckman & Whitley, Inc.
Block Engineering, Inc.
Canadian Arsenals, Ltd.
Chicago Aerial Industries, Inc.
Chrysler Corp., Space Div.
Conductron Corp.
CONSOLIDATED SYSTEMS CORP. SEE ADV. P. 212
DBM Research Corp.
Davidson Optronics, Inc.
Diffraction Ltd., Inc.
Eastman Kodak Co.
Elgeet Optical Co., Inc.
Engis Equipment Co.
Fairchild Space and Defense Systems Div., Fairchild Camera and Instrument Corp.
Farrand Optical Co., Inc.
J. W. Fecker Div., American Optical Co.
Ferson Optics, Inc.
Flight Research, Inc.
Flui-Dyne Engineering Corp.
Gaertner Scientific Corp.
General Dynamics/Electronics—Rochester
General Electric Co., Ordnance Dept.
General Electrodynamics Corp.
General Precision, Inc., Information Systems Group, Commercial Co.
Geophysics Corp. of America, Physics Research Div.
Geo-Science, Inc.
Gordon Enterprises
W. & L. E. Gurley
Houston Fearless Corp.
Hughes Aircraft Co.
Hycon Mfg. Co.
Infrared Industries, Inc.
Intectron, Inc.
Itek Corp.
C. E. Johansson Gage Co., Swedish Gage Co. Affiliate
Keuffel & Esser Co., Optics & Metrology Div.
Ernst Leitz (Canada) Ltd.
Lenox Instrument Co.
McDONNELL AIRCRAFT CORP. SEE ADV. P. 230
Measurement Systems, Inc.
Mini-Tool Technical Industries, Inc.
Minnesota Mining & Mfg. Co., Revere Wollensak Div.
Mitchell Camera Corp.

It can do a thousand things:



What can it do for you?

In nearly 60 years of pioneering in seamless metal bellows, we've seen them used in countless ways — and design engineers develop new ones every week. In aerospace, they have many applications as flexible connectors, or as "living metal" components in precision assemblies. ■ Bellows can be formed of copper, brass, phosphor bronze, inconel, inconel-X, monel, aluminum, many types of stainless steel. They can stand temperatures from −400° F. to above 2,000° F., and pressures exceeding 5,000 psi. ■ Our comprehensive book on bellows applications may help solve a future design problem for you. Why not write for it today? Just ask for Catalog G-R.

Robertshaw
ROBERTSHAW CONTROLS COMPANY

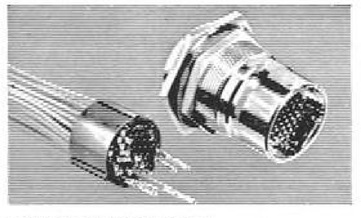
FULTON SYLPHON DIVISION • KNOXVILLE 1, TENNESSEE



NOW CHOOSE FROM 22 MULTI-PIN LAYOUTS

Microdot offers a wide choice of MIL-C-26500 interface markings in multi-pin connectors. Choose from 22 layouts for convenience, assembly ease and time saving. Every tenth cavity is identified by brackets and the first and last of each series is numbered if space permits. Power inserts are black, coaxial and combined power/coaxial inserts are red, and all markings are white.

The industry's most versatile line of reliable microminiature connectors is offered in three O.D. shell sizes: A. 49/64"; B. 61/64"; C. 1-9/64". One-fourth the size and one-third the weight of most competitive types with comparable capabilities, these connectors can accommodate up to 61 power or 19 coaxial contacts. And Microdot offers the only coaxial contact connector in its microminiature size range!



HERMETIC EXCLUSIVE!

Only Microdot offers a multi-pin crimp-type hermetic seal connector, in addition to standard and custom type hermetics, with compression bonded glass seals of superior strength. For more details on the above products, write direct, or use reader service card.

MICRODOT INC.

220 Pasadena Ave., South Pasadena, Calif.
Overseas: Microdot-Varec AG, Brussels

CIRCLE 199 ON READER SERVICE CARD

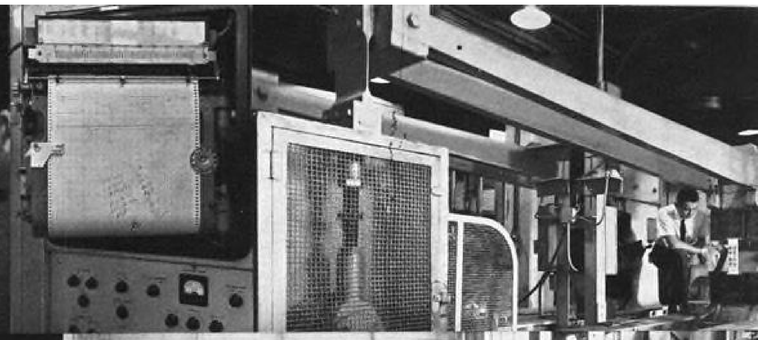
←CIRCLE 198 ON READER SERVICE CARD



John Hood speaks with authority on quality control of aluminum

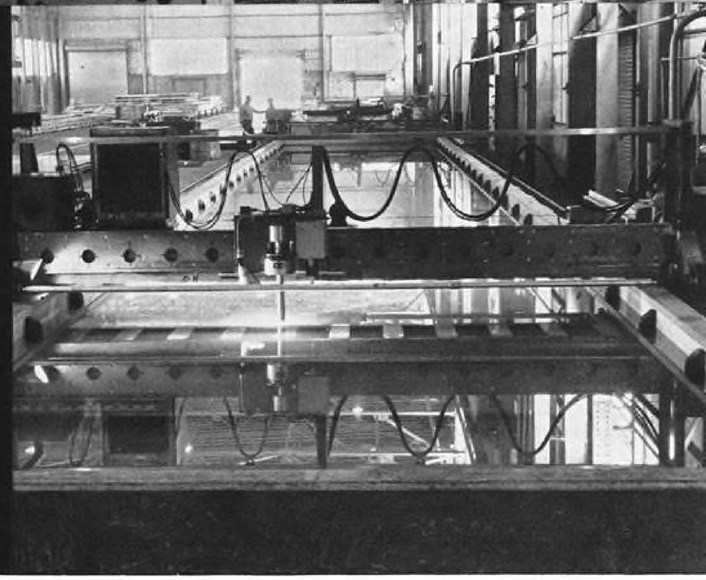








John Hood
speaks
with authority
on quality
control
of aluminum



This man is your insurance
against hidden flaws in the metal you buy

ALCOA

One day early in 1952, representatives of six airframe manufacturers met in Pittsburgh with John Hood and 14 other Alcoa metallurgists. John was then head of the Quality Standards Department of the Alcoa Metallurgical Division. He and the others had gathered to begin setting up industry-wide standards for ultrasonic inspection of aluminum.

Alcoa was there because it was the leader in industry to employ ultrasonic inspection methods, having started in 1945. Under John's direction, 73 units are now in service at Alcoa facilities producing ingot, forgings, plate and extrusions. Result? Flaws which had formerly enjoyed the privacy of nondetection can now be identified. This gives Alcoa the information needed to improve manufacturing techniques and furnish products of higher integrity. This, in turn, lowers manufacturing costs for customers.

Alcoa's preoccupation with quality goes back more than 50 years. Dissatisfied with the excessive time and cost of the wet method of analysis, Alcoa scientists fought a ceaseless battle to improve the economy, accuracy and speed of analysis.

The first breakthrough came in 1938 when Alcoa helped develop the spectrographic process. Again in 1950, Alcoa's four years of work with the instrument manufacturer yielded the first quantometer.

Today Alcoa operates four photoelectric spectrometers and 32 quantometers. But perhaps an even greater measure of Alcoa's reputation in the field of quality control is this startling statistic: Over the past five years, Alcoa Research Laboratories has sold and distributed an average of 4,787 spectrographic standards *per year.* Users include the U.S. Bureau of Standards, competitors, customers and government laboratories.

John Hood is now Alcoa's chief metallurgist and is responsible for the continuing quality of the company's output. "Customer acceptance of Alcoa products must be earned," he says, "based upon controlled characteristics and a history of performance when manufactured into critical components."

John Hood is but one of hundreds of Alcoa specialists who are available to help you meet performance requirements on difficult defense contracts or other business. When you need help with aluminum, just call your nearest Alcoa sales office. Or write Aluminum Company of America, 1868-Z Alcoa Building, Pittsburgh, Pa. 15219

Alcoa Brings You America's Finest News Show... **The Huntley-Brinkley Report,** on NBC-TV

ALCOA

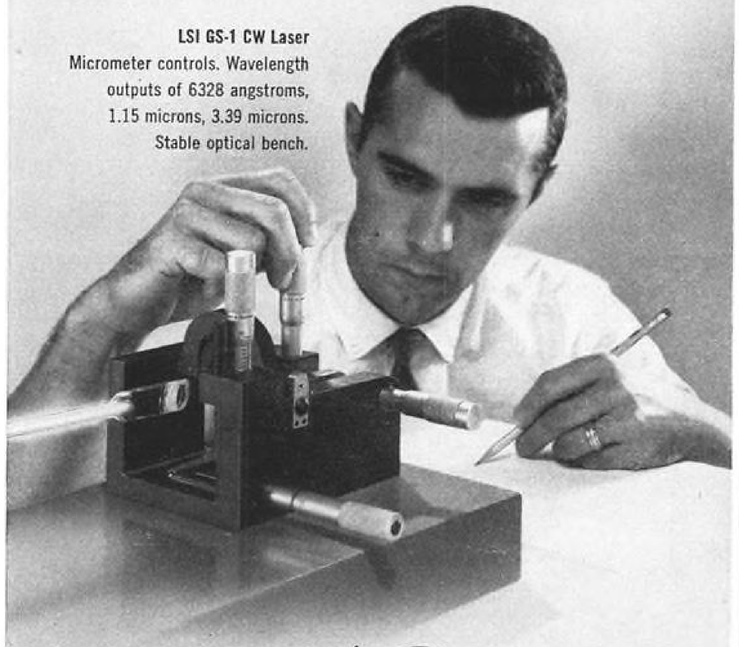
PERFECTIONIST with an angle

When mode selection and setting of mirror angles is important, the perfectionist can depend on the LSI CW Gas Laser. This precision laboratory tool, designed *by* perfectionists *for* perfectionists, is equipped with both fine and coarse controls for setting *and resetting* mirror angles . . . accurate within 0.06 second of arc.

The GS-1 Continuous-Wave Gas Laser, a product of the LSI Laser Systems Center, is engineered and built to meet the most demanding specifications for broad-range CW laser experimentation. You can have it as a complete gas laser laboratory including thermopile, r-f wattmeter, image converter, a variety of plane and confocal mirrors, and a vacuum system . . . or you can start with the basic laser unit and add the accessories when you need them. Write or call for the GS-1 CW Gas Laser Bulletin.

Note: If the GS-1 Laser does not fill all your requirements, Laser Systems Center's skilled technical staff will give you complete assistance in development of a CW laser specifically oriented to your needs.

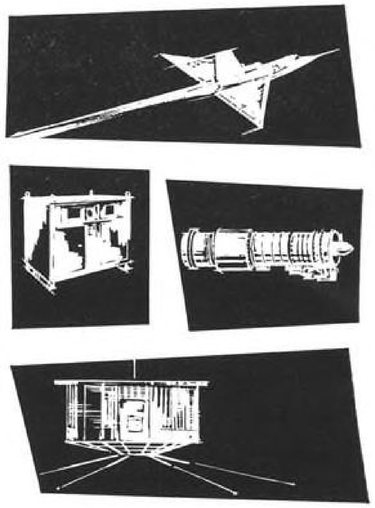
LSI GS-1 CW Laser
Micrometer controls. Wavelength outputs of 6328 angstroms, 1.15 microns, 3.39 microns. Stable optical bench.



LEAR SIEGLER, INC. / LSI® LASER SYSTEMS CENTER
FORMERLY TRION INSTRUMENTS, INC.
2320 WASHTENAW AVENUE
ANN ARBOR, MICHIGAN
TELEPHONE 313-665-8844

Circle Number 208 on Reader-Service Card

LOOKING FOR QUALITY?



When you look for quality, look to Lavelle!

Since 1940, Lavelle Aircraft has continuously supplied quality components to the most prominent companies in the aircraft, turbine engine, electronics and aerospace fields.

Quality engineering and precision manufacturing together with long years of experience and pride of workmanship has enabled Lavelle Aircraft to participate in Tiros, Telstar and many other projects of both a prototype and high-quantity production nature.

When you look for quality, look to Lavelle!

To find out more information about Lavelle Aircraft Corporation's quality controlled services, write for free booklet: "Precision Aerospace Components" or call our Contracts Manager, William Devoe at (215) WO 8-3838.

Lavelle
LAVELLE AIRCRAFT CORPORATION
NEWTOWN, BUCKS COUNTY, PA.

Circle Number 209 on Reader-Service Card

HI-TEMP

MATERIALS MACHINING, Inc.

AMERICA'S LEADING SPECIALISTS
in the machining and fabrication of

GRAPHITE

and Pyrolytic Graphite Products for
• MISSILES • ROCKETS
• INDUSTRY

Experts in design, engineering and tooling for graphite rocket and missile components.

Complete production and job manufacturing department.

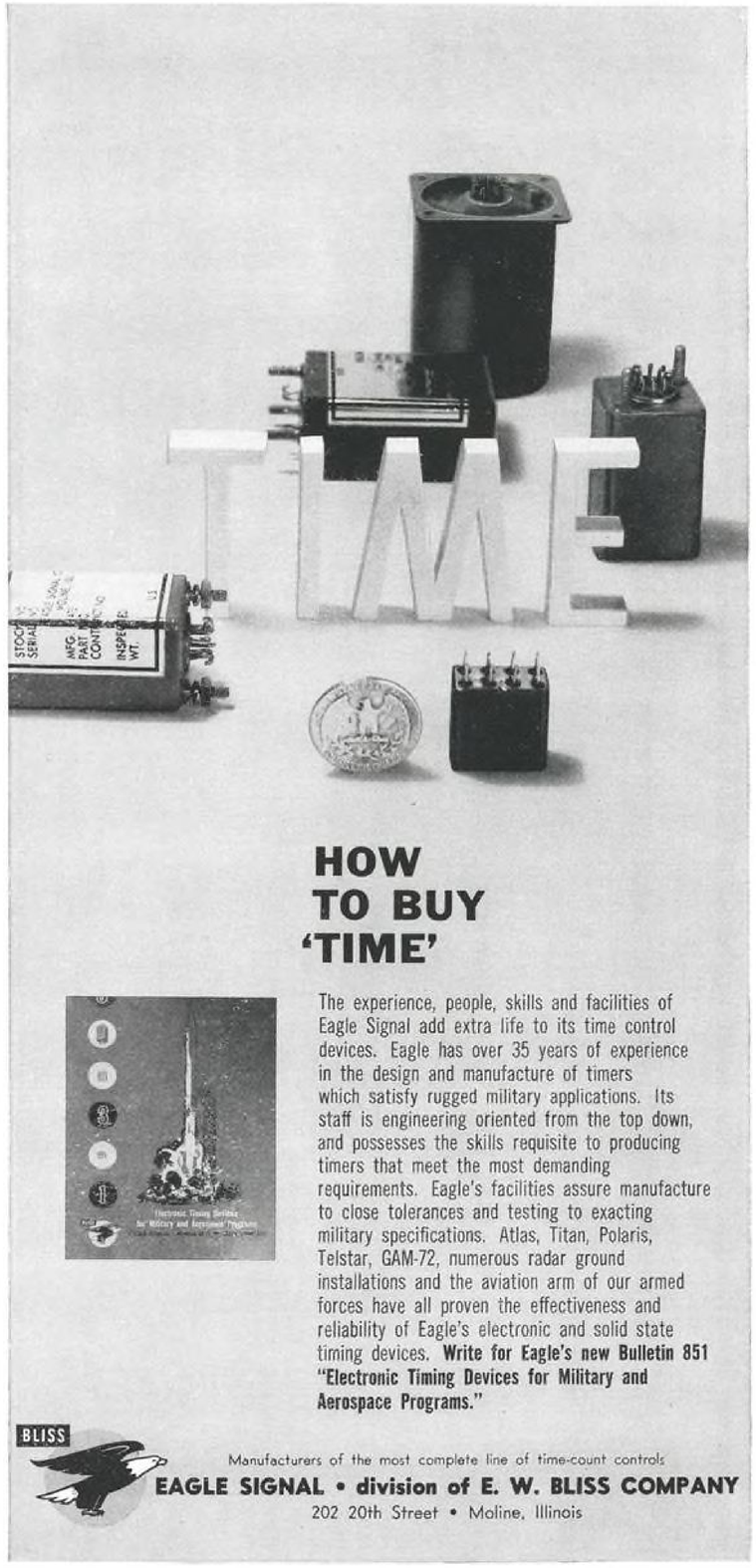
Rigid inspection facilities assure you of highest standards of accuracy.



Write for Illustrated Brochure

HI-TEMP
MATERIALS MACHINING, Inc.
1729 E. 10 Mile Rd.
Madison Heights, Michigan
Phone LIncoln 8-7800
Area Code: 313

Circle Number 210 on Reader-Service Card



HOW TO BUY 'TIME'

The experience, people, skills and facilities of Eagle Signal add extra life to its time control devices. Eagle has over 35 years of experience in the design and manufacture of timers which satisfy rugged military applications. Its staff is engineering oriented from the top down, and possesses the skills requisite to producing timers that meet the most demanding requirements. Eagle's facilities assure manufacture to close tolerances and testing to exacting military specifications. Atlas, Titan, Polaris, Telstar, GAM-72, numerous radar ground installations and the aviation arm of our armed forces have all proven the effectiveness and reliability of Eagle's electronic and solid state timing devices. **Write for Eagle's new Bulletin 851 "Electronic Timing Devices for Military and Aerospace Programs."**

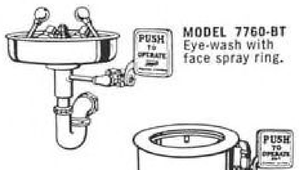
BLISS
Manufacturers of the most complete line of time-count controls
EAGLE SIGNAL • division of E. W. BLISS COMPANY
202 20th Street • Moline, Illinois

Circle Number 211 on Reader-Service Card

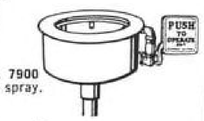
HAWS

Safety on tap!

...for in-plant protection against injury from contamination by caustics, chemicals, radioactive materials, etc. Provide emergency first-aid with HAWS "fool proof" equipment!



MODEL 7760-BT
Eye-wash with face spray ring.



MODEL 7900
Eye and face spray.



MODEL 7300
Cast aluminum eye-wash.

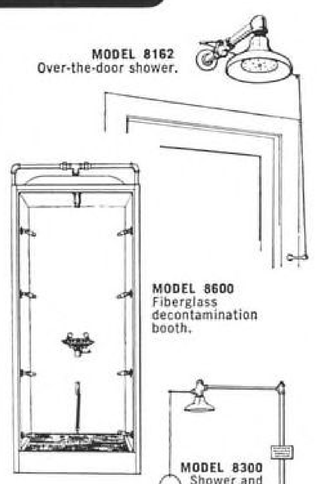


EMERGENCY
EYE WASH
FACE WASH

Facial areas are instantly flooded with relieving water, from wall or pedestal mounted units.



MODEL 8162
Over-the-door shower.



MODEL 8600
Fiberglass decontamination booth.



MODEL 8300
Shower and eye-wash combination.

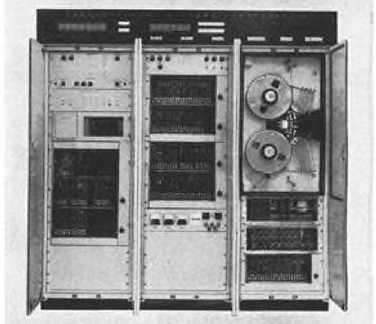
DECONTAMINATION
DRENCH
SHOWERS

Both multiple nozzle and single head showers wash away dangerous matter from body and clothing.

Haws manufactures a complete line of emergency eye-wash, face-wash and drench shower equipment. For full information and specification details write for Haws Safety Catalog.

HAWS EMERGENCY EQUIPMENT
1443 Fourth Street • Berkeley 10, California
Since 1909

SYSTEMS PROGRESS



CUSTOM-DESIGNED DATA SYSTEMS

MicroSADIC Digital Data systems are the efficient, economical link between instrumentation and digital computers—automatically handling data acquisition, conversion, and recording in computer-ready format.

Because of CSC's modern design techniques, you can order a custom MicroSADIC system assembled from field-proven modules to fit your application requirements. Every system is:

- **Expandable after installation**
- **Built with NOR/NAND logic cards**
- **Self-checking**
- **Based on proven components**
- **Easy to operate**
- **Easy to calibrate**

For test facility or flight vehicle, hard-wired or telemetered, analog or PCM, high or low level signals, CSC can promptly deliver a custom system tailored to meet your needs.

Call your CSC engineering representative for more information. He will be glad to show you examples—you can choose from hundreds of successful installations. Or write direct:

CONSOLIDATED SYSTEMS CORPORATION
1500 So. Shamrock Ave. • Monrovia, California
AN ASSOCIATE COMPANY OF ALLIS-CHALMERS, BELL & HOWELL, CONSOLIDATED ELECTRODYNAMICS

North American Aviation, Inc., Rocketdyne Div., 1
Northern Research & Engineering Corp., 1, 2
Parker-Hannifin Corp., Parker Aircraft Co., Div.
Parker-Hannifin Corp., Parker Hydraulics Div., 2
Paul Chemical Co., Inc.
PESCO PRODUCTS, DIV. BORG-WARNER CORP., 1. SEE ADV. P. 34
Philco Corp., Lansdale Div., Sub. Ford Motor Co., 2
Racine Hydraulics & Machinery, Inc., 2
Reaction Motors, Div. Thiokol Chemical Corp., 1
Republic Mfg. Co., 2
Roper Hydraulics, Inc., Aviation Products Div., 1
Roper Hydraulics, Inc., Aviation & Special Products Div., 1, 2
Rucker Co., The, 2
Ruthman Machinery Co., 2
S. A. M. M., 1, 2
Sabema Corp., 2
Saunders Valve Co., Ltd., Aircraft Div., 2
Standard Products, Inc., 1
Standard Steel Corp., 1, 2
Stewart Warner Corp., South Wind Div., 1, 2
Sundstrand Aviation-Denver, 1, 2
Superior Air Products Co., 2
Szemco, Inc., 1, 2
T.K.S. Aircraft De-Icing, Ltd., 1
Tapco Div., Thompson Ramo Wooldridge, Inc., 1, 2
Task Corp., 1, 2
Thompson Ramo Wooldridge, Inc., 1, 2
Vickers, Inc., Div. Sperry Rand Corp., 1, 2
Vickers, Inc., Marine & Ordnance Dept., Div. Sperry Rand Corp., 2
Viking Pump Co., 1, 2
Wallace & Tiernan, Inc., 2
Weldon Tool Co., The, 1, 2
Westinghouse Electric Corp., 1, 2
Wisconsin Hydraulics, Inc., 2

Punches

Abalon Precision Mfg. Corp.
Ace Drill Bushing Co., Inc.
Billings & Spencer Co., Div. Crescent Niagara Corp.
Blackhawk Industrial Products Co., Enerpac Div.
Crescent Tool Co., Div. Crescent Niagara Corp.
General Precision, Inc., Information Systems Group (Commercial Computer Div.)
Greenlee Bros. & Co.
Harrington Tool & Die Co., Ltd.
Hickok Electrical Instrument Co., The
Hydraulic Products Co.
International Tel. & Tel. Corp.
C. E. Johansson Gage Co., Swedish Gage Co. Affiliate
Lavoie Laboratories, Inc.
Leader Products Co., Ltd.
Sippican Corp.
Snap-On-Tools Corp.
Southern Instruments, Ltd.
L. S. Starrett Co., The
Telecomputing Corp., Electronic Systems Div.
Textron, Inc., California Tehnical Industries
Torrington Co., The
Wales Strippit Co., A Unit of Houdaille Ind., Inc.
Whitney Metal Tool Co.
Wiedemann Machine Co.
J. H. Williams & Co.

Punching Equipment

American Data Machines
Blackhawk Industrial Products Co., Enerpac Div.
Buffalo Forge Co.
General Precision, Inc., Information Systems Group (Commercial Computer Div.)
Greenlee Bros. & Co.
Hannifin Press Co., Div. Parker-Hannifin Corp.
Hickok Electrical Instrument Co., The
Hydraulic Products Co.
Lavoie Laboratories, Inc.
Lennox Tool & Machine Builders
Sippican Corp.
Wm. H. Snow Co.
Textron, Inc., California Technical Industries
Wales Strippit Co., A Unit of Houdaille Ind., Inc.
Whitney Metal Tool Co.
Wiedemann Machine Co.

Punching Service

Accessories Manufacturers, Ltd.
Albion Welding & Mechanical Works, Ltd.
Astral Electronics, Inc.
Emmert Mfg. Co.
Flight Equipment & Engineering Corp.
General Dynamics/Convair
Hydraulic Products Co.
Jay Mfg. Corp.
Kellett Aircraft Corp.
Laminated Shim Co., Inc.
Lavoie Laboratories, Inc.
Leader Products Co., Ltd.
Magna Electronics Corp., Ltd.
Miller Dial & Name Plate Co.
Northrop Corp., Norair Div.
Notifier Corp./Notifier Engineering, Inc.
Rimak Electronics, Inc.
Rockwell-Standard Corp., Stamping Div.
Sippican Corp.
Wm. H. Snow Co.
Strat-O-Seal Mfg. Co.
Synthane Corp.
Unitron Engineering Co.

Purification Equipment

1. Air/Gas Systems, 2. Fluid Systems

Aero-Flow Dynamics, Inc., Aero-Corry Div., 1, 2
Air Logistics Corp., 2
Air-Dry Corp. of America, 1
Atlantic Research Corp., 1
Barton Instrument Corp., 2
Bowser-Briggs Filtration Div., Bowser, Inc.
Cambridge Filter Corp., 1, 2
Cardair Div., Marmon-Herrington Co., Inc., 1
Donaldson Co., Inc., 1
Dynamic Filters, Div. Michigan Dynamics, Inc., 1, 2
Fram Aerospace, Div. Fram Corp., 1, 2
Garrett Corp., The, 1
Hamilton Standard Div., United Aircraft Corp., 1, 2
Hilliard Corp., The, 1, 2
Hymatic Engineering Co., Ltd., The, 1
Ionics, Inc., 1
Kahn & Co., Inc., 1
Walter Kidde & Co., Inc., 1
LEAR SIEGLER, INC., POWER EQUIPMENT DIV., 1, 2. SEE ADV. P. 94, 95
Arthur D. Little, Inc., Div. 50, 1
Michigan Dynamics, Inc., 1, 2
Millipore Filter Corp., 1, 2
Mine Safety Appliances Co., 1, 2
Northern Research & Engineering Corp., 1
Parmatic, Inc., 1, 2
Puritan Equipment, Inc., Aerospace Div., 1
Selas Corp. of America, 1, 2
Space Equipment Corp., 2
Sparkler Mfg. Co., 2
Henry Spen & Co., Inc., 1
Standard Mfg. Co., Inc., 2
Stearns Roger Corp., 1
Stewart Warner Corp., South Wind Div., 1, 2
Swiss Electro Instruments, Div. Pastushin Indusries, Inc., 2
Ultrasonic Industries, Inc., 2
Western Filter Co., Inc., 1, 2
Westinghouse Electric Corp., 1, 2
Wheelabrator Corp., 1
Zep Aero, 1
Zurn Industries, Inc., 2

Pushbuttons

Allen-Bradley Co.
Clark Controller Co., The, Los Angeles Div.
Cutler-Hammer, Inc.
EAGLE SIGNAL DIV., E. W. BLISS CO. SEE ADV. P. 211
Furnas Electric Co.
Honeywell, Micro-Switch Div.
Joy Mfg. Co., Electrical Products Dept.
Nelson Electric Mfg. Co.
North Electric Co.
Westinghouse Electric Corp.

Pushrods

Amco Mfg., Inc.
Continental Motors Corp., Aircraft Engine Div.
Gabriel Co., The, Gabriel Electronics Div.
Lamson & Sessions Co., The
Le Fiell Mfg. Co.
Nonco, Inc.
Southwest Products Co.
Standard Screw Co., Chicago, Hartford, Western Divs.
United Aircraft of Canada

Pyrometers

Assembly Products, Inc.
Bristol Co., The
British Insulated Callenders Cables, Ltd.
Burling Instrument Co.
CSF-Compagnie Generale de Telegraphie Sans Fil
Canadian Curtiss-Wright, Ltd.
Canadian Research Institute
Epic, Inc.
Claud S. Gordon Co., Sub. Pneumodynamics Corp.
Gulton Industries, Inc.
Honeywell, Military Products Group
Howell Instruments, Inc.
Huppert, K. H. Co.
ITT General Controls, Inc.
Infrared Industries, Inc.
Instrument Development Laboratories, Inc.
International Instruments, Inc.
Kollmorgen Corp.
Leeds & Northrup Co.
Lewis Engineering Co.
Metal Treating Equipment Exchange, Inc.
Meters, Inc.
Milletron, Inc.
North American Aviation, Inc. Atomics International Div.
Pacific Transducer Corp.
Pyrometer Instrument Co., Inc.
Servo, Corp. of America
Thermo Electric Canada, Ltd.
Thermovolt Instruments, Ltd.
West Instrument Corp.

Pyrotechnic Equipment

Aerolab Development Co., Sub. Marshall Industries
Amcel Propulsion Co., Div. Cleanese Corp. of America
Atlantic Research Corp.
Chromalloy Corp., Propellex Div.
Douglas Aircraft Co., Inc. Missile & Space Systems Div.
Hercules Powder Co.
Jet Research Center, Inc.
Walter Kidde & Co., Inc.
Wallace O. Leonard, Inc.
Lundy Electronics & Systems, Inc.
McCormick-Selph Associates, Inc.
McDONNELL AIRCRAFT CORP. SEE ADV. P. 230
Northrop Corp.
Northwest Aerospace Co.
Olin Mathieson Chemical Corp., Associated Products Operations
Ordnance Engineering Associates, Inc.
Ordnance Research & Development Co.
Quantic Industries, Inc., Pelmac Div.
Special Devices, Inc.
Talley Industries, Inc.
Weber Aircraft Corp.

Pyro-thermoelectric Components

Aero Research Instrument Dept., Advanced Technology Labs.
Auto-Control Laboratories, Inc.
Bristol Co., The
CSF-Compagnie Generale de Telegraphie Sans Fil
General Devices, Inc.
Claud S. Gordon Co., Sub. Pneumodynamics Corp.
Gulton Industries, Inc.
Hickok Electrical Instrument Co., The
Lewis Engineering Co.
MARTIN CO., DIV. MARTIN-MARIETTA CORP. SEE ADV. P. 224
Ordnance Research & Development Co.
PESCO PRODUCTS, DIV. BORG-WARNER CORP. SEE ADV. P. 34
Royco Instruments, Inc.
Sperry Gyroscope Co., Div. Sperry Rand Corp.
Thermovolt Instruments, Ltd.
West Instrument Corp.
Westinghouse Electric Corp., Aerospace Electrical Dept.
Westinghouse Research and Development Center Westinghouse Electric Corp.

Pyro-thermoelectric Materials

Bristol Co., The
General Devices, Inc.
Claud S. Gordon Co., Sub. Pneumodynamics Corp.
High Temperature Materials, Inc.
Semi-Elements, Inc.
Thermovolt Instruments, Ltd.
West Instrument Corp.
Westinghouse Electric Corp., Aerospace Electrical Dept.
Westinghouse Research and Development Center Westinghouse Electric Corp.

Quadrants, Engine Control

Adams-Rite Mfg. Co.
Aero Flow Dynamics, Inc., Aero Corry Div.
Avionic Products Engineering Corp.
Burner-Hollomon Mfg. Corp.
Hansen-Lynn Co., Inc.
Special Corp., The

Racks

1. Avionics, 2. Bomb, 3. Storage

Amco Engineering Co., 3
Accessories Manufacturers, Ltd., 3
Aeronca Mfg. Corp., 2
Aeronca Mfg. Corp., Aerocal Div., 2
Aerospace Products, Inc., 1, 2
American Metal Products Co., 3
Aviation Traders Engineering, Ltd., 1
Avnet Instrument Corp., Div. Avnet Electronics Corp., 1
Barry Wright Corp., Barry Controls Div., 1
Bell Aerosystems Co., Div. Bell Aerospace Corp., a Textron Co., 1
Bethlehem Steel Co., 3
Bristol Aero-Industries, Inc., Winnipeg Div., 2
Bud Radio, Inc., 1
Canadair, Ltd., 2
Chrysler Corp., Space Div., 1, 2
Dare, Inc., 1
Dayton Aircraft Products, Inc., 2
Douglas Aircraft Co., Inc., Missile & Space Systems Div., 1
Dynalectron Corp., 1
Electro Rack, 1, 3
Electro-Neutronics, 1
Ellanef Machine Tool Co., Inc., 2
Falstrom Co., 1, 3
Glaco Industrial Div., Ecko Products Co., 3
Guardline Controls, 1
Handley Industries, 2
Hansen-Lynn Co., Inc., 2
Hupp Corp., Hupp Aviation Div., 2
Hydraulic Products Co., 2
Idaho-Maryland Industries, Inc., 3
A. Imhof, Ltd., Ashley Works, 1
Intercontinental Mfg. Co., Inc., Sub. The Lionel Corp., 2
Irving Air Chute Co., Inc., 1, 2, 3
Jervis Corp., 1, 2
Kellett Aircraft Corp., 2
Lockheed Aircraft Corp., 1
M-H Standard Corp., 3
Magnesium Aerospace Products
Navan Products, Inc., Sub. North American Aviation
M. Neushul Co., Inc.
Northrop Corp., Norair Div., 1, 2
On Mark Engineering Co., 1
Ozone Metal Products Corp., 2
Penco Products, Inc., Sub. Alan Wood Steel Co., 3
Premier Metal Products Co., Inc.
Prosser Industries, Inc., 2
Radio Corp. of America, 1
Randall Engineering Corp.
Rapids Standard Co., Inc., The, 3
Regent Jack Mfg. Co., Inc., 1, 2, 3
Republic Aviation Corp., 2
Republic Steel Corp., Manufacturing Div., 3
Rocket Power, Inc., 2
SIREN, 1
Sabema Corp., 2
Singer Metrics Div., The Singer Co., 2
Henry Spen & Co., Inc., 2
Standard Armament, Inc., 2
Standard Tube & T. I., Ltd., 3
Talley Corp.
Talley Industries, Inc., 2
Twin Industries Corp., Aerospace Div., 2
Unitron Engineering Co., 3
Westinghouse Electric Corp., Aerospace Electrical Dept., 1

Radar Equipment

1. Airborne, 2. Ground-Based, 3. Ship Based, 4. Spaceborne

ACEC, 1, 2, 3, 4
ACF Industries, Inc., 1, 2, 4
Admiral Corp., 1, 2
Advanced Development Laboratories, Inc., 1, 2, 3, 4
Aero Geo Astro Corp., 1, 2, 3, 4
Aeronca Mfg. Corp., 2
Airborne Instruments Laboratory, Div. Cutler-Hammer, Inc., 1, 2, 3, 4
Aircraft Armaments, Inc., 1, 2, 3, 4
Airtec, Inc., 1, 2, 3, 4
Airtron Div., Litton Industries, Inc., 1, 2, 3, 4
American Avionics, Inc., Div. Astro-Science Cor., 2, 3
American Electronics Labs., Inc., 1, 2, 3, 4
American Machine & Foundry Co., Advanced Products Group, 2, 3
Amphenol-Borg Electronics Corp., FXR Div., 2, 3
Antenna Systems, Inc., 2, 3
Avco Corp., Electronics Div., 2
Beaconing Optical & Precision Materials Co., Ltd., 2, 3
Bell Aerosystems Co., Div. Bell Aerospace Corp., A Textron Co., 1, 2, 3, 4
Bell Aerosystems Co., Tucson Research Laboratory, 1, 2, 4
Belock Instrument Corp., 1, 2, 3
Bendix Corp., The, Bendix Mishawaka Div., 1
Bendix Corp., The, Bendix Pacific Div., 1
Bendix Corp., The, Bendix Radio Div., 1, 2, 3, 4
Bendix Corp., The, Bendix Research Laboratories, 1, 4
Bendix Corp., The, York Div., 4
Budd Electronics, Div. Budd Co., Inc., 2, 3
CSF-Compagnie Generale de Telegraphie Sans Fil, 1, 2, 3, 4
Canadian Arsenals, Ltd., 1, 2, 3, 4
Canadian Curtiss-Wright, Ltd., 2, 3
Canadian-Westinghouse Co., Ltd., Electronics Div., 1
Canoga Electronics Corp., 2, 3
Capehart Corp., 3
Cardion Electronics, Inc., 1, 2, 3, 4
Collins Radio Co., 1
Conductron Corp.
Contraves Italiana S.p.A., 2
Cook Electric Co., Technological Center Div., 1, 2, 3, 4
A. C. Cossor, Ltd., Cossor Electronics, Ltd., 1, 2, 3
Cubic Corp., 1, 2, 3, 4
Dalmo Victor Co., Textron, Inc., 1, 2



RADIATRONICS

VAN NUYS, CALIFORNIA

Antennas, Microwave equipment, Electromechanical devices.
Openings for qualified microwave and antenna engineers.

STANDARD-THOMSON

MEANS **INGENUITY**

. . . . in HEAT EXCHANGERS

STC offers unmatched competence in the evaluation, design and manufacture of sophisticated heat exchangers and heat exchanger packages for aircraft, space vehicles and ground support equipment. Our high performance equipment is lighter in weight and smaller in size . . . at lower cost because they are engineered and produced creatively.



. . . . in VALVES

STC valves, such as this differential pressure actuated unit, are not just variations of a theme, but are specifically designed to meet a specific need — by some of the most knowledgeable and experienced men in the business. Our capability also includes temperature sensitive valves, and barometric operated units.



. . . . in BELLOWS

STC bellows and bellow assemblies have long been recognized for their accuracy and dependability. We have been designing and producing ordinary and complex units from ¼" to over 22" in diameter for over thirty-five years. And we can produce them economically in any volume required.

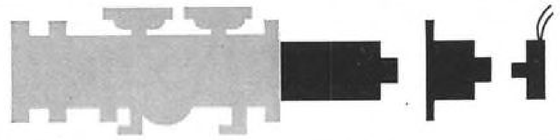


. . . Let us show you why and how. Write for free literature. Better still, send along your prints for confidential analysis. WRITE: Standard-Thomson, Aircraft Division, 162 Grove Street, Waltham 54, Massachusetts.

STANDARD-THOMSON IS INGENUITY

Circle Number 215 on Reader-Service Card

DIRECT-CURRENT SOLENOIDS shaped to fit!

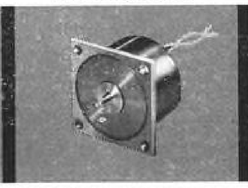


THE CONVENTIONAL



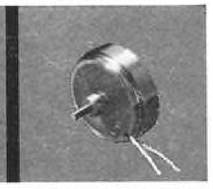
¾" to 2" dia. D.C. or rectified. Long or short strokes. Push or pull. Foot, flange or thread mount. Sealed coil.

THE COMPACT*



1" to 2" dia. D.C. or rectified. Long or short strokes. Push or pull. Flange or thread mount. Sealed coil.

THE WAFER*



1" to 2" dia. D.C. Short stroke. Push or pull. Flange or thread mount. Sealed coil.

Standard shaped solenoids available from stock parts. **Other products: Miniature Valves — Ordnance Valves — Manifold Valves.** *Trademark

MANUFACTURING DIVISION OF
KOONTZ WAGNER ELECTRIC COMPANY INCORPORATED
516 N. MICHIGAN ST.
SOUTH BEND, INDIANA

Circle Number 216 on Reader-Service Card

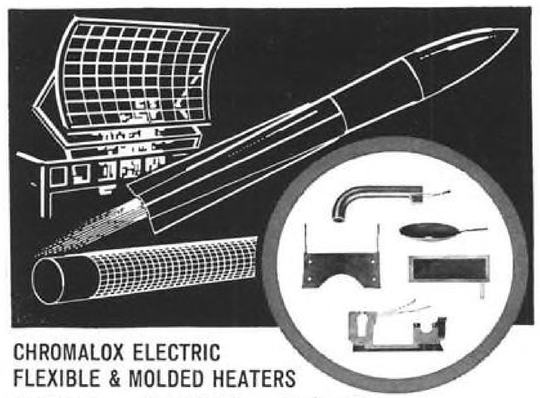
DAVID CLARK CO., INC. WORCESTER, MASSACHUSETTS

Our current development of space and environmental suits and allied projects consistently brings us in contact with materials having special properties. Our integrated Research and Development Departments can help solve your problems in the production of rubber dipped and flocked items, close tolerance molded rubber and machined parts.

Send us your specifications today for a prompt quotation and a realistic delivery date.

DAVID CLARK COMPANY INC.
360 FRANKLIN ST.
WORCESTER, MASS.

Circle Number 217 on Reader-Service Card



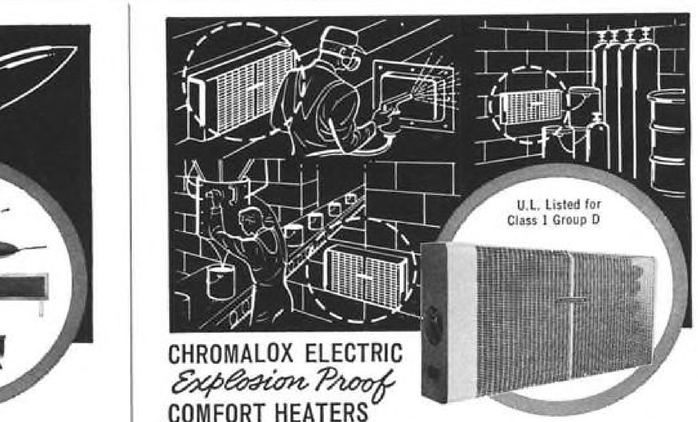
CHROMALOX ELECTRIC
FLEXIBLE & MOLDED HEATERS

WRAP...CLAMP...BOND heat to any surface and shape.

Lightweight Chromalox Flexible and Molded Heaters can be shaped to almost any form. Easy to apply—they provide exact temperatures to all parts, or only sections, of an object. Available in a wide variety of voltages and coverings in temperatures up to 800° F. Typical uses include heating harnesses, battery protectors, computers, controls, fuel systems, guidance devices and similar components requiring controlled heat. **Write for Bulletin PJ-100.**

WI-41

CHROMALOX ELECTRIC HEAT
EDWIN L. WIEGAND COMPANY
7804 THOMAS BOULEVARD, PITTSBURGH 8, PA
PROCESS COMFORT



CHROMALOX ELECTRIC
Explosion Proof
COMFORT HEATERS

COMPLETELY SAFE HEAT in hazardous atmospheres

Now—get the comfort heat you want even in hazardous areas. These new Chromalox electric air heaters are designed to provide desired warmth safely, economically, in areas where gases, solvents, gasolines and other flammables are present. Heat source is Finstrip®, an exclusive, extremely low watt density metal sheathed heating element. Special baffle directs heat flow outward . . . can easily be mounted on wall. **Write for Bulletin PF 101.**

WI-38

CHROMALOX ELECTRIC HEAT
EDWIN L. WIEGAND COMPANY
7804 THOMAS BOULEVARD, PITTSBURGH 8, PA.
PROCESS COMFORT

HIGH RESPONSE... a new concept in

TIME COMPRESSION



FULL CLOSED TO FULL OPEN
IN LESS THAN 6 MILLISECONDS

Uncompromised RELIABILITY, full flow characteristics and absolute dead-tight sealing. The unique interlocked pilot and poppet design makes it possible. Circle Seal's standard line of solenoid valves permits numerous configuration options to meet custom design requirements.

Send for complete engineering details.

CIRCLE SEAL SOLENOID VALVES

JAMES, POND & CLARK, INC.,
2181 East Foothill Blvd., Pasadena, Calif.
For filter requirements, consult Circle Seal's Microporous Filter Division

CIRCLE 220 ON READER SERVICE CARD



CHROMALOX ELECTRIC STRIP HEATERS

An exclusive, time-proved process gives more ELECTRIC HEATER LIFE FOR YOUR $$

Industry's best known metal-sheathed electric heater is still made by the exclusive process that made it famous. It gives longer heater life because Chromalox construction gives heat a solid, fast route from resistor wire to sheath—no air gaps to cause localized overheating and oxidized wire. Completely insulated. The more vital your product or process the more it deserves Chromalox Electric Strip Heaters. Yes, they're still competitive, even inexpensive when you divide dollars by years. **Write for Catalog 60.**

WI-40

CHROMALOX ELECTRIC HEAT
EDWIN L. WIEGAND COMPANY
7804 THOMAS BOULEVARD, PITTSBURGH 8, PA.
PROCESS COMFORT

Anything you're apt to need in ELECTRIC HEAT

- HEATING ELEMENTS
- PACKAGED HEATERS
- HEATING SYSTEMS
- INFRARED HEATERS AND OVENS
- COMFORT HEATING EQUIPMENT
- CONTROLS

At Your Service...
CHROMALOX
Sales Engineering Representatives

Albany, N.Y.	518 HO 3-0626	Kansas City, Mo.	816 VI 2-3306
Atlanta, Ga.	404 875-7244	Little Rock, Arkansas	501 FR 4-9398
Baltimore, Md.	301 HO 7-3280	Los Angeles, Cal.	213 LU 9-6321
Baton Rouge, La.	504 342-9874	Middletown, Conn.	203 DI 6-9606
Bloomfield, N.J.	201 ED 8-6900	Milwaukee, Wis.	414 BR 1-3021
Boston, Mass.	617 CE 5-8040	Infrared ovens	332-2720
Buffalo, N.Y.	716 TT6-4000	Minneapolis, Minn.	612 FE 6-6631
Burlingame, Cal.	415 697-6500	Nashville, Tenn.	615 CY 2-7016
Charlotte, N.C.	704 334-4244	New York City, N.Y.	212 WO 4-2990
Chattanooga, Tenn.	615 AM 5-3862	Omaha, Nebraska	402 341-7600, 7610
Chicago, Ill.	312 HA 7-5464	Philadelphia, Pa.	215 TE 9-3000
Cincinnati, Ohio	513 761-5566	Phoenix, Ariz.	602 277-1662
Clearwater, Fla.	813 446-7706	Pittsburgh, Pa.	412 361-2900
Cleveland, Ohio	216 771-7112	Portland, Oregon	503 223-4197
Columbia, S.C.	803 256-6057	Richmond, Virginia	703 643-7897
Columbus, O.	614 885-3933	Rochester, N.Y.	716 HA 6-2070
Dallas, Texas	214 EM 3-5436	St. Louis, Missouri	314 CH 1-2433
Davenport, Iowa	319 326-5233	Salt Lake City, Utah	801 485-3462
Dayton, Ohio	513 298-9701	San Francisco, Cal.	(See Burlingame)
Denver, Colorado	303 244-4291	Seattle, Wash.	206 MA 4-7297
Des Moines, Iowa	515 255-3116	Syracuse, N.Y.	315 463-6641
Detroit, Mich.	313 538-2100, 357-0677	Toledo, Ohio	(See Detroit)
Houston, Texas	713 OV 6-3483	Tulsa, Okla.	918 LU 2-5520
Indianapolis, Ind.	317 ME 5-5313	Washington, D. C.	(See Baltimore)
Kalamazoo, Mich.	616 345-7181	Wichita, Kansas	316 AM 2-5647

Edwin L. Wiegand Co., 7804 Thomas Boulevard, Pittsburgh 8, Pa. WI-37(P)

CIRCLE 219 ON READER SERVICE CARD

NEW DIGITAL CLOCK . . in *Stainless Steel*



#920 VANGUARD TYMETER® CLOCK
12-HOUR READ OUT . . **22.50**
24-HOUR READ OUT . . **24.50**

Engineered and designed for the synchronization of your operations. Brushed satin stainless steel case with walnut wood ends. Large, easy-to-read 5/8" Colorama numerals give you "time at a glance". Self starting electric, 110-120V, 60 cy. AC. 7¾" x 3¾" x 3⅞". UL approved motor and cord. One Year Guarantee. Plus applicable tax.

ORDERS PROMPTLY FILLED

TYMETER ELECTRONICS
PENNWOOD NUMECHRON CO.
7249 FRANKSTOWN AVE. PITTSBURGH 8, PA.

Circle Number 75 on Reader-Service Card

Specify the newest
CONNECTORS
Connector devices.

On-time delivery of connectors by Bendix, Microdot, Gremar, U.S. Components*

*Reg. T.M. Bendix Corp.

For the best service
AVNET
Call your Local Avnet Headquarters:

San Diego, 714-279-1550; Los Angeles; 213 UPO 6141; Sunnyvale, Calif., 408-RE 6-0300; Bellevue, Wash., 206-GL 4-4911; Phoenix, Ariz., 602-273-1261; Salt Lake City, Utah, 801-486-7566; Chicago, Ill., 312-GL 5-8160; Syracuse, N. Y., 315-454-3238; Westbury, L. I., N. Y., 516-ED 3-5800; Burlington, Mass., 617-BR 2-3060

The Avnet System
LOCAL
Coast to Coast

Circle Number 223 on Reader-Service Card

IF YOUR COMPANY

IS NOT LISTED

IN THE

AVIATION WEEK &

SPACE TECHNOLOGY

BUYERS GUIDE ISSUE,

WRITE TO:

BUYERS GUIDE EDITOR
AVIATION WEEK & SPACE TECHNOLOGY
330 WEST 42 STREET
NEW YORK 36, N. Y.



IRVING KEEPS **COMING UP** WITH THE ANSWERS TO **COMING DOWN**

In 1919, when the project was to get men safely down from flying machines, young Leslie L. Irvin helped develop the answer, made the first jump himself, and established the first company to manufacture parachutes.

Forty years later, the problem had moved on to getting capsules down safely from space. The Discoverer Space Capsule recovery system was developed by this same Mr. Irvin's company's research and development center at Glendale.

Back of these historic highlights is a continuity of leadership in personnel, cargo, and parabrake chute system development and production. Successful Irving Air Chute recovery systems serve Corvus, NERV, and Sidewinder, plus the related Lockheed high altitude, Mach 4 aircraft ejection capsule project.

Irving can take over from earliest planning and carry through to prototype, pilot model, and full production. Ask for proposal without obligation.

IRVIN PARA-SPACE CENTER
Irving Air Chute Company, Inc.
622 Rodier Drive, Glendale, California

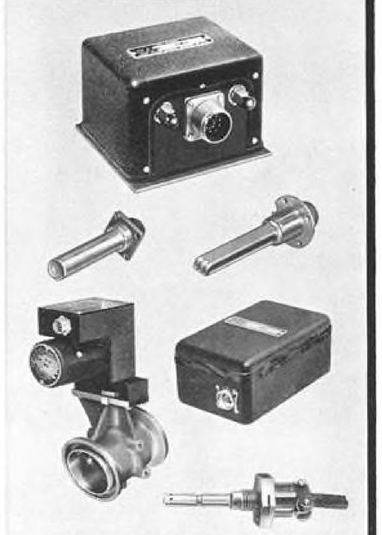
Circle Number 77 on Reader-Service Card

BARBER COLMAN

aircraft and missile products



AIR VALVES



TEMPERATURE CONTROL AND POSITIONING SYSTEMS



ELECTROMECHANICAL ACTUATORS

Air Valves—electrically and pneumatically operated, for temperature- and pressure-control applications. Models in butterfly . . . check . . . poppet . . . and automatic-drain types. Designed to meet your needs.

Temperature Control and Positioning Systems—designed to meet your requirements. Operate from electronic, magnetic amplifier, transistor, or relay control.

Electromechanical Actuators—rotary or linear. Wide range of strokes, speeds, and configurations. Auxiliary devices include switches, clutches, load limiters.

Electromagnetic Shielding—POLYFORM spray process is the *modern* method of shielding or enclosing any configuration.

For complete details, consult the Barber-Colman engineering sales office nearest you, see VSMF File, or write for catalog.

BARBER-COLMAN COMPANY

Aircraft and Missile Products Division

Dept. BG, 1422 Rock Street, Rockford, Illinois

SMART MAN

INVESTIGATE

your career potential with the **TITAN III** systems integration contractor. Martin Denver has challenging new career assignments at all science and engineering levels.

At Martin you'll find new avenues for professional achievement... exceptional advanced educational opportunities . . . excellent family living conditions.

Openings exist in:

- **SOLID PROPELLANTS**
- **GUIDANCE CONCEPTS**
- **AIRBORNE ANTENNAS**
- **FLIGHT MECHANICS**

To be considered for these and other specialties, submit your resume to:

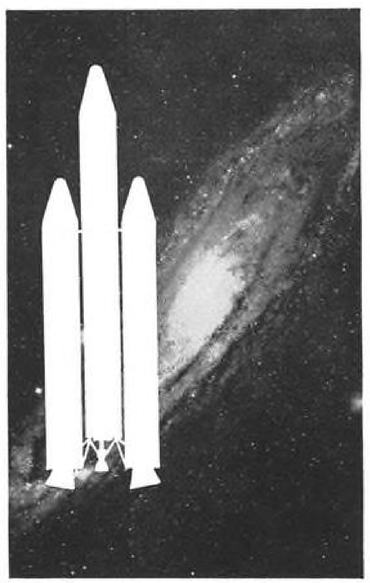
F. A. McGregor,
Mgr. of Personnel Staffing
Mail #A-251

MARTIN MARIETTA

DENVER DIVISION

P.O. Box 179-A-16, Denver, Colo. 80201

An equal opportunity employer



International Resistance Co., 1, 2, 3, 4
Leeds & Northrup Co., 3
P. R. Mallory & Co., Inc., 2, 4
Markite Corp., 4
Marsland Engineering, Ltd., 2
Mechatrol Div., Servomechanisms, Inc., 4
Mektron, Div. California General, Inc., 4
Microelectron, Inc., 1, 2, 3
Micro Products Corp., 3
Miniature Electronic Components Corp., 4
Molectro Corp.
Muirhead Co., Ltd., 3
New England Instrument Co., 3, 4
Ohmite Mfg. Co., 2, 3, 4
On Mark Engineering Co., 3
Pacific Resistor Co., 2, 3
Pyrofilm Resistor Co., 2, 3
Reon Resistor Corp., 2, 3, 4
Resistors, Inc., 2, 3, 4
Shallcross Mfg. Co., 3
Singer Metrics Div., The Singer Co., 3
Speer Resistor Div., Speer Carbon Co., 2
Sprague Electric Co., 1, 2, 3
Stackpole Carbon Co., 2, 4
Standard Telephones & Cables, Ltd., 1, 2, 3
TIC Div., Bowmar Instrument Corp., 4
Technology Instrument Corp. of Calif., 2, 3, 4
Texas Instruments Incorporated, Semiconductor Components Div., 2, 3
Ultronix, Inc., 2, 3
Ward Leonard of Canada, Ltd., 2, 3, 4
Weston Instruments & Electronics Div., Daystrom, Inc., 1, 2, 3, 4
Whiteley Electrical Radio Co., Ltd., 4
EDWIN L. WIEGAND CO., 2, 3. SEE ADV. P. 218, 219

Resolvers

Aviation Electric, Ltd.
Bendix Corp., The, Eclipse-Pioneer Div.
Bendix Corp., The, Montrose Div.
CSF-Compagnie Generale de Telegraphie Sans Fil.
Del Electronics Corp.
Farrand Controls, Inc.
Ford Instrument Co., Div. Sperry Rand Corp.
G-M Laboratories, Inc.
General Precision, Inc., Aerospace Group (Kearfott Div., Systems Div., Research Center)
General Scientific Equipment Co.
Giannini Controls Corp.
Harowe Servo Contorls, Inc.
IMC Magnetics Corp., Eastern Div.
IMC Magnetics Corp., Western Div.
Intercontinental Electronics Corp.
Ketay, Ltd.
Muirhead Co., Ltd.
Muirhead Instruments, Inc.
Norden Div., United Aircraft Corp.
R. B. Pullin & Co., Ltd.
Reeves Instrument Corp.
Societe D'Applications Generales D'Electricite et de Mecanique (SAGEM)
Sperry Gyroscope Co., Div. Sperry Rand Corp.
Vernitron Corp., Faringdale Div.
Vernitron Corp., Torrance Div.
Westinghouse Electric Corp.

Respirators

Binks Mfg. Co.
Davis Emergency Equipment Co., Inc.
Martindale Electric Co.
Scott Aviation Corp.
Westinghouse Electric Corp.

Restrictors, Hydraulic Systems

Benton Corp.
Fairey Co., Ltd., The
Flodyne Controls, Inc.
Fluid Regulators Corp.
Harris Mfg. Co., Inc.
Holley Carburetor Co.
Jarry Hydraulics, Ltd.
LEAR SIEGLER, INC., POWER EQUIPMENT DIV. SEE ADV. P. 94, 95
Messier S. A.
National Water Lift Co., Div. Pneumodynamics Corp.
Northwest Aerospace Co.
Ozone Metal Products Corp.
Pneu-Draulics, Inc.
Racine Hydraulics & Machinery, Inc.
Remm Co.
Ronson Hydraulic Units Corp.
Sterer Engineering & Mfg. Co.
Stewart Warner Corp., South Wind Div.
TACTAIR FLUID CONTROLS CORP. SEE ADV. P. 184

Resurfacing Service

Collins Microflat Co., Inc.
C. E. Johansson Gage Co., Swedish Gage Co. Affiliate
Tufcrete Co., Inc.

Retainers

Aero Mfg. & Machine Co., Inc.
Aetna Bearing Div., Parkersburg-Aetna Corp.
International Electronic Research Corp.
Kickhaefer Mfg. Co.

Reticles, Optical

ACR Electronics Corp.
Aero Service Corp., Div. Litton Industries, Inc.
American Optical Co.
Block Engineering, Inc.
Canadian Arsenals, Ltd.
Engis Equipment Co.
Fairchild Space and Defense Systems Div., Fairchild Camera and Instrument Corp.
General Electrodynamics Corp.
W. & L. E. Gurley
Infrared Industries, Inc.
Itek Corp.
Keuffel & Esser Co., Optics & Metrology Div.
Optical Coating Laboratory, Inc.
Photogrammetry, Inc.
Photographic Applications Co.
Trodyne Corp.

Reversers, Thrust

Douglas Aircraft Co., Inc., Missile & Space Systems Div.
Jervis Corp.
LAVELLE AIRCRAFT CORP. SEE ADV. P. 208
McGregor Mfg. Corp.
Pacific Universal Products Corp.
Pratt & Whitney Aircraft Div., United Aircraft Corp.
SNECMA

Rheostats

Aircraft Components, Inc.
Allen-Bradley Co.
James G. Biddle Co.
CTS of Canada, Ltd.
Clark Controller Co., The, Los Angeles Div.
Cutler-Hammer, Inc.
John Fluke Mfg. Co., Inc.
General Radio Co.
Gunnar Laboratories, Inc.
Hanson-Van Winkle-Munning Co.
Hardwick-Hindle, Inc.
Honeywell, Military Products Group
Lear Jet Corp.
P. R. Mallory & Co., Inc.
Ohmite Mfg. Co.
Ward Leonard of Canada Ltd.
Weser Flugzeugbau G.m.b.H.
Westinghouse Electric Corp.
Whiteley Electrical Radio Co., Ltd.

Rings

1. Clamping, Gas Turbine Engine, 2. Collector, 3. Hydraulic Backup, 4. Piston, 5. Retainer, 6. Scraper, 7. Sealing, 8. Shock Absorber, 9. Slip, 10. Wiper

Abscoa Industries, Inc., 3, 6, 7, 10
ADVANCED PRODUCTS CO., THE, 7. SEE ADV. P. 262
Aero Mfg. & Machine Co., Inc., 5
Aero-Stat Co., The, 7
Altamil Corp., Defense Products Sales, 7
Amco Mfg., Inc.
American Welding & Mfg. Co., 1, 5, 7
Associated Spring Corp., Ohio Div., 5
Auburn Mfg. Co., The, 3, 7, 10
Bancroft Industries (62) Ltd., 7
Canada Foundries & Forgings, Ltd.
Carmac Aviation, 7
Collectron Corp., 9
Continental Motors Corp., Aircraft Engine Div., 4
Cook Airtomic Div., Dover Corp., 4, 7
Dixon Corp., 3, 4, 7
Edgewater Steel Co., 1, 5, 7
Electrada Corp., The, Stillman Div., 7
Electro Miniatures Corp., 9
Electro-Tec Corp., 2, 9, 10
Engelhard Industries, Inc., Makepeace Div., 2, 9
Firth Brown, Ltd.
Fluorocarbon Co., The, 3, 4, 5, 7, 9, 10
Garlock, Inc., 3, 4, 5, 6, 7, 9, 10
General Devices, Inc., 2, 9, 10
Greene, Tweed & Co., 3, 4, 7, 10
Harrison Mfg. Co., 7
Haveg Industries, Inc., 7
Hydraulic Products Co., 3
Industrial Electric Reels, Inc., 2, 9
Jaros Aircrafters, 3, 5, 6, 7, 10
Johns-Manville, 6, 7, 10
Johnson, Matthey & Mallory, Ltd., 9
Kentucky Metals, Inc., 7
Koppers Co., Inc., Metal Products Div., 4, 6, 7
Lawrence Aviation Industries, Inc., 1, 2
J. M. Ney Co., The, 9
Nippert Electric Products Co., 9
PIC Design Corp., Sub. Benrus Watch Co., Inc., 5
Pacific Scientific Co., 9
Palnut Co., The, Div. United-Carr Fastener Corp., 5
Parker Seal Co., 3, 7, 10
Parts Mfg. Associates, Inc., 4, 7
Penn Fibre & Specialty Co., Inc., 4, 5
Perfect Circle Corp., 4, 5, 6, 7
Physical Sciences Corp., 7
Plastic & Rubber Products Co., 3, 7
Precision Piston Rings, Inc., 4, 7
R. B. Pullin & Co., Ltd., 9
Ramsey Corp., Sub. Thompson Ramo Wooldridge, Inc., 3, 4, 5, 6, 10
Raybestos-Manhattan, Inc., 3
Reynolds Tube Co., Ltd., 1
Richardson Co., The, 3, 7
Roberts-Toledo Rubber Co., The, 7, 8
Rogers Corp., 3
Russell Mfg. Co., The, 8
Sandon, Inc., 7
Seals, Inc., 7
Servonic Instruments, Inc., 9
W. S. Shamban & Co., 2, 4, 6, 7, 10
Simonds Saw & Steel Co., 5
Skyron Corp., 5
Skytronics, Inc., 3, 7
Sparta Mfg. Co., Div. U. S. Ceramic Tile Co., 3, 4, 7, 10
Specialty Products Corp., 1
Spincraft, Inc., 1, 2, 5, 7
Superior Spinning & Stamping Co., 2, 5
Tanner Engineering Co., 7
Tetrafluor, Inc.
Thermech Engineering Corp., 3, 4, 5, 7
Tinnerman Products, Inc., 5
Albert Trostel Packings, Ltd., 7, 10
UNITED AIRCRAFT PRODUCTS, INC., 7. SEE ADV. P. 4
Vacuum Technology, Inc., 7
Vernay Laboratories, Inc., 7
Vibraseal Corp., 7
Wellworthy, Ltd., 4, 5, 6, 7, 8
Westinghouse Electric Corp., 1, 2
Wickes Corp., U. S. Graphite Co. Div., 7
Wyman Gordon Co., 1

Riveting Equipment

ACF Industries, Inc., ACF Electronics Div.
Aircraft Materials, Ltd.
Aircraft Tools, Inc.
Chicago Pneumatic Tool Co.
Cleco Tools Div., Reed Roller Bit Co.
Gardner-Denver Co.
General Electro-Mechanical Corp.
B. F. Goodrich Aerospace & Defense Div., B. F. Goodrich Co.
Hannifin Press Co., Div. Parker-Hannifin Corp.
Hi-Shear Corp.
Jaros Aircrafters
George E. Kaercher Co.
Lamert Engineering Co., Inc.
Martin Aircraft Tool Co.
National Rivet & Mfg. Co.
Skyproducts
Edwin B. Stimpson Co., Inc.
Superior Pneumatic & Mfg., Inc.
Whitney Metal Tool Co.

Rivets

1. Blind, 2. Blind, Nylon, 3. Explosive, 4. General Purpose, 5. Special, 6. Tubular & Split

Accessories Manufacturers, Ltd., 5
Accles & Pollock, Ltd., 6
Aircraft Materials, Ltd., 1, 4
Allmetal Screw Products Co., Inc., 1, 2, 3, 4, 5, 6
ALUMINUM CO. OF AMERICA, 4, 5, 6. SEE ADV. P. 203, 204
Anti-Corrosive Metal Products, 4
Bancroft Industries (62) Ltd., 4
Bethlehem Steel Co., 4, 5
Bland Burner Co., The, Precision Threaded Products Div., 5
Century Fasteners Corp.
Champion Commercial Industries, Inc. 4
CHERRY RIVET DIV., TOWNSEND CO., 1, 5. SEE ADV. P. 128
Chicago Rivet & Machine Co., 6
Circon Component Corp.
Cooper Industries, Inc., 1, 4
Deutsch Fastener Corp., 1, 5
E. I. duPont de Nemours & Co., Inc., 1, 3
B. F. Goodrich Aerospace & Defense Div., B. F. Goodrich Co., 1
Hardware Specialty Co., Inc.
John Hassall, Inc., 4, 5
Hi-Shear Corp., 1, 3, 5
Huck Mfg. Co., 1, 4, 5
Jaros Aircrafters, 1, 2, 3, 4, 5, 6
Lamert Engineering Co., Inc., 1, 4, 5
Liberty Engineering & Sales, 1, 3, 4
Mercury Air Parts Co., Inc., 1, 2, 3, 4, 5, 6
National Rivet & Mfg. Co., 4, 5, 6
Niagara Screw & Bolt Co., Inc., 1, 4, 5, 6
Olympic Screw & Rivet Corp., 1, 4, 5
Parker Seal Co., 5
Republic Steel Corp., 4, 5
Screw Corp., 5
Sido, Ltd., 5
Skyproducts, 1, 4
Southco Div., South Chester Corp., 1, 2
Edwin B. Stimpson Co., Inc., 4, 5, 6
Swiss Electro Instruments Div., Pastushin Industries, Inc., 1, 2, 4, 5, 6
United Shoe Machinery Corp., Fastener Div., 1, 5
Voi Shan Mfg. Co., 4, 5

Rocket Motors

Advanced Dynamics, Inc.
Aeronutronic Div., Philco Corp., Sub. Ford Motor Co.
Aircraft and Missile Consultants
Amcel Propulsion Co., Div. Celanese Corp. of America
Atlantic Research Corp.
Bell Aerosystems Co., Div. Bell Aerospace Corp., A Textron Co.
Bermite Powder Co.
BLACK, SIVALLS & BRYSON, INC., FILAMENT STRUCTURES DIV. SEE ADV. P. 16
Boelkow-Entwicklungen
Bristol Aero-Industries, Inc., Winnipeg Div.
Bristol Aerojet, Ltd.
Canadian Arsenals, Ltd.
Canadian Bristol Aerojet, Ltd.
Canadian Flight Equipment Cobourg, Ltd.
Chromalloy Corp., Propellex Div.
Cleveland Pneumatic Div., Pneumodynamics Corp.
Curtiss-Wright Corp., Wright Aeronautical Div.
Firth Brown, Ltd.
B. F. Goodrich Aerospace & Defense Div., B. F. Goodrich Co.
Goodyear Aerospace Corp.
Haveg Industries, Inc.
Hercules Powder Co.
Ingersoll-Kalamazoo Div., Borg-Warner Corp.
Intercontinental Mfg. Co., Inc., Sub. the Lionel Corp.
Walter Kidde & Co., Inc.
Lear Siegler, Inc., Astro Structures Div.
Ling-Temco-Vought, Inc.
Lockheed Aircraft Corp.
Marquardt Corp., The
McCormick Selph Associates, Inc.
McGregor Mfg. Corp.
Mektron Div., California General, Inc.
National Electric Div., H. K. Porter Co., Inc.
North American Aviation, Inc., Rocketdyne Div.
Northern Research & Engineering Corp.
Northwest Aerospace Co.
Olin Mathieson Chemical Corp., Associated Products Operations
H. K. Porter Co., Inc., Electrical Div.
Pratt & Whitney Aircraft Div., United Aircraft Corp.
Pressed Steel Tank Co.
Propellant Technology Corp.
Reaction Motors Div., Thiokol Chemical Corp.
Rocket Power, Inc.
Rocket Research Corp.
Rolls Royce, Ltd.
Space Technology Laboratories, Inc.
Special Devices, Inc.
Stellardyne Laboratories, Inc.
Talley Industries, Inc.
THIOKOL CHEMICAL CORP. SEE ADV. P. 36
Thiokol Chemical Corp., Longhorn Div.
Thiokol Chemical Corp., Rocket Operations Center
Thiokol Chemical Corp., Wasatch Div.
United Aircraft Corp., Corporate Systems Center
U. S. STEEL CORP. SEE ADV. P. 110, 111
United Technology Center Div., United Aircraft Corp.
Value Engineering Co.
Vickers, Inc., Div. Sperry Rand Corp.
Westinghouse Electric Corp., Astronuclear Laboratory

Rocket Vehicles

Aerolab Development Co., Sub. Marshall Industries
Aeronutronic Div., Philco Corp., Sub. Ford Motor Co.
Aircraft Armaments, Inc.
All American Engineering Co.
Amcel Propulsion Co., Div. Celanese Corp. of America
Atlantic Research Corp.
Bell Aerosystems Co., Div. Bell Aerospace Corp., A Textron Co.
BLACK, SIVALLS & BRYSON, INC., FILAMENT STRUCTURES DIV. SEE ADV. P. 16
Boelkow-Entwicklungen
Bristol Aero-Industries, Inc., Winnipeg Div.
Bristol Aerojet, Ltd.
Canadian Arsenals, Ltd.
Canadian Bristol Aerojet, Ltd.
Chrysler Corp., Space Div.
Douglas Aircraft Co., Inc., Missile & Space Systems Div.
Douglas Aircraft Co., Inc., Tulsa Div.
General Dynamics/Astronautics
General Dynamics/Convair
Geophysics Corp. of America, Physics Research Div.
Goodyear Aerospace Corp.
Hawker Siddeley Canada, Ltd., Engineering Div.
Honeywell, Military Products Group
Intercontinental Mfg. Co., Inc., Sub. The Lionel Corp.

SPECTROLAB SOLAR INSTRUMENTS PROMINENT IN IQSY

Never before in the history of solar science have so many facets of our star been under study. Spectrolab is jusifiably proud of its participation in many of the research programs scheduled for 1964, the central year of the International Quiet Sun Year (IQSY). An interesting note—by the time the next 11-year sun spot cycle is completed, our men will be on the moon, if our experimental data proves valid.

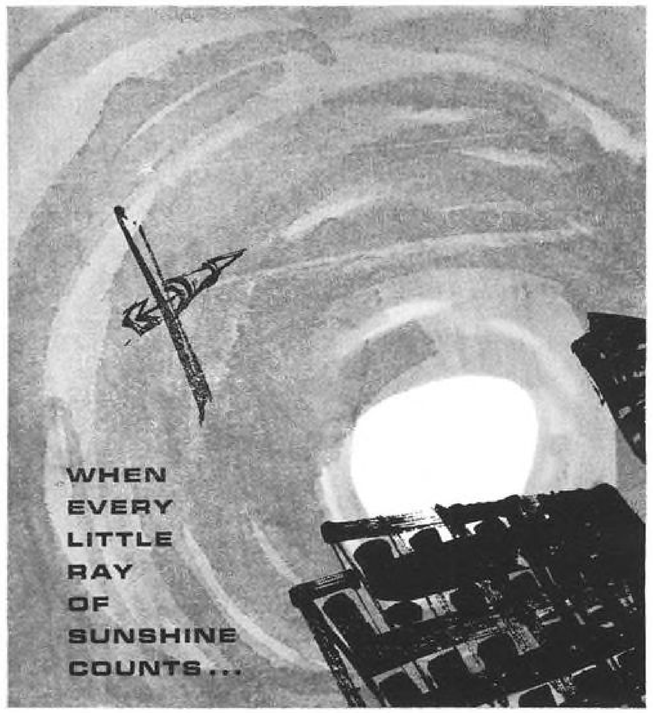
Spectrolab products fall into five separate, but interrelated, areas. Satellite power systems, solar systems, optical components, narrow bandpass filters, and rocket instruments all have one thing in common—they help us learn more about our sun.

Solar simulators at Spectrolab are big business. Under way right now is the final assembly of three large solar simulators to be used in conjunction with vacuum chambers for the testing of satellite components and structures. And at the same time, the Spectrosun Model X-25 Solar Simulator, a new laboratory instrument, is being built on a production line. In yet another area, a research staff is developing a plasma arc—heated radiative re-entry simulator.

In optical design and fabrication, Spectrolab has concentrated on developing its ability to take on jobs that other people have avoided. Large parabolic mirrors, schlieren windows, off-axis mirrors, and deep aspheric lenses, are typical products. Metal mirrors, made by electro forming techniques, are in regular production.

Spectrolab multilayer dielectric filters are used throughout the world for laboratory and field experiments in solar physics. Most recently, a selected group of filters was combined with the Spectrolab Model RD-100 Rocket Photometer System for a high altitude solar energy measurement probe. Other new developments include ultra-narrow bandpass filters (1.5-2.5 Å) for laser applications.

For more information on these programs and other activities of Spectrolab, contact Spectrolab Field Engineering Department, 12484 Gladstone Avenue, Sylmar, California.



SOLAR POWER BY SPECTROLAB

Orbiting satellites need a reliable means of gathering solar power to transmit their valuable data back home—and continue to do so. That's one important reason so many programs use Spectrolab solar cell arrays and auxiliary power systems.

NASA'S Orbiting Astronomical Observatory (OAO) will take its big "look-see" with the assistance of Spectrolab solar cell arrays. The OAO satellite is under prime contract to Grumman Aircraft Engineering Corporation from NASA/Goddard Space Flight Center. Uniquely qualified to participate in this program, Spectrolab has fabricated auxiliary power systems using over **a million and a half** cells for important missions in the last three years alone.

More than just meeting specs, Spectrolab designs to the ultimate in environmental reliability. Each high-quality solar cell used is isolated from its neighbors—anchored to **stay** on the specially designed, lightweight substrates. Exclusive formulas, such as Solabond® resin and Solakote® optically coated filter glass add to the performance and reliability of the solar cell panel. Patented assembly techniques provide a new margin of protection against thermo-mechanical stresses in even the most severe environments.

Spectrolab-designed systems producing as much as 825 watts per vehicle are typical projects now in production. But let's hear about **your** project. For quality components, complete systems, or long-range research, write to Spectrolab.

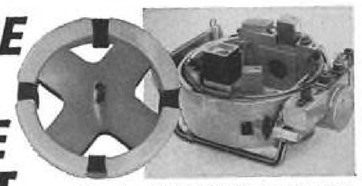
spectrolab
DIVISION OF TEXTRON ELECTRONICS, INC.
12484 Gladstone Ave., Sylmar, California • Telephone: 365-4623. Area Code: 213. TWX: 213-764-5923

SPACE POWER SYSTEMS • SOLAR CELL ARRAYS • SOLAR CELL TESTING EQUIPMENT • LARGE ASPHERIC OPTICS • SPECTROSUN* SOLAR SIMULATORS • NARROW BAND-PASS FILTERS • SPECTRAL MEASURING INSTRUMENTS • SPECTROSCAN* MONOCHROMATORS • SOUNDING ROCKET INSTRUMENTATION • ELECTRO-FORMED OPTICS • OPTICAL DESIGN SERVICES

Senior Engineers and Technicians: Investigate the long-range opportunities at Spectrolab.
An equal opportunity employer

Circle Number 226 on Reader-Service Card

WHEN PRECISE CONTROL IS AN ABSOLUTE REQUIREMENT



Aeroflex ART-30 Stabilized Camera Platform and its Brushless Torquer.

The world's largest manufacturer of stabilized aerial camera mounts has developed a DC Torque Motor of outstanding accuracy and sensitivity — that can be used as a direct drive servo motor, low speed, high accuracy tachometer, instrument drive, valve-motor, missile control surface actuator, throttle control, business machine and computer drive.

This torquer has only two parts — a solid rotor and a toroidal wound stator — there are no brushes, no commutator. It is explosion-proof and has virtually unlimited service life. It meets full military environmental qualifications and exhibits no motor ripple; therefore, allows infinite resolution.

The Aeroflex DC Torque Motor is available in circular or segmented configurations in capacities from 0.1 oz. in. to 75 lb. ft., with rotational limits to ±60 degrees.

For more information on this unique drive, write Dept. RB-68.

AEROFLEX LABORATORIES
INCORPORATED
SOUTH SERVICE ROAD · PLAINVIEW, NEW YORK
STABILIZED PLATFORMS · GYROS · CABLE ISOLATING SYSTEMS · ANALOG COMPUTERS

Circle Number 229 on Reader-Service Card

MCDONNELL ELECTRONICS

ANNOUNCES
A NEW CONCEPT IN
DYNAMIC DATA REDUCTION



The Analog Signal Correlator*

for providing, in real time, a dynamic measurement of coherence between any two random signals. Data analysis Applications include: Multi-Variant Correlations, Signal Detection, Pattern Recognition, Propagation Velocity, Structural Responses, Logarithmic Decrements, Fluctuating Pressure Tests, Adaptive Control, Speech Recognition and Nyquist Stability Criterion. *Patent Pending

For operational parameters, price and delivery schedule on the McDonnell Analog Signal Correlator, write:

W. W. Toole
Sales Manager
McDonnell EED
St. Louis, Missouri, 63166

Circle Number 230 on Reader-Service Card



Always "ON"... Always Visible

ISOLITE®

SELF-LUMINOUS, ISOTOPE-EXCITED

EXIT MARKERS*

FOR CIVILIAN & MILITARY AIRCRAFT

No external power source, crash-sensitive switches or circuitry required . . . visible in the dark at 150 feet.

- Meet FAA, ATA Task Force Committee & AEC Requirements
- 10 or More Years of Maintenance-Free Operation
- Simple, Low Cost Installation
- Legible Without Dark Adaptation
- No External Radiation
- No AEC Specific License Required

*U. S. Patent No. 2,953,684

US RADIUM

For Literature and Detailed Specifications, Write:

UNITED STATES RADIUM CORPORATION
DEPT. AW-12 MORRISTOWN, NEW JERSEY

Circle Number 231 on Reader-Service Card

Hughes Aircraft Co., 3
Hycon Mfg. Co., 3, 4
Infrared Industries, Inc., 3, 4
Intectron, Inc., 4
International Tel. & Tel. Corp.
Itek Corp., 2, 4
Keuffel & Esser Co., Optics & Metrology Div., 3, 4
Kollmorgen Corp., 3, 4
Laboratory For Electronics, Inc., 2
LITTON INDUSTRIES, INC., ELECTRON TUBE DIV., 4. SEE ADV. P. 174
Measurement Systems, Inc., 3, 4
Melchior Engineering Corp.
Metal Bellows Corp., 1
Minnesota Mining Mfg Co., Revere Wollensak Div., 3, 4
Molectro Corp., 1, 2, 3, 4
Northrop Corp., 3, 4
Optical Coating Laboratory, Inc., 3, 4
Philco Corp., Sub. Ford Motor Co., 3
Pyrotector, Inc., 3, 4
Radio Corp. of America, 3
Raytheon Co., Microwave & Power Tube Div., 3
Razdow Laboratories, Inc. 4
Republic Lens Co., Inc., 3, 4
Rhodes & Bloxsom, 1, 2
Rosemount Engineering Co., 1
Santa Barbara Research Center, 3
Semi-Elements, Inc., 3, 4
Servo Corp. of America, 3
Simmonds Precision Products, Inc., 2
Space Technology Laboratories, Inc., 3
Specialties, Inc., 1
SPECTROLAB, DIV. TEXTRON ELECTRONICS, INC. 4. SEE ADV. P. 226
Task Corp., 1
Te Co., The, 3, 4
Tracerlab, Div. Laboratory For Electronics, Inc., 2
United Sensor & Control Corp.
Varo, Inc., 3, 4
Viewlex, Inc., 4
VIRDON DIV., GEOPHYSICS CORP. OF AMERICA, 2. SEE ADV. P. 262
Wang Laboratories, Inc., 4
Weldotron Corp., 4
Western Semiconductors, Inc., 3
Westinghouse Electric Corp., 2

Sensors, Voltage

Allied Research Associates, Inc.
Autronics Corp.
Beckman Instruments, Inc., Helipot Div.
California Instrument Corp.
Electronic Products Corp.
Electronic Specialty Co.
Engineered Magnetics, Div. Gulton Industries, Inc.
Frost Engineering & Development Corp.
G-V Controls, Inc.
Garrett Mfg., Ltd., Sub. The Garrett Corp.
General Electric Co., Instrument Dept.
General Precision, Inc., Aerospace Group (Kearfott Div., Systems Div., Research Center)
Genisco, Inc.
Hartman Electrical Mfg. Co.
Hi-G, Inc.
Hurletron, Inc., Hurletron Control Products Div.
Kinetics Corp.
Kurz & Root Co., Inc.
Mace Corp.
Magnetic Circuit Elements, Inc.
MARTIN CO., DIV. MARTIN-MARIETTA CORP. SEE ADV. P. 224
Peschel Instruments, Inc.
Standard Products, Inc.
Tempo Instruments, Inc.
United Control Corp.
WacLine, Inc.
Westinghouse Electric Corp.
Weston Instruments & Electronics Div., Daystrom, Inc.
Wheaton Engineering, Div. Hurletron, Inc.

Separation Systems

Aircraft and Missile Consultants
Bulova Systems and Instruments Div. (Incl. Bulova R & D Laboratories, Bulova Watch Co., Inc.)
Cook Electric Co., Technological Center Div.
Dels Tumbling Service
EXPLOSIVE TECHNOLOGY, INC. SEE ADV. P. 272
Garrett Corp., The
Hi-Shear Corp.
Wallace O. Leonard, Inc.
Ling-Temco-Vought, Inc.
Marquardt Corp., The
MARTIN CO., DIV. MARTIN-MARIETTA CORP. SEE ADV. P. 224
McCormick-Selph Associates, Inc.
Northern Research & Engineering Corp.
Ordnance Engineering Associates, Inc.
Quantic Industries, Inc.
Seaton-Wilson Mfg. Co.
Stearns Roger Corp.
Sundstrand Aviation-Denver
Talley Industries, Inc.
Universal Match Corp., Unidynamics Div.

Separators

1. Air-Water, 2. Fuel-Water, 3. Oil

AIR-MAZE DIV., ROCKWELL STANDARD CORP., 3. SEE ADV. 3RD COVER
AIRCRAFT POROUS MEDIA, INC., SUB. OF PALL CORP., 3. SEE ADV. P. 157
Bendix Corp., The, Pioneer-Central Div., 1
Bendix Corp., The, Utica Div., 3
Bethlehem Steel Co., 2, 3
Bowser-Briggs Filtration Div., Bowser, Inc., 2, 3
Cambridge Filter Corp., 1
Cardair, Div. Marmon-Herrington Co., Inc., 1
Donaldson Co., Inc., 1, 2, 3
Dynamic Filters, Div. Michigan Dynamics, Inc., 2
Fairchild Stratos Corp., Stratos Div., 1
Firestone Tire & Rubber Co., 2
Fram Aerospace, Div. Fram Corp., 1, 2, 3
Garrett Corp., The, 1
Garwin, Inc., 3
Hamilton Standard Div., United Aircraft Corp., 1, 2, 3
Hannifin Pneumatic Div., Parker-Hannifin Corp., 1
Karnish Instruments, Inc., 3
Walter Kidde & Co., Inc., 1
LAVELLE AIRCRAFT CORP., 1. SEE ADV. P. 208
Lockheed Precision Products, Ltd., 2
Metal Bellows Corp.
Michigan Dynamics, Inc., 2
Nooter Corp., 1, 2, 3
Normalair (Canada), Ltd., 1
Pall-Trinity Micro Corp., Sub. of Pall Corp., 1
Roper Hydraulics, Inc., Aviation Products Div., 1, 3
Henry Spen & Co., Inc., 1, 2
Stewart-Warner Corp., Alemite Div., 1
Stewart-Warner Corp., South Wind Div., 1
Sundstrand Aviation-Denver, 1
Swiss Electro Instruments, Div. Pastushin Industries, Inc., 2, 3
Warner Lewis Div., Fram Canada, Ltd., 1, 2, 3
Wilkerson Corp., 1
Zurn Industries, Inc., 3

Servos

ACEC
ACE Industries, Inc.
A. I. R. Corp.
Aerojet-General Corp.
American Brake Shoe Co.
American Scientific Corp.
Antlab, Inc.
Astronautics Corp. of America
Astrosystems, Inc.
Aviation Electric, Ltd.
Ball Bros. Research Corp.
Beckman Instruments, Inc., Helipot Div.
Belock Instrument Corp.
Bendix Corp., The, Bendix Pacific Div.
Bendix Corp., The, Eclipse-Pioneer Div.
Bendix Corp., The, Montrose Div.
Bendix Corp., The, Pioneer-Central Div.
Boonshaft & Fuchs, Inc.
Bowmar Instrument Corp.
Canadian Aviation Electronics, Ltd.
Carco Electronics
Cedar Engineering Div., Control Data Corp.
CHANDLER EVANS CORP. SEE ADV. P. 164
Cincinnati Milling and Grinding Machines, Inc.
CLIFTON PRECISION PRODUCTS CO., INC. SEE ADV. P. 114, 115
Clipper Gear & Machine Co.
G. L. Collins Corp.
Computer Sciences, Inc., Sub. telecomputing Corp.
Conductron Corp.
Consolidated Ohmic Devices, Sub. Consolidated Airborne Systems
Contraves Italiana S. p. A.
Control Technology Co., Inc.
A. C. Cossor, Ltd., Cossor Electronics, Ltd.
Cubic Corp.
Curtiss-Wright Corp., Curtiss Div.
Dalmo Victor Co., Textron, Inc.
Datex Corp., Sub. Giannini Controls Corp.
Daystrom, Ltd.
Del Electronics Corp.
Edcliff Industries, Sub. General Laboratories
Electric Indicator Co., Inc.
Electronic Systems Div., Antenna Systems, Inc.
Esterling-Angus Instrument Co., Inc.
Exactel Instrument Co.
Fairey Co., Ltd., The
J. W. Fecker Div., American Optical Co.
Ford Instrument Co., Div. Sperry Rand Corp.
G-M Laboratories, Inc.
Gap Instrument Corp.
Garrett Corp., The
Garwin, Inc.
General Dynamics/Electronics—Rochester
General Electric Co., Aircraft Accessory Turbine Dept.
General Precision, Inc., Aerospace Group (Kearfott Div., Systems Div., Research Center)
General Precision, Inc., Information Systems Group (Commercial Computer Div.)
General Precision, Inc., Information Systems Group (Librascope Div.)
Goodyear Aerospace Corp.
Guidance Technology, Inc.
Gulton Industries, Inc.
Hamilton Standard Div., United Aircraft Corp.
Harowe Servo Controls, Inc.
H. M. Hobson, Ltd.
Holley Carburetor Co.
Honeywell, Military Products Group
Hycon Mfg. Co.
Hydra-Power Corp.
International Tel. & Tel. Corp.
Ketay, Ltd.
Kollmorgen Corp.
Kollsman Instrument Corp., Sub. Standard Industries, Inc.
Kollsman Motor Corp., Sub. Standard-Kollsman Industries
LEAR SIEGLER, INC., POWER EQUIPMENT DIV. SEE ADV. P. 94, 95
Lear Siegler GmbH
Ling-Temco-Vought, Inc.
Lockheed Precision Products, Ltd.
Lundy Electronics & Systems, Inc.
F. B. MacLaren Co., Inc.
Markite Corp.
Marquardt Corp., The
MARTIN CO., DIV. MARTIN-MARIETTA CORP. SEE ADV. P. 224
McQuiston Associates
Measurement Systems, Inc.
Messier S.A.
Midwestern Instruments, Inc.
Moog Servocontrols, Inc.
Muirhead Co., Ltd.
Muirhead Instruments, Inc.
National Water Lift Co., Div. Pneumodynamics Corp.
Louis Newmark, Ltd.
Norden Div., United Aircraft Corp.
North Atlantic Industries, Inc.
Northrop Corp.
John Oster Mfg. Co., Avionic Div.
Power-Tronic Systems, Inc.
R. B. Pullin & Co., Ltd.
Reeves Instrument Corp.
Rocket Jet Engineering Corp.
Rucker Co., The
S. A. M. M.
Sanders Associates, Inc.
Sciaky Brothers
Scientific-Atlanta, Inc.
Servo Corp. of America
Servo Development Corp.
Servo-Tek Products Co.
Societe Alsacienne de Constructions Mecaniques, Dept. Energie Nucleaire Telecommunications—Electronique
Societe d'Applications Generales d'Electricite et de Mechanique (Sagem)
Solid State Instruments Corp., Sub. of Kollmorgen
Sparton Corp., Sparton Electronics Div.
Specialties, Inc.
Sperry Gyroscope Co., Div. Sperry Rand Corp.
Sperry Gyroscope Co., Ltd.
Sperry Rand Corp., Sperry Phoenix Co.
Tapco Div., Thompson Ramo Wooldridge, Inc.
M. Ten Bosch, Inc.
Thermovolt Instruments, Ltd.
Theta Instrument Corp.
Thomson-Houston Div., Systems Electronique Radars
Trio Laboratories, Inc.
United Data Control, Inc., Sub. United Control Corp.
Vacco Valve Co.
Venitron Corp., Farmingdale Div.
Venitron Corp., Torrance Div.
Vickers, Inc., Sperry Rand Corp.
Warner Electric Brake & Clutch Co.
Westinghouse Electric Corp.
Weston Hydraulics, Ltd., Sub. Borg-Warner Corp.

Sets, Rivet

Bethlehem Steel Co.
Hi-Shear Corp.
Jaros Aircrafters
Lamert Engineernig Co., Inc.
Martin Aircraft Tool Co
Skyproducts
Edwin B. Stimpson Co., Inc.
Superior Pneumatic & Mfg., Inc.
Whitney Metal Tool Co.

Sextants

1. Bubble, 2. Periscopic

A. I. R. Corp., 1, 2
Baird-Atomic, Inc., 1, 2
Keuffel & Esser Co., Optics & Metrology Div., 1, 2
Kollsman Instrument Corp., Sub. Standard Kollsman Industries, Inc., 1, 2
MARTIN CO., DIV. MARTIN-MARIETTA CORP., 2. SEE ADV. P. 224
Northrop Corp., 2
S. Smith & Sons England, Ltd., Smiths Aviation Div., 2
Weems Systems of Navigation, Inc., 1

Shackles

Aerospace Products, Inc.
American Chain & Cable Co., Inc., American Chain Div.
Bancroft Industries (62), Ltd.
Canada Foundries & Forgings, Ltd.
Canadair, Ltd.
Crosby-Laughlin Div., American Hoist & Derrick Co.
Eastern Rotocraft Corp.
Freeman Co., The
Jaros Aircrafters
Qualified Air Components

Shafts

1. Cam, 2. Crank, 3. Flexible, 4. Propeller, 5. Rigid, 6. Turbine, 7. Valve Rocker

Advance Gear & Machine Corp., 5
American Standard Products, Inc., 5
Barbour-Stockwell Instruments, Div. Curtis & Marble Machine Co., 3
Bendix Corp., The, Utica Div., 3
Bethlehem Steel Co., 1, 5
Canada Foundries & Forgings, Ltd., 6
CATERPILLAR TRACTOR CO., DEFENSE PRODUCTS DEPT., 1, 2. SEE ADV. P. 22
Clipper Gear & Machine Co., 5
Continental Motors Corp., Aircraft Engine Div., 1, 2, 7
Continental-Emsco Co., Div. Youngstown Sheet & Tube Co., 5
Curtiss-Wright Corp., Curtiss Div., 3, 5
Ex-Cello-O Corp., 6
Ex-Cello-O Corp. of Canada, Ltd., 5, 7
Geartronics Corp., Actuator Products Div. & Mass Gear Div., 3
Hupp Corp., Hupp Aviation Div., 6
Hydraulic Products Co., 4
Joly Engineering, Ltd., 1, 2
Jones Motrola Corp., 3
Kelsey Hayes Co., Steel Products Engineering Co., 3, 5
Ladish Co., 1, 2, 5
La Vezzi Machine Works, 5
National Forge Co., 4, 6
PIC Design Corp., Sub. Benrus Watch Co., Inc., 5
Parts Mfg. Associates, Inc., 5, 6
Raytee Co.
Research Development Mfg., Inc., 5
SNECMA, 6
Servwell Products Co., 3
F. W. STEWART CORP., 3. SEE ADV. P. 252
STOW MFG. CO., 3. SEE ADV. P. 246
Szemco, Inc., 3, 4, 6, 7
Teleflex, Inc., 3
Thiokol Chemical Corp., Wasatch Div., 4
United Aircraft of Canada, 1, 2, 4
Western Gear Corp., Precision Products Div., 3, 6
Westinghouse Electric Corp., 4, 6
Wyzenbeek & Staff, Inc., 3
York Gears, Ltd., 5
Zurn Industries, Inc., 3

Shakers, Control Stick

U. S. Science Corp.

Shaping Equipment

Ex-Cell-O Corp.
C. E. Johansson Gage Co., Swedish Gage Co., Affiliate
Lennox Tool & Machine Builders
South Bend Lathe, Inc.

Shaping Service

Advanced Dynamics, Inc.
CATERPILLAR TRACTOR CO., DEFENSE PRODUCTS DEPT. SEE ADV. P. 22
Chrysler Corp., Defense Space Group
Chrysler Corp., Missile Div., Florida Missile Operations
Ellanef Machine Tool Co., Inc.
Ex-Cell-O Corp.
Ex-Cell-O Corp. of Canada, Ltd.
Federal Machine Co., Inc.
Hanlon & Wilson Co.
Harrington Tool & Die Co., Ltd.
Hupp Corp., Hupp Aviation Div.
Jarry Hydraulics Ontario, Ltd.
C. E. Johansson Gage Co., Swedish Gage Co., Affiliate
Kellett Aircraft Corp.
Ladish Co.
Lennox Tool & Machine Builders
McDONNELL AIRCRAFT CORP. SEE ADV. P. 230
Rockwell Standard Corp., Stamping Div.
Universal Match Corp., Unidynamics Div.

Shearing Equipment

Buffalo Forge Co.
Hanlon & Wilson Co.
Lennox Tool & Machine Builders
Skyproducts
Whitney Metal Tool Co.

First choice of the rocket and missile industry...



Three superlative Marsh products are widely used and approved by the aircraft and missile industry:



MARSH Pressure Gauges... because they combine the most advanced features ever found in pressure, vacuum and compound gauges. There is a Marsh Gauge for every conceivable application.



MARSH Needle and Solenoid Valves... because they are guaranteed to give micrometer regulation at their respective pressure ranges—up to 10,000 psi for needle valves. Both lines are complete and proven.



MARSH Dial Thermometers... because they offer the accuracy a precision industry demands. Both vapor tension and bimetal lines are available in wide temperature ranges, dial sizes, patterns and finishes.





All Marsh products available with AND threads

MARSH *Write for New Condensed Catalog*

MARSH INSTRUMENT COMPANY, *Division of Colorado Oil and Gas Corporation,* Dept. 27, Skokie, Ill
Marsh Instrument & Valve Co., (Canada) Ltd., 8407 103rd St., Edmonton, Alberta • Branch Plant: 1121 Rothwell St., Sect. 15, Houston, Tex. • Eastern Seaboard Warehouse: 1209 Anderson Ave., Fort Lee, N.J.

Circle Number 234 on Reader-Service Card



CUT IT, WRAP IT!

NETIC AND CO-NETIC MAGNETIC SHIELDS APPLIED IN SECONDS

Guard against performance degradation from unpredictable magnetic field conditions to which your equipment may be exposed. Economical CO-NETIC and NETIC Magnetic Shielding Foils are adaptable to any size or shape components. Simply cut with ordinary scissors. Available in continuous lengths on rolls up to 15" wide. Furnished in final annealed state.

Co-Netic and Netic alloys are not affected significantly by vibration or shock, assuring components performance repeatability over a wider range of flux intensities. They are also non-retentive and do not require periodic annealing. When grounded, they shield electrostatic as well as magnetic fields. They have many applications in satellite instrumentation and many other magnetically sensitive devices.

MAGNETIC SHIELD DIVISION
Perfection Mica Co. Phone EVerglade 4-2122
1322 North Elston Avenue, Chicago 22, Illinois

Antennas

OUR SPECIALTY!

We enjoy doing the difficult jobs requiring low-cost engineering, precision machining and assembly of electrical and mechanical devices.

AT-141A/ARC
for airborne communication sets. 225-400 megacycles.





AT-536/ARN-32
Cavity type VHF marker beacon receiving. Horizontally polarized.



AT-256A/ARC
Omni-directional. For UHF command sets. 225 to 400 megacycles.



AN-104B
for radio sets ARC-3, ARC-36 & ARC-49. 100-156 megacycles.

AT-740/A
For UHF airborne Tacan and IFF sets. 960 to 1220 megacycles. Omni-directional.



AT-209/ARR-26	Antenna, 162-175 m/c
AT-214/APR	Antenna, 5,000-10,000 m/c
AS-125/APR	Antenna, 1,000-3,500 m/c
AT-929/APR	Antenna, 80-320 m/c
AB-620/A	Antenna Mast, Lightning Arrestor Type.

Special Antennas to your design.

We invite your inquiries and orders for prompt and efficient service.

R. A. MILLER INDUSTRIES, INC.
GRAND HAVEN, MICH.
AREA 616 PH. 842-9450

Circle Number 232 on Reader-Service Card

Circle Number 233 on Reader-Service Card



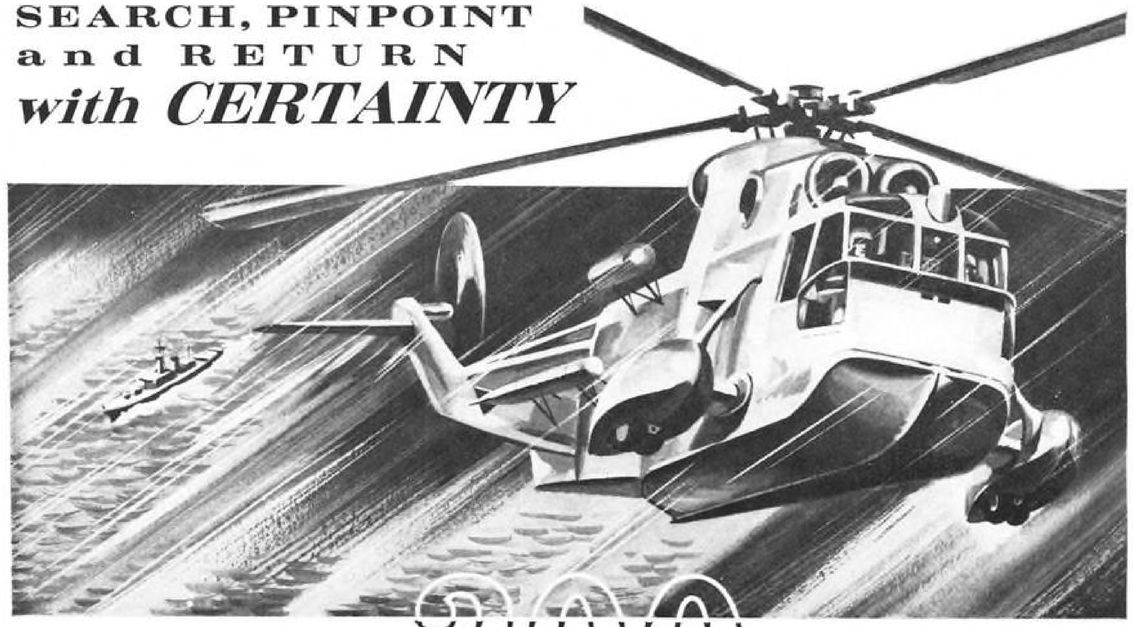
10943-CH

Chandler's unique combination of capabilities and facilities is the vital key to producing precision standard and special fasteners. Broad knowledge, coupled with efficient production equipment, skilled engineers and advanced technological techniques are the reasons why Chandler fasteners, from standard hex cap screws to special aircraft bolts, are produced to meet rigid specifications of fit and uniformity.

producing precision fasteners is an art ...at chandler

CP **chandler products corporation** • 1491 chardon road • cleveland 17, ohio

SEARCH, PINPOINT
and RETURN
with CERTAINTY



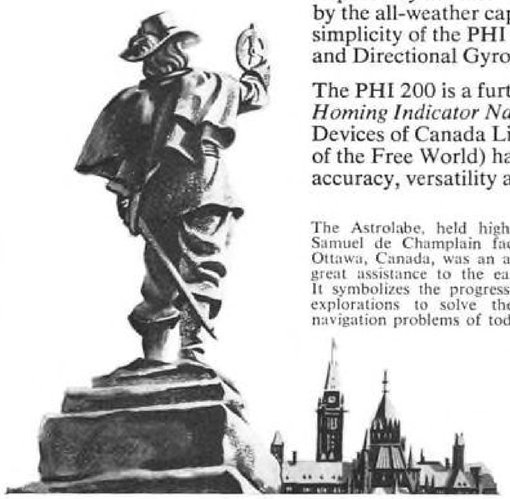
the PHI 200

HELICOPTER NAVIGATION SYSTEM

Navigation problems of Anti-Submarine-Warfare Helicopters are complicated by constantly changing positions of submerged submarines and the movement of base ships or convoy. These problems are efficiently solved with the PHI 200 and its specialized A.S.W. System Options.

The multiplicity and complexity of search patterns plus the difficulties imposed by adverse weather conditions are mastered by the all-weather capability of helicopters combined with the operational simplicity of the PHI 200. Input sources of the PHI 200 are Doppler and Directional Gyro, Tacan and Magnetic Compass or Inertial Platform.

The PHI 200 is a further development of the *Position and Homing Indicator Navigation System* designed and developed by Computing Devices of Canada Limited. The PHI systems (adopted by 10 Nations of the Free World) have received universal acclaim for their reliability, accuracy, versatility and low maintenance costs.



The Astrolabe, held high in the hand of the statue of Samuel de Champlain facing the Parliament Buildings in Ottawa, Canada, was an ancient navigational instrument of great assistance to the early explorers of the new world. It symbolizes the progressive spirit of this company in its explorations to solve the new and vastly complicated navigation problems of today.



Computing Devices
OF CANADA LIMITED
P. O. BOX 508 • OTTAWA 4 • CANADA
AN AFFILIATE OF THE BENDIX CORPORATION

CIRCLE 238 ON READER SERVICE CARD

Airwork
CORPORATION

MILLVILLE, N.J., U.S.A. 609-825-6000 TWX: 609-825-7951

FACTORY AUTHORIZED DISTRIBUTOR

FOR AVIATION

- AC SPARK PLUG
- AEROJET GENERAL
- AEROQUIP
- AIRBORNE ACCESSORIES
- BENDIX
  - Eclipse-Pioneer
  - Filter
  - Friez
  - Montrose
  - Pacific
  - Pioneer-Central
  - Products Aero-space
    - Landing Gear
    - Stromberg
  - Red Bank
  - Scintilla
  - Utica
- CHANDLER EVANS
- CONTINENTAL MOTORS
- CO-OPERATIVE INDUSTRIES
- DELCO-REMY
- GENERAL ELECTRIC
  - Lamp Division
- GENERAL LOGISTICS
- GLIDDEN
- B. F. GOODRICH
- GRIMES
- HAMILTON STANDARD
- HOLLEY CARBURETOR
- JEPPESEN
- LEAR SIEGLER
  - (Pwr. Equip. Div.)
  - Jack & Heintz
  - Romec
- LUCAS-ROTAX
- LYCOMING
- MARMAN
- MARVEL-SCHEBLER
- MITCHELL
- NARCO
- NEW YORK AIR BRAKE
- PACKARD CABLE
- PESCO PRODUCTS
- PRATT & WHITNEY AIRCRAFT
- ROLLS-ROYCE
- SCOTT AVIATION
- STEWART WARNER
- THOMAS & BETTS
- UNITED AIRCRAFT OF CANADA

—AND OTHER LEADING LINES—

FOR AEROSPACE

- BENDIX ELECTRICAL CONNECTORS
- BIRTCHER
- CONTINENTAL CONNECTORS
- LEACH
- ZIPPERTUBING

FACTORY AUTHORIZED OVERHAUL AGENCY

CONTINENTAL MOTORS CORPORATION • ROLLS-ROYCE OF CANADA, LTD.
PRATT & WHITNEY AIRCRAFT • LYCOMING DIVISION OF AVCO MFG. CO.
• POOL AGENCY FOR BRISTOL SIDDELEY VIPER 521 ENGINES

■ATLANTA, GA. 404-766-3605 ■BOSTON, MASS. 617-569-3503 ■CHICAGO, ILL. (NEW) 312-437-5230 ■CLEVELAND, OHIO 216-BE 4-8822
■DETROIT, MICH. 313-LA 1-2300 ■MIAMI, FLA. 305-885-2551 ■MILLVILLE, N.J. 609-825-6000
■NEWARK, N.J. 201-TA 4-3400 ■NEW YORK, N.Y. 212-341-1000 ■PHILADELPHIA, PA. 215-HO 4-2200 ■WASHINGTON, D.C. 703-HU 1-9400

Circle Number 242 on Reader-Service Card

SIMPLIFY WIRE ASSEMBLY



CODE MARK YOUR OWN WIRE WITH A KINGSLEY WIRE-MARKING MACHINE

Now you can permanently mark each wire with its own individual circuit number, at any desired spacing. You can reduce wire inventories because only one color of wire is necessary for as many codes as desired.

Simplify your assembly methods and speed production with the same machine that has proved so successful in the aircraft industry. Special machines are available for marking flexible vinyl sleeves.

Write for complete information.

KINGSLEY MACHINE CO.
850 Cahuenga, Hollywood 38, Calif.

Circle Number 241 on Reader-Service Card



PARTS, COMPONENTS, TOOLS, FIXTURES & RAW MATERIALS FOR AIRCRAFT & MISSILES

Anglo American serves as a convenient and economical single source of components, equipment and materials for aircraft and missiles. Write, cable, telex or telephone if you require: airframe components & parts • engines & parts • instruments • wheels, brakes & tires • seals • rubber hose & ducting • radio & electrical parts • control cables, fittings & terminals • electronic components & parts • tools, fixtures & equipment for operation, maintenance & overhaul • raw materials to specification of aircraft, power plants, missiles & missile launchers.

Missile, USAF & Navy standard parts are in accordance with AN, MS, AN-6 DIGIT, NAS, NAF & AF specs. Raw materials with Federal, Mil-Spec or AMS.

ANGLO AMERICAN AVIATION CO.
P. O. Box 149, Burbank, California, U. S. A.
TELEX: USA 06-7390 • TELEPHONE: Area Code 213 849-5716 • CABLES: AMTRADE • TWX: 213-846-3216

Inquiries from U. S. manufacturers seeking increased export sales are invited.

Circle Number 243 on Reader-Service Card

Stewart Engineering Co., 18
Stewart Warner Corp., South Wind Div., 8, 15, 20, 33
Stromberg Carlson, Div. General Dynamics Corp., 3, 11
Sundstrand Aviation-Denver, 2, 3, 4, 24
Swiss Electro Instruments, Div. Pastushin Industries, Inc., 2, 3, 4, 6, 15, 16, 19, 20, 32
Switchcraft, Inc., 3, 10, 12, 19, 23, 29, 31
Sylvania Electric Products, Inc., Sub. General Telephone & Electronics Corp., Lighting Products Div., 16, 17, 23, 30
Sylvania Electric Products, Inc., Sub. General Telephone & Electronics Corp., Sylvania Semiconductor Div., 18
Sylvania Electric Products, Inc., Microwave Devices Div., 18
Sylvania Electric Products, Inc., Special Products Div., 3, 13, 14, 16, 17, 19, 27, 28, 29, 30, 33
Sylvania Electronic Systems, Div. Sylvania Electric Products, Inc., 1, 18, 21
Systems Engineering Labs., Inc., 21
TIC Div., Bowmar Instrument Corp., 24
TACTAIR FLUID CONTROLS CORP., 6, 8, 15, 33. SEE ADV. P. 184
Talley Industries, Inc., 5
Tamar Electronics, Inc., 20
Tavco, Inc., 2, 20, 28, 33
Technical Development Co., 6, 15
Technical Oil Tool Corp., 9
Teddington Aircraft Controls, Ltd., 2, 3, 4, 8, 20
Telex, Inc., Telex/Acoustic Products Div., 3, 10, 19, 23, 29, 31
Tempo Instruments, Inc., 4, 9, 19
Texas Instruments Incorporated, Metals & Controls, Inc., 2, 3, 4, 9, 10, 13, 15, 19, 20, 23, 26, 27, 28, 29, 30
Thermovolt Instruments, Ltd., 17, 24
Tiltman Langley, Ltd., 6, 30
Transco Products, Inc., 18
Trans-Sonics, Inc., 20
George Ulanet Co., 30
United Control Corp., 3, 4, 6, 10, 13, 16, 30, 32
United Electric Controls Co., 2, 3, 4, 8, 10, 13, 15, 20, 21, 28, 30, 32, 33
U. S. Flare-National Northern Div., Atlantic Research Corp., 5
U. S. Science Corp., 30
U. S. Switch Corp., 4, 10, 13, 27, 28, 29, 31
Universal Match Corp., Unidynamics Div., 3, 5, 8, 21, 24
Univex Corp., 18
Vactric Control Equipment, Ltd., 3, 21, 24
Varian Associates, Bomac Div., 30
Wallace & Tiernan, Inc., 20, 33
WaveLine, Inc., 18
Jervis B. Webb Co., Control Engineering Div., 13, 21
Weldotron Corp., 13
Westinghouse Air Brake Co., 3
Westinghouse Electric Corp., 3, 4, 10, 11, 12, 13, 14, 16, 18, 19, 20, 23, 24, 26, 27, 28, 30, 31
Westinghouse Electric Corp., Air Arm Div., 18
Westinghouse Electric Corp., Electronic Tube Div., 18
Westinghouse Electric Corp., Electronics Div., 18
Westport Development & Mfg., Inc., 2, 3, 4, 8, 20, 30
Wiancko Engineering Co., Div. Tamar Electronics, Inc., 20

Switching Systems, Crossbar

American Bosch Arma Corp.
American Machine & Foundry Co., Advanced Products Group
Bendix Corp., The, Bendix Mishawaka Div.
Central Dynamics, Ltd.
James Cunningham Son & Co., Inc.
Datametrics, Inc.
Electronic Controls, Inc.
Fisher-Akin Co.
Gems Co., Inc., The
General Dynamics/Electronics-Rochester
International Tel. & Tel. Corp., ITT Federal Laboratories Div.
North Electric Co.
Stromberg Carlson, Div. General Dynamics Corp.
Sylvania Electronic Systems, Div. Sylvania Electric Products, Inc.

Synchronizers

1. Digital Signal, 2. Engine

ACF Industries, Inc., ACF Electronics Div., 1
Adler Electronics, Inc., 1
American Scientific Corp., 1
Bendix Corp., The, Bendix Radio Div., 1
Computer Control Co., Inc., 1
Control Logic, Inc., 1
Cubic Corp., 1
Curtiss-Wright Corp., Curtiss Div., 2
Datex Corp., Sub. Giannini Controls Corp., 1
Defense Electronics, Inc., 1
Dynatronics, Inc., 1
Elden Co., Inc., The, 2
Electro Mechanical Research, Inc., 1
Electronic Designs, Div. Maxson Electronics Corp., 1
Frontier Electronics, Div. International Resistance Co., 1
Honeywell, Military Products Group
Hycon Mfg. Co., 1
Ithaco, Inc., 1
International Data Systems, Inc.
International Tel. & Tel. Corp.
Kurz & Root Co., Inc., 2
McDONNELL AIRCRAFT CORP., 1. SEE ADV. P. 230
Metric Systems Corp., 1
Moore Associates, Inc., 1
North Electric Co., 1
Ortronix, Inc., 1
RADCOM/Emertron, Div. Litton Industries, Inc., 1, 2
Ransom Research/Wyle Labs., 1
Sperry Gyroscope Co., Div. Sperry Rand Corp.
Systems Engineering Labs., Inc., 1
Telemetrics, Inc., 1
Teleregister Corp., The, 1
Vickers, Inc., Electric Products Div., 2
Wang Laboratories, Inc., 1
Westinghouse Electric Corp., 1

Synchroscopes

Aircraft Components, Inc.
Airpax Electronics, Inc.
American Electronics, Inc.
Bancroft Industries (62), Ltd.
Barbour Stockwell Instruments, Div. Curtis & Marble Machine Co.
Beckman Instruments, Inc., Berkeley Div.
Beckman Instruments, Inc., Helipot Div.
Bendix Corp., The, Montrose Div.
Bristol Co., The
Cedar Engineering, Div. Control Data Corp.
Daystrom, Inc., Transicoil Div.
Daystrom, Ltd.
Diehl Luftfahrtgerate
Durant Mfg. Co.
Electric Indicator Co., Inc.
Electro Products Laboratories, Inc.
Electronics Systems, Inc.
Epic, Inc.
Field Aircraft Service, Ltd.
G-M Laboratories, Inc.
Garwin, Inc.
General Electric Co., Instrument Dept.
General Products Corp.
General Radio Co.
W. & L. E. Gurley
Harowe Servo Controls, Inc.
Heinz Mueller Engineering Co., Inc.
Hewlett-Packard Co.
Hickok Electrical Instrument Co., The
E. Vernon Hill & Co.
Honeywell, Military Products Group
Ideal Industries, Inc.
INLAND MOTOR CORP., SUB. KOLLMORGEN CORP. SEE ADV. P. 26
Jones Motrola Corp.
Kahn & Co., Inc.
Ketay, Ltd.
Kollmorgen Corp.
Martindale Electric Co.
Meriam Instrument Co., The
Metron Instrument, Inc.
MICRODOT, INC. SEE ADV. P. 198
Muirhead Co., Ltd.
Newton Brothers (Derby), Ltd.
Norden Div., United Aircraft Corp.
John Oster Mfg. Co., Avionic Div.
Pioneer Electric & Research Co.
R. B. Pullin & Co., Ltd.
Radiation Technology, Inc.
Servo-Tek Products Co.
Slaughter Co.
S. Smith & Sons England, Ltd., Smiths Aviation Div.
Societe d'Applications Generales d'Electricite et de Mecanique (SAGEM)
Southern Instruments, Ltd.

Synchros

American Electronics, Inc.
Aviation Electric, Ltd.
Bendix Corp., The, Montrose Div.
CSF-Compagnie Generale de Telegraphie Sans Fil
CLIFTON PRECISION PRODUCTS CO., INC. SEE ADV. P. 114, 115
Clipper Gear & Machine Co.
Electric Indicator Co., Inc.
Ford Instrument Co., Div. Sperry Rand Corp.
G-M Laboratories, Inc.
General Precision, Inc., Aerospace Group (Kearfott Div., Systems Div. Research Center)
Guidance Technology, Inc.
Harowe Servo Controls, Inc.
Honeywell, Military Products Group
IMC Magnetics Corp., Eastern Div.
IMC Magnetics Corp., Western Div.
International Tel. & Tel. Corp.
Ketay, Ltd.
Lear Siegler, Inc., Instrument Div.
Lear Siegler, GmbH
Muirhead Co., Ltd.
Muirhead Instruments, Inc.
Muirhead Instruments, Ltd.
Norden Div., United Aircraft Corp.
R. B. Pullin & Co., Ltd.
Reeves Instrument Corp.
S. Smith & Sons England, Ltd., Smiths Aviation Div.
Societe d'Applications Generales d'Electricite et de Mecanique (SAGEM)
Sparton Corp., Sparton Electronics Div.
Sperry Gyroscope Co., Div. Sperry Rand Corp.
Sperry Gyroscope Co., Ltd.
Vernitron Corp., Farmingdale Div.
Vernitron Corp., Torrance Div.

Tables

1. Rotary, 2. Slip

Acton Laboratories, Inc., Sub. Bowmar Instrument Corp., 2
Antlab, Inc., 1
Binks Mfg. Co., 1
Boonshaft & Fuchs, Inc., 1
Collins Microflat Co., Inc., 2
Custom Scientific Instruments, Inc., 1
Dumore Co., The, 2
Engis Equipment Co., 1
Ex-Cell-O Corp. of Canada, Ltd., 1
Farmington Mfg. Co., 1
J. W. Fecker Div., American Optical Co., 1
Genisco, Inc., 1
George Gorton Machine Co., 1
W. & L. E. Gurley, 1
Ideal Aerosmith, Div. Royal Industries, Inc., 1, 2
C. E. Johansson Gage Co., Swedish Gage Co. Affiliate, 1
Machine Products Corp., 1
Micro Gee Products, Inc., 1
Remm Co., 1
Sciaky Brothers, 1
Theta Instrument Corp., 1
Trio-Tech, Inc., 1
Wayne George Corp., 1
Wyle Laboratories, 2

Tachometers

Aircraft Components, Inc.
Airpax Electronics, Inc.
American Electronics, Inc.
Bancroft Industries (62), Ltd.
Barbour Stockwell Instruments, Div. Curtis & Marble Machine Co.
Beckman Instruments, Inc., Berkeley Div.
Beckman Instruments, Inc., Helipot Div.
Bendix Corp., The, Montrose Div.
Bristol Co., The
Cedar Engineering, Div. Control Data Corp.
Daystrom, Inc., Transicoil Div.
Daystrom, Ltd.
Diehl Luftfahrtgerate
Durant Mfg. Co.
Electric Indicator Co., Inc.
Electro Products Laboratories, Inc.
Electronics Systems, Inc.
Epic, Inc.
Field Aircraft Service, Ltd.
G-M Laboratories, Inc.
Garwin, Inc.
General Electric Co., Instrument Dept.
General Products Corp.
General Radio Co.
W. & L. E. Gurley
Harowe Servo Controls, Inc.
Heinz Mueller Engineering Co., Inc.
Hewlett-Packard Co.
Hickok Electrical Instrument Co., The
E. Vernon Hill & Co.
Honeywell, Military Products Group
Ideal Industries, Inc.
INLAND MOTOR CORP., SUB. KOLLMORGEN CORP. SEE ADV. P. 26
Jones Motrola Corp.
Kahn & Co., Inc.
Ketay, Ltd.
Kollmorgen Corp.
Martindale Electric Co.
Meriam Instrument Co., The
Metron Instrument, Inc.
MICRODOT, INC. SEE ADV. P. 198
Muirhead Co., Ltd.
Newton Brothers (Derby), Ltd.
Norden Div., United Aircraft Corp.
John Oster Mfg. Co., Avionic Div.
Pioneer Electric & Research Co.
R. B. Pullin & Co., Ltd.
Radiation Technology, Inc.
Servo-Tek Products Co.
Slaughter Co.
S. Smith & Sons England, Ltd., Smiths Aviation Div.
Societe d'Applications Generales d'Electricite et de Mecanique (SAGEM)
Southern Instruments, Ltd.
Space Instrumentation Corp.
Standard Products, Inc.
Stewart-Warner Corp., Alemite Div.
Technical Oil Tool Corp.
Trio-Tech, Inc.
WacLine, Inc.
Waltham Precision Instrument Co., Electromechanical Div.
Westberg Mfg. Co.
Westinghouse Electric Corp.
Weston Instruments & Electronics, Div. Daystrom, Inc.

Tanks

1. Auxiliary, 2. Corrosion-resistant, 3. Cryogenic, 4. Drop, 5. Fuel & Oil, Airborne, 6. Fuel & Oil, Mobile, 7. Fuel & Oil, Storage, 8. Pressure

ACF Industries, Inc., 2, 6, 7, 8
Aeronca Mfg. Corp., 4
Aeronca Mfg. Corp., Aerocal Div., 1, 2, 3, 4, 5, 6, 7, 8
Aerosmith Products Corp., 1, 2
Agrinautics, 4
Air Products & Chemicals, Inc., 3
Airtek Dynamics, Inc., 1, 2, 3, 5, 8
Alloy Products Corp., 1, 2, 3, 4, 8
ALUMINUM CO. OF AMERICA, 7. SEE ADV. P. 203, 204
Arde-Portland, Inc., 2, 3, 8
Atkins & Merrill, Inc., 2
Aviation Traders Engineering, Ltd., 1, 5, 6, 7
Baldwin-Lima-Hamilton Corp., Industrial Equipment Div., 8
Barogenics, Inc., 8
Bell and Gossett Co., 7, 8
Benson Mfg. Co.
Berkeley Steel Construction Co., 3, 7, 8
Bethlehem Steel Co., 2, 6, 7, 8
Bigelow Co., The, 8
Binks Mfg. Co., 2, 8
Black, Sivalls & Bryson, Inc., 2, 8
Blaw-Knox Co., 2, 8
Bowser-Briggs Filtration Div., Bowser, Inc., 8
Bristol Aero-Industries, Inc., Winnipeg Div., 1, 4, 5, 8
BROOKS & PERKINS, INC., 1, 2, 3, 4, 5, 6, 7, 8. SEE ADV. P. 20
Brunswick Co. of Canada, Ltd., The, 2
BRUNSWICK CORP., DEFENSE PRODUCTS DIV., 2, 3, 8. SEE ADV. P. 31
Canadair, Ltd., 4
Cardair Div., Marmon-Herrington Co., Inc., 8
Central Dynamics, Ltd., 5
Champion Co., The, 8

cppc

SYNCHROS
& ROTATING COMPONENTS

Clifton Precision offers an extremely wide variety of synchros as transmitters, receivers, control transformers, differentials and resolvers in sizes 8, 10, 11, 15 and 22. These are high accuracy production line units (7' max. error is typical). Double ended shafts, BuWeps types and ultra high temperature resistant (450°F) types are available.
CPPC custom designs any type of gyro pickoff synchro or resolver. Precision computing resolvers, linear transformers (induction potentiometers), servo motors, motor generators, motor rate tachometers, gearhead motors, D.C. motors and many other rotating components are in stock.
Look to CPPC for any rotating component.

CLIFTON PRECISION PRODUCTS CO., INC.
5050 State Road, Drexel Hill, Pa.
Area 215 MAdison 2-1000
TWX 215 623-6068
or our Representatives

Circle Number 73 on Reader-Service Card

SEE CORPORATE INDEX FOR ADDRESSES

AMONG OTHER THINGS...*



Garsite helps fuel jets...

At just about any major air terminal equipped for hydrant fueling, you'll find hydrant service pits, hydrant fueling carts and floating suction equipment designed and built by Garsite. This type of equipment — the unglamorous but functional and essential tools of civil and military ground service operations — has become a specialty at Garsite. In the process, we've acquired a pretty intimate understanding of the many problems you face when you're responsible for keeping aircraft ground service time to the minimum.

If you have this responsibility, and if you're convinced there must be a better way of handling a particular ground service operation, call Garsite. Chances are we'll say, "can do," (if we haven't already done it).

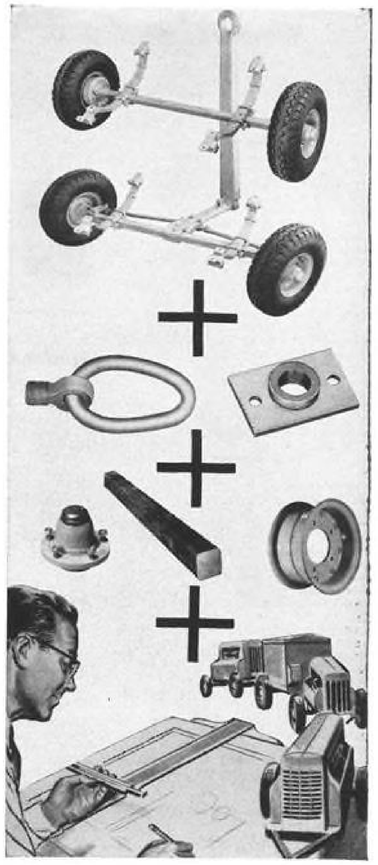
* **JET ENGINE STANDS ■ AIRCRAFT FUELING AND SERVICE LADDERS HYDRANT SERVICE PITS ■ HYDRANT FUELING CARTS ■ FUELING SYSTEM COMPONENTS ■ FUEL AND LIQUID DISPENSING EQUIPMENT**

Write for the "CAN DO" story and data file on Garsite aircraft ground service equipment.

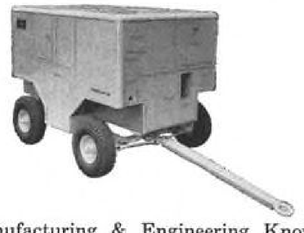
GARSITE *products, inc.*

10 GRAND BOULEVARD, DEER PARK L. I., NEW YORK

Circle Number 244 on Reader-Service Card



PUT 'EM ALL TOGETHER



Manufacturing & Engineering Know-How is the key to United's continuous growth and success in the designing and manufacturing of axles, running gear and ground support equipment.
At United there is no substitute for the Design and Manufacture of a Superior Product.

NEW CATALOG
Write today for United's illustrated catalog on Caravan Axles, Running Gear, Ground Support Equipment and component parts.



THE UNITED MAUFACTURING COMPANY

5250 Dobeckmun Ave., Cleveland 2, Ohio
West Coast Representative: AER-BEA CO.
6320 Dale Ave., Buena Park, California

Circle Numzer 245 on Reader-Service Card

Chicago Bridge & Iron Co., 2, 3, 7, 8
Cosmodyne Corp., 3
Cryogenic Research Co., Inc., 3
Cryovac, Inc., 3
de Havilland Aircraft of Canada, Ltd., 5
Delaney Gallay, Ltd., 1, 2, 5, 8
DeVilbiss Co., The, 8
Dominion Bridge Co., Ltd., 3, 7, 8
Dominion Rubber Co., Ltd., 2
Douglas Aircraft Co., Inc., Missile & Space Systems Div., 1, 2, 3, 5, 6, 7, 8
F. P. T. Industries, Ltd., 2, 4, 5, 6
Fairchild Stratos Corp.
Fiat, S.p.A. Divisione Aviazione, 1, 4, 5
Firestone Tire & Rubber Co., 1, 4, 5, 6, 7
Flexiliner Corp., 2, 6, 7
Flight Refueling, Ltd., 5
Focke Wulf, G.m.b.H., 4
G. W. Galloway Co., 2, 3, 4, 8
B. F. Goodrich Aerospace & Defense Div., B. F. Goodrich Co., 1, 2, 5, 6, 7, 8
Goodyear Aerospace Corp., 3
Goodyear Tire & Rubber Co., Aviation Products Div., 1, 2, 5, 6, 7
Haveg Industries, Inc., 2
Hawker Siddeley Aviation, 4
Houston Fearless Corp.
Ingersoll-Kalamazoo, Div. Borg-Warner Corp., 8
Jervis Corp., 1, 5
Kaiser Steel Corp., 3, 6, 7, 8
Walter Kidde & Co., Inc., 2, 8
Walter Kidde & Co. of Canada, Ltd., 8
LAVELLE AIRCRAFT CORP., 5. SEE ADV. P. 208
Lawrence Aviation Industries, Inc., 2, 5, 8
Lear Siegler, Inc., Astro Structures Div., 3, 8
Linde Co., Div. Union Carbide Corp., 3
Liquid Carbonic Div., General Dynamics Corp., 3
Lockheed Aircraft Corp., 1, 2, 3, 4, 5, 6, 7, 8
Long Sault Woodcraft, Ltd., 2, 8
Luzerne Rubber Co., The, 2
Magnesium Aerospace Products, 5
R. C. Mahon Co., The, 8
Marston Excelsior, Ltd., 1, 2, 3, 4, 5, 6, 7
MARTIN CO., DIV. MARTIN-MARIETTA CORP., 3, 5, 6, 7, 8. SEE ADV. P. 224
McDONNELL AIRCRAFT CORP., 4. SEE ADV. P. 230
McGregor Mfg. Corp., 1, 2, 3, 5, 6, 7, 8
Messier S. A., 8
National Annealing Box Co., 2, 3, 8
National Forge Co., 8
Nooter Corp., 2, 3, 7, 8
On Mark Engineering Co., 5
Paul Chemical Co., Inc., 2, 3
Pittsburgh-Des Moines Steel Co.
Pressed Steel Tank Co., 8
Product Development Group, 1, 2, 3, 5, 8
Raven Industries, Inc., 2
Raymond Development Industries, 2
Rockwell-Standard Corp., Stamping Div., 1, 2, 3, 4, 8
Rohr Corp., 5, 8
Royal Industries, Inc., Royal Jet Div., 1, 4
SABCA, S. A. Belge de Constructions Aeronautiques, 4
S-P Mfg. Corp., 8
Sargent Fletcher Co., 1, 2, 3, 4, 5
Seamless Products Co., Inc., 8
A. O. Smith Corp., 2
Southern Calif. Metal Spinning Co., 1, 4, 5, 8
Henry Spen & Co., Inc., 2, 6
Standard Steel Corp., Leader Div., 3, 8
Stearns Roger Corp., 2, 3, 8
Stolper Industries, Inc., 1, 2, 6
E. C. Styberg Engineering Co., Inc., 5
Superior Air Products Co., 3
Tapco Div., Thompson Ramo Wooldridge, Inc., 8
Tavco, Inc., 8
Taylor Corp., 2, 8
Telecomputing Corp., Advanced Structures Div., 1, 4, 5
C. W. Torrgren Co., 1, 4
Tri-D Corp., 8
Twin Industries Corp., Aerospace Div., 1, 4, 5
U. S. Plastic Corp., 2
U. S. STEEL CORP., 3, 7, 8. SEE ADV. P. 110, 111
Whitlock Mfg. Co., The, 7

Tape

1. Adhesive, 2. Carbon, 3. Electric Heating, 4. Fiberglass, 5. Glass-reinforced, 6. High-temperature, 7. Identification, 8. Insulating, Adhesive-backed, 9. Insulating, Heat-sealing, 10. Insulating, Plain, 11. Magnetic, Recording, 12. Paper, Recording, 13. Pressure-sensitive Adhesive, 14. Printed or Color-coded, 15. Thermoplastic, Recording, 16. Waxed Nylon Lacing

Acro Chemical Products Corp., 1, 8, 13
Adhesive Engineering, 1, 5, 6, 7
Adhesive Tape Corp., 1, 4, 5, 6, 7, 8, 13
Aircraft Components, Inc., 1
Aircraft Materials, Ltd., 1, 7
Airtech, Ltd., 11
American Optical Co., Safety Products Div., 7
American Pres-Stix Tape Co., 1, 4, 5, 6, 7, 13, 14
Anchor Continental, 5, 7, 8, 13, 14
Anodyne, Inc., 14
Armour Coated Products and Adhesives Co., 13
Arnold Engineering Co., 11
Bancroft Industries (62), Ltd.
Behr-Manning Co., Div. Norton Co., 1, 5, 6, 7, 8, 13
Bemis Bros. Bag Co., 8, 12, 13, 14
W. H. Brady Co., 1, 7, 8, 13, 14
British Insulated Callenders Cables, Ltd., 8
Budd Co., The, Polychem Div., 5
Burgess Battery Co., 11
Canrad Precision Industries, Inc., 7, 13, 14
Carbone Corp., The, 2
Carborundum Co., The, 6, 10
Co. Engineering Co., 11
Consolidated Electrodynamics Corp., 11
Cooper Industries, Inc., 5, 6, 13
Cordo Chemical Corp., Mobile Plastics Div., 2, 5, 6, 8, 9, 10
Cox & Co., Inc., 3
Demp-Nock Co., The, 13
Dennison Mfg. Co., 7, 10, 13, 14
Dixon Corp., 6, 10
Dominion Rubber Co., Ltd., 8
John L. Dore Co., Military Products Div.
Eastman Kodak Co., 11
Electrofilm, Inc., 3
B. K. Elliott Co.
Fabric Research Laboratories, Inc., 6, 16
Ferro Dynamics Corp., 11
Fiberite Corp., Universal Mfg. Co., 2, 5, 6
Flightex Fabrics, Inc., 4, 10
Friden, Inc., 12, 14
General Plastics Corp. N. J., 1, 4, 5, 7, 8, 10, 13
Gudebrod Bros. Silk Co., Inc., 4, 6, 16
Hanlon & Wilson Co., 6, 9
Hastings Plastics, Inc., 4, 5
Hi-G, Inc., 6
High Temperature Materials, Inc., 6, 8, 10
Illumitronic Engineering Corp., 5, 8, 16
Industrial Timer Corp., 12
Joclin Mfg. Co., 1, 5, 6, 8, 13, 14
Johns-Manville, 5, 6, 8, 10
Joy Mfg. Co., Electrical Products Dept., 6, 10
Kendall Co., Polyken Sales Div., 4, 5, 6, 7, 8, 13
Master Tape Printers, Inc., 7, 14
McMillan Laboratory, 4, 5, 6
Memorex Corp., 11
MINNESOTA MINING & MFG. CO., MAGNETIC PRODUCTS DIV., 11. SEE ADV. P. 123
Minnesota Mining & Mfg. Co., New Product Liaison, 1, 5, 6, 7, 8, 9, 10, 11, 13, 14
Narmco Research & Development Div., Telecomputing Corp., 1, 5, 11
Narrow Fabric Co., The
National Electric Div., H. K. Porter Co., Inc., 6, 8
Natvar Corp., 9, 10
Omnitronics, Inc., Sub. Borg-Warner Corp., 2
Paper Manufacturers Co., 12
Permacel, 1, 4, 5, 6, 7, 8, 10, 13, 14
Photographic Applications Co., 11
Polymer Corp., The, 6, 10
H. K. Porter Co., Inc., Thermoid Div., 5, 6, 13
Prestoseal Mfg. Corp., 6
Prodesco, Inc., 4, 5, 6
Radiant Color Co., 13
Radio Corp. of America, 11
Raybestos-Manhattan, Inc., Plastic Products Div., 5, 6, 10
Raymond Development Industries, 4, 5
Reeves Soundcraft Corp., 11
Russell Mfg. Co., The, 4
Safeway Heat Elements, Inc., 3
SANBORN CO. SEE ADV. P. 66
Sandon, Inc., 1, 8, 10, 13
G. T. Schjeldahl Co., 1, 6, 8, 9
W. S. Shamban & Co., 5, 6, 10
Simon Adhesive Products Corp., Div. Litton Industries, Inc., 1, 13
Soroban Engineering, Inc., 12
Sparta Mfg. Co., Div. U. S. Ceramic Tile Co., 5, 6, 10, 13
Stanpat Co., 13
Tally Corp., 12
Jerome A. Taudte Co., Inc., 1, 5, 6, 8, 9, 10, 13
Technical Tape Corp., 1, 5, 6, 13, 14
Telectro Industries Corp., 11
Tensolite Insulated Wire Co., Inc., 6
Tetrafluor, Inc.
H. I. Thompson Fiber Glass Co., 2, 6
Topflight Corp., 13, 14
Tri-Point Plastics, Inc., 6
Turner Brothers Asbestos Co., Ltd., 4, 6, 8, 9
U. S. Polymeric Chemicals, Inc., 2, 4, 5, 6
U. S. RADIUM CORP., 7, 14. SEE ADV. P. 230
U. S. Rubber Co., 10, 13
Warren Wire Co., 4, 5, 6
Westline E-Z Code Div., Western Lithograph Co., 1, 4, 5, 6, 7, 13, 14
WILDING, INC., 11. SEE ADV. P. 278
Zippertubing Co., The, 3, 4, 5, 6, 7

Tape Decks

American Concertone, Inc., Div. Astro-Science Corp.
American Scientific Corp.
Amplifier Corp. of America
Astronautics Corp. of America
Consolidated Electrodynamics Corp.
Cook Electric Co., Technological Center Div.
Cubic Corp.
Dashew Business Machines, Inc.
S. Davoll & Sons, Ltd.
Gables Engineering, Inc.
General Kinetics, Inc.
International Radio & Electronics Corp., 2
Kinelogic Corp.
Lear Siegler, Inc., Bogen Communications Div.
Ling-Temco-Vought, Inc.
Lockheed Aircraft Corp.
Mnemotron Div., Technical Measurement Corp.
Omnitronics, Inc., Sub. Borg-Warner Corp.
Pacific Electro Magnetics Co., Inc.
Ralph M. Parsons Co., Electronics Div.
Pentron Electronics Corp.
Photographic Applications Co.
Potter Instrument Co., Inc.
Presentey Engineering Products, Ltd.
Radio Corp. of America
S-I Electronics, Inc.
SANBORN CO. SEE ADV. P. 66
Stancil-Hoffman Corp.
Technical Service Corp.
Telecomputing Corp., Electronic Systems Div.
Telectro Industries Corp.
Thermionic Products Electronics, Ltd.
Thompson Ramo Wooldridge, Inc.
United Data Control, Inc., Sub. United Control Corp.
Viewlex, Inc.

Taps

English Steel Corp., Ltd.
Exotic Tools, Inc.
Geometric Tool Co., Div. United Greenfield Corp.
Heli-Coil Corp.
Messier S. A.
Mini-Tool Technical Industries, Inc.
J. I. Morris Co.
Morse Twist Drill & Machine Co.
Ridge Tool Co., The
Union Twist Drill Co., Union Card Div.

Target Scoring Systems

Aeronca Mfg. Corp.
Bulova Systems and Instruments, Div. (Incl. Bulova R & D Laboratories), Bulova Watch Co., Inc.
Cubic Corp.
Electronic Specialty Co.
Franklin Systems, Inc.
Giannini Controls Corp.
International Tel. & Tel. Corp.
Ralph M. Parsons Co., Electronics Div.
Stanley Aviation Corp.
Teleregister Corp., The

Targets

1. Free Flight, 2. Tow

Aerojet-General Corp., 1
Aeronca Mfg. Corp., 1, 2
Aerospace Products, Inc., 2
Allison Div., Genereal Motors Corp., 2
Anderson, Greenwood & Co.
Beech Aircraft Corp., Aerospace Div., 1
Bendix Corp., The, Bendix Mishawaka Div., 1
Boyt Harness Co., 2
Canadian Flight Equipment Cobourg, Ltd., 2
Del Mar Engineering Laboratories, 1, 2
Electronic Specialty Co., 2
Flight Refuelling, Ltd., 1, 2
M. C. Gill Corp., 2
Goodyear Aerospace Corp., 1, 2
IRVING AIR CHUTE CO., INC., IRVIN RESEARCH AND DEVELOPMENT CENTER, 2. SEE ADV. P. 223
Northrop Corp., 1
PANEL CORP. OF AMERICA, 2. SEE ADV. P. 260
Ralph M. Parsons Co., Electronics Div., 1, 2
Pioneer Parachute Co., Inc., 1, 2
Republic Aviation Corp., 1
Ryan Aeronautical Co., 1, 2
Stanley Aviation Corp., 1, 2
Studebaker Corp., CTL Div., 2
Twin Industries Corp., Aerospace Div., 1, 2
VIRON DIV., GEOPHYSICS CORP. OF AMERICA, 1, 2. SEE ADV. P. 262

Tarpaulins

Canadian Flight Equipment Cobourg, Ltd.
C. R. Daniels, Inc., Aviation Div.
Fabric Research Laboratories, Inc.
Flexiliner Corp.
John J. Foster Mfg. Co.
Herculite Protective Fabrics Corp.
Prodesco, Inc.
Raven Industries, Inc.
M. L. Snyder & Son, Inc.
Uniform Hood Lace Co.
U. S. Rubber Co.

Tees

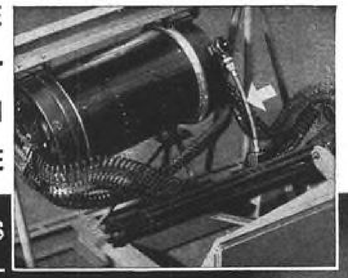
Aircraft Components, Inc.
Bethlehem Steel Co.
Breeze-Illinois, Inc.
Demornay-Bonardi, Inc.
Luzerne Rubber Co., The
Microlab
Sperry Gyroscope Co., Div. Sperry Rand Corp.
Victaulic Co. of America

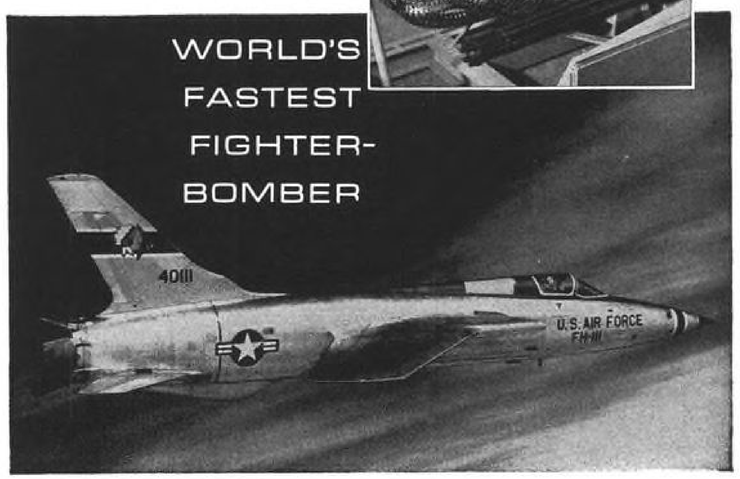
Telemetry Equipment

1. Airborne, 2. Ground-based, 3. Ship-based, 4. Spaceborne

ACEC, 1, 2, 4
ACF Industries, Inc., 1, 2, 4
Accurate Instrument Co.
Acton Laboratoeris, Inc., Sub. Bowmar Instrument Corp., 1
Adler Electronics, Inc., 2, 3
Advanced Communications, Inc., 1, 4
Aero Geo Astro Corp., 1, 2, 3, 4
Aerojet-General Corp., 4
Aeronca Mfg. Corp., 1
Aeronutronic Div., Philco Corp., Sub. Ford Motor Co.
Aeroscience Electronics, Inc., 1, 2
Aerospace Research, Inc., 1, 2, 4
Aircraft Armaments, Inc., 1, 2, 3, 4
Airpax Electronics, Inc., 1, 2
Airtech, Ltd., 1, 2
Allied Research Associates, Inc., 1, 2, 4
American Bosch Arma Corp., Tele-Dynamics Div., 1, 2, 3, 4
American Electronics Labs., Inc.
American Scientific Corp., 2
ANDREW CORP., 2, 3. SEE ADV. P. 196
Antenna Systems, Inc., 2, 3
Antlab, Inc., 2, 3
Applied Electronics Corp. of N. J., 1, 2, 3, 4
Applied Technology, Inc., 1, 2, 3, 4
Astral Electronics, Inc., 1, 2, 3, 4
ASTRODATA, INC., 2. SEE ADV. P. 150
Astronautics Corp. of America, 4
Astronetic Research, Inc., 1, 4
Avco Corp., Electronics Div., 4
Avco Corp., Research & Advanced Development Div., 4
Ball Bros. Research Corp. ,1
Barth Engineering & Mfg. Co., Inc., 2, 3
Beckman Instruments, Inc., Berkeley Div., 2
Beckman Instruments, Inc., Systems Div., 2
Bell Aerosystems Co., Div. Bell Aerospace Corp., A Textron Co., 1, 2, 3
Bell Aerosystems Co., Tucson Research Laboratory, 1, 2
Beme Telecommunications, Ltd., 1
Bristol Aero-Industries, Inc., Winnipeg Div., 4
Bristol Co., The, 2
British Aircraft Corp., Ltd., 1, 2
Budd Electronics, Div. Budd Co., Inc.
Burndept, 1
CSF-Compagnie Generale de Telegraphie Sans Fil, 1, 2, 3, 4
Canadian Aviation Electronics, Ltd., 2
Canadian Bristol Aerojet, Ltd., 4
Canoga Electronics Corp., 2, 3
Chrysler Corp., Defense Space Group, 1, 2, 3, 4
Chrysler Corp., Missile Div., Florida Missile Operations, 1, 2, 3, 4
Chrysler Corp., Space Div., 1, 2, 4
G. L. Collins Corp., 1, 4
Collins Radio Co., 1, 2, 3, 4
Communication Electronics, Inc., 1, 2, 3, 4
Compudyne Corp., 2, 3
Computer Control Co., Inc., 1, 2, 3, 4
Conductron Corp.
Consolidated Electrodynamics Corp., 1, 2, 3, 4
CONSOLIDATED SYSTEMS CORP., 2, 3, 4. SEE ADV. P. 212
Continental Technical Service, Inc., 2
Control Science Corp.
Cook Electric Co., Technological Center Div., 1, 4
Cubic Corp., 1, 2, 3, 4
Dalmo Victor Co., Textron, Inc., 1, 2, 3
Data Control Systems, Inc., 1, 2, 3, 4
Datametrics, Inc., 1, 4
Datex Corp., Sub. Giannini Controls Corp., 2, 3
S. Davoll & Sons, Ltd., 1, 2, 3, 4
Daystrom, Inc., Control Systems Div., 2
Defense Electronics, Inc., 1, 2, 3, 4
Destron Co., 2
Dorsett Electronics, Inc., 1, 2, 3, 4
Douglas Aircraft Co., Inc., Missile & Space Systems Div., 1, 2, 4
Dynatronics, Inc., 1 ,2, 3, 4
Eitel-McCullough, Inc., 1, 2, 4
Electro Mechanical Research, Inc., 1, 2, 3, 4
Electronic Designs, Div. Maxson Electronics Corp., 1, 2, 3, 4
Electronic Development Corp.
Electronic Specialty Co., 1

STOW FLEXIBLE SHAFTING FEEDS THE WORLD'S FASTEST CANNON ON THE WORLD'S FASTEST FIGHTER-BOMBER





USAF All-Weather F-105 THUNDERCHIEF, world's fastest fighter-bomber, tears through the sky at twice the speed of sound. Stinger on the F-105 is the Vulcan Automatic Cannon, world's fastest machine gun, capable of firing 20MM cannon shells at the rate of 6000 rounds per minute. That's performance!

And right in there, power-driving the feed mechanism for the rapid firing Vulcan, they've put reliable Stow flexible shafting . . . designed for *dependable* performance despite extreme temperature, torsion, vibration and shock.



If you have a product requiring power drive, consider Stow flexible shafting—at the design stage! Often it's the simplest, most dependable way to transmit power between non-collinear components.

For further information and complete details on Stow flexible shafting, write for STOW Engineering Bulletin #627, and our new Flexible Shaft Engineering Handbook.

STOW MANUFACTURING CO.
Dept. T-3, 68 SHEAR ST. BINGHAMTON, N. Y.

Circle Number 246 on Reader-Service Card

Introducing the new, low cost
EMERGENCY DISTRESS SIGNAL GENERATOR



K-Alpha Corporation is now in full production of its GANDER model Distress Signal Generator, a transmitter capable of contacting all routine private and commercial flights. Portable, rugged, compact and test proven, it is accepted by FAA and CAP.

- Weighs only 18 oz.
- Telescoping Antenna
- Power: 20.25 volt DC mercury battery
- Range: 50 miles
- Signal: Continuous or manual
- 30 hours continuous operation

Remarkably efficient, only . . . **$79.95** ppd.

Distributor inquiries invited

CUSTOM MANUFACTURING—We invite your requirements for any special type of transmitter or receiver.

Write or call:
KALPHA CORPORATION
2456 West 2nd Avenue
DENVER, COLORADO 80223
Dial: (303) 936-2349
KA 3-1

A MB MARKETING EFFORT

Circle Number 248 on Reader-Service Card

New engineering manual available on request.

BONDED HONEYCOMB STRUCTURES

Typical Applications: Instrument Panels • Bulkheading and Flooring • Console Cabinets • Parabolic Reflectors • Access Doors • Test Benches • Mobile Shelters • Housings for Airborne Instruments • Packaging • Transit Cases

Engineering Properties: Weight-to-Strength Ratio • Dielectric Barriers • R-F Shielding Properties • Corrosion and Fungus Proof • Low Moisture Absorption • Wide Temperature Range • Sound Deadening • Resistance to Sonic Vibration • Low Thermal Conductivity • High-heat Resistance

ALBANO HONEYCOMB DIVISION
555 West 54th Street, New York 19, N. Y.

ALBANO represented in Canada by:
Railway & Power Engineering Corporation, Ltd.
3745 St. James Street West
Montreal 30, Canada

Circle Number 247 on Reader-Service Card

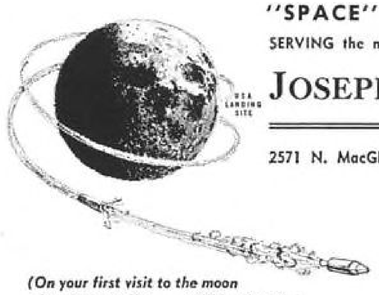


USE ARENS STANDARD-DESIGNS Eliminate "high-cost specials"

See us first . . . and you will probably find the control you are looking for. Save the time and expense of having a special remote control designed, because one of Arens' 44 (and growing all the time) standard-designs will probably fulfill your requirements. But if not, our engineering and research department will be pleased to work with you on special controls for your application. Write us your requirements.

ARENS CONTROLS, INC. 2021 Greenleaf Street, Evanston, Illinois

Circle Number 249 on Reader-Service Card



"SPACE" IS OUR PRODUCT
SERVING the needs of the Aerospace Industry

JOSEPH L. SMITH and Associates
2571 N. MacGREGOR DRIVE • HOUSTON 4, TEXAS
JA 6-3721

(On your first visit to the moon drop in for coffee . . . we'll be there!)



WE ARE SPECIALISTS IN SPACE OF ALL KINDS . . .

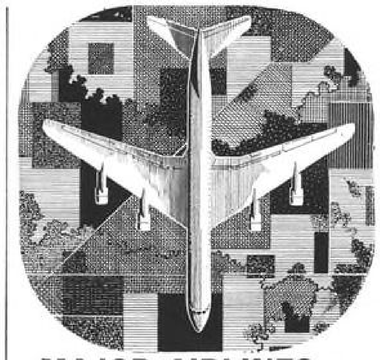
We will DESIGN IT, ENGINEER IT, FINANCE IT, BUILD IT, MANAGE IT, LEASE IT . . . BUY IT or SELL IT.

SPACE . . . in OFFICE BUILDINGS, INDUSTRIAL COMPLEXES, RESEARCH FACILITIES, APARTMENTS, MOTELS, SHOPPING CENTERS, or UNDEVELOPED LAND.

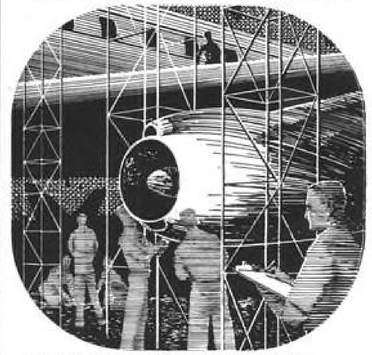
We are NASA Area's leading Real Estate Agency and either own or have exclusive listings on numerous tracts near the MANNED SPACECRAFT CENTER on CLEAR LAKE for both USERS and INVESTORS. WE BUILT and LEASED to NASA their largest single location in the Houston Area.

JOSEPH L. SMITH and Associates will represent you on a confidential and professional basis. We have industrial and commercial properties, with or without trackage, in all sections of the Houston Area. We also have some excellent acreages for residential development. FREE planning and engineering service to our clients. Write or call for an appointment or brochure.

Circle Number 250 on Reader-Service Card



MAJOR AIRLINES . . .



MANUFACTURERS . . .



MILITARY AIRCRAFT

PROTECT AGAINST IN-FLIGHT ENGINE FAILURE with LISLE *Magnetic* CHIP DETECTORS

LISLE CORPORATION • CLARINDA, IOWA

Circle Number 251 on Reader-Service Card

American Electronics, Inc.
Analytical Research Associates, Inc.
Arinc Research Corp.
Associated Laboratories, Inc.
Associated Testing Laboratories, Inc., New England Div.
Auto Control Laboratories, Inc.
Avco Corp., Research & Advanced Development Div.
Balco Research Laboratories, Capacitor Div.
Barnes & Reinecke, Inc.
Barry Wright Corp., Barry Controls Div.
Basic & Experimental Physics
Bell Aerosystems Co., Div. Bell Aerospace Corp., A Textron Co.
Bell Aerosystems Co., Tucson Research Laboratory
Belock Instrument Corp.
Bendix Corp., The, Bendix Mishawaka Div.
Bendix Corp., The, Bendix Systems Div.
Bendix Corp., The, Utica Div.
Dayton T. Brown, Inc., Testing Laboratories
Bulova Systems and Instruments Div. (Incl. Bulova R & D Laboratories), Bulova Watch Co., Inc.
Burroughs Corp.
G. F. Bush Associates
California Testing Labs., Inc.
Canadian Research Institute
Capehart Corp.
Cardair, Div. Marmon-Herrington Co., Inc.
CHANDLER EVANS CORP. SEE ADV. P. 164
Chicago Spectro Service Laboratory, Inc.
Colorado Research Co., Div. Bell & Gosset Co.
COMPUTING DEVICES OF CANADA, LTD. SEE ADV. P. 238
Conductron Corp.
Cook Electric Co., Technological Center Div.
Cornell Aeronautical Lab., Inc.
Cornell-Dubilier Electronics, Div. Federal Pacific Electric Co.
Corning Glass Works
Curtiss-Wright Corp., Electronics Div.
DBM Research Corp.
DCF Systems, Ltd.
Data Corp.
de Havilland Aircraft of Canada, Ltd.
Delsen Corp.
Dunlap & Associates, Inc.
Dynamic Filters, Div. Michigan Dynamics, Inc.
Dynatech Corp.
Electrical Testing Labs., Inc.
Electro-Mechanics Co.
Electronic Designs, Div. Maxson Electronics Corp.
Electronic Space Structures Corp.
Electronics Development Corp.
Electrospace Corp.
Ellis Fluid Dynamics Corp.
Environ Laboratories, Inc.
F & M Systems Co., Div. Fishback and Moore, Inc.
Fabric Research Laboratories, Inc.
Fairchild Space and Defense Systems, Div. Fairchild Camera and Instrument Corp.
Field Aircraft Service, Ltd.
Flui Dyne Engineering Corp.
Frederick Research Corp.
Garwin, Inc.
General Kinetics, Inc.
General Testing Laboratories, Inc.
Goodrich—High Voltage Astronautics
Goodyear Aerospace Corp.
Hanlon & Wilson Co.
Hass Instrument Corp., The
Hathaway Instruments, Inc.
Hawker Siddeley Canada Ltd., Engineering Div.
Houston Engineering Research Corp.
Howe Precision Products Co., Div. Howe Sound Co.
Hughes Aircraft Co.
Hyda Laboratories, Inc.
ITT Canada, Ltd.
Idaho-Maryland Industries, Inc.
Industrial Acoustics Co., Inc.
Ingersoll-Kalamazoo Div., Borg Warner-Corp.
International Tel. & Tel. Co., Industrial Products Div.
Kaman Nuclear
Kaydon Engineering Corp., The
Kinetics Corp., Sub. Waltham Precision Instrument Co., Inc.
George W. Klein Aviation Engines & Parts, Inc.
Lear Siegler Service, Inc., Sub. Lear Siegler, Inc.
Ledoux & Co. Inc.
Ling-Temco-Vought, Inc.
Lockheed Aircraft Corp.
Magnaflux Corp.
McDONNELL AIRCAFT CORP. SEE ADV. P. 230
McGregor Mfg. Corp.
Metcut Research Associates, Inc.
R. A. MILLER INDUSTRIES, INC. SEE ADV. P. 232
National Research Corp. Research Div.
New York Testing Laboratories, Inc.
Northrop Corp., Norair Div.
Penniman & Browne, Inc.
Philco Corp., Sub. Ford Motor Co.
Radiation, Inc.
Rototest Laboratories, Inc.
Rousseau Controls, Ltd.
Royal Industries, Inc., Royal Jet Div.
Tom W. Scotney, Ltd.
Shielding, Inc.
Sierra Engineering Co.
Sparton Corp., Sparton Electronics Div.
Sperry Gyroscope Co., Div. Sperry Rand Corp.
Stellardyne Laboratories, Inc.
Swiss Electro Instruments, Div. Pastushin Industries, Inc.
Tenney Engineering, Inc.
THIOKOL CHEMICAL CORP. SEE ADV P. 36
Thiokol Chemical Corp., Wasatch Div.
H. I. Thompson Fiber Glass Co.
Torrington Mfg. Co. of Canada
Ultra Electronics, Ltd.
Ultrasonic Research & Testing Laboratories
U. S. Testing Co., Inc.
United Testing Laboratories
Verosolv Safety Solvents, United Research & Development Associates
Vibration Isolation Products, Inc.
Washington Technological Associates, Inc.
Western Gear Corp., Precision Products Div.
Westinghouse Research and Development Center, Westinghouse Electric Corp.
Wyle Laboratories

Textbooks

All Language Services, Inc.
Bell Aerosystems Co., Div. Bell Aerospace Corp., A Textron Co.
Burroughs Corp.
Campbell Aeronautical Service, Inc.
Harcourt, Brace & World, Inc.
McGraw-Hill Book Co.
D. Van Nostrand Co., Inc.

Theodolites

American Optical Co.
Askania-Werke, U. S. Branch Office
Barnes Engineering Co.
Barth Engineering & Mfg. Co., Inc.
B. K. Elliott Co.
Engis Equipment Co.
Farrand Optical Co., Inc.
J. W. Fecker, Div. American Optical Co.
General Electric Co. Ordnance Dept.
Gordon Enterprises
W. & L. E. Gurley
Keuffel & Esser Co., Optics & Metrology Div.
Kollsman Instrument Corp., Sub. Standard Kollsman Industries, Inc.
Perkin-Elmer Corp.
Razdow Laboratories, Inc.
Redfield Gun Sight Co.
Warren-Knight Co.

Thermionic Devices

Allied Research Associates, Inc.
American Astrophysics
Astropower, Inc., Sub. Douglas Aircraft Co., Inc.
Cambridge Thermionic Corp.
Clevite Corp., Aerospace Div.
Consolidated Controls Corp.
Electro-Optical Systems, Inc.
General Electric Co., Missile and Space Div.
Goodyear Aerospace Corp.
Hathaway Instruments, Inc.
High Temperature Materials, Inc.
MARTIN CO., DIV. MARTIN-MARIETTA CORP. SEE ADV. P. 224
Martin-Marietta Corp., Nuclear Div.
North American Aviation, Inc., Atomics International Div.
Philco Corp., Sub. Ford Motor Co.
Pratt & Whitney Aircraft, Div. United Aircraft Corp.
Radio Corp. of America
Sperry Gyroscope Co., Div. Sperry Rand Corp.
Standard Telephones & Cables, Ltd.
Varian Associates, Bomac Div.
Westinghouse Electric Corp., Aerospace Electrical Dept.
Westinghouse Electric Corp., Astronuclear Laboratory

Thermistors

Barnes Engineering Co., Defense & Space Div.
CSF-Compagnie Generale de Telegraphie Sans Fil
Carbone Corp., The
Carborundum Co., The
Fenwal Electronics, Inc.
Garrett Corp., The
Gulton Industries, Inc.
Hewlett-Packard Co.
Hispano-Suiza
Carl E. Holmes Co.
INTERELECTRONICS CORP. SEE ADV. P. 260
Kevlin Mfg. Co.
Narda Microwave Corp., The
North Electric Co.
PRD Electronics, Inc.
Radio Corp. of America
Servo Corp. of America
Simmonds Precision Products, Inc.
Standard Telephones & Cables, Ltd.
Thermovolt Instruments, Ltd.
Victory Engineering Corp.
Weinschel Engineering Co., Inc.
Westinghouse Electric Corp.
Yellow Springs Instrument Co., Inc.

Thermocouple Accessories

Advanced Dynamics, Inc.
Advanced Technology Laboratories, Div. American-Standard
Aero Research Instrument Dept., Advanced Technology Labs.
Amperex Electronic Corp.
B. G. Corp., The
Bristol Co., The
Central Dynamics, Ltd.
Conax Corp.
Consolidated Controls Corp.
Claud S. Gordon Co., Sub. Pneumodynamics Corp.
Gulton Industries, Inc.
Kinetics Corp., Sub. Waltham Precision Instrument Co., Inc.
Leeds & Northrup Co.
Lewis Engineering Co.
National Beryllia Corp.
Pall-Trinity Micro Corp., Sub. of Pall Corp.
Qualified Air Components
Thermo Electric Co., Inc.
Thermo Electric Canada, Ltd.
Thermovolt Instruments, Ltd.
Union Carbide Stellite Co., Div. Union Carbide Corp.
United Sensor & Control Corp.
West Instrument Corp.
Weston Instruments & Electronics, Div. Daystrom, Inc.

Thermocouples

1. Basic, 2. High-temperature, 3. Pyrometric, 4. Reference Junction, 5. Vacuum-type

A.I.R. Corp., 1, 2
Advanced Dynamics, Inc., 1, 2, 3
ADVANCED PRODUCTS CO., THE, 1. SEE ADV. P. 262
Advanced Technology Laboratories Div., American-Standard, 1, 2, 3, 4, 5
Aero Research Instrument Corp., Advanced Technology Labs., 1, 2, 3, 4
Aircraft Components, Inc., 1
American Instrument Co., 2, 4
Amperex Electronic Corp., 2
Auto Control Laboratories, Inc., 1, 2, 3, 5
B.G. Corp., The, 1, 2, 4
Baldwin-Lima-Hamilton Corp., Electronics Div., 2
Barnes Engineering Co.
J. Bishop & Co., Platinum Works, 2
Bristol Co., The, 1, 2, 3, 4
British Insulated Callenders Cables, Ltd., 1, 2, 3, 4
Central Dynamics, Ltd., 1, 2, 3, 4
Conax Corp., 1, 2
Consolidated Airborne Systems, Inc., 4
Consolidated Controls Corp., 1, 4
Consolidated Ohmic Devices, Sub. Consolidated Airborne Systems, 4
Consolidated Vacuum Corp., 5
Cosmodyne Corp., 5
S. Davoll & Sons, Ltd., 1, 2, 3, 4
Elion Instruments, 5
Engelhard Industries, Inc., 2
Farrand Optical Co., Inc., 1
Fenwal, Inc., 1, 4
Fredericks Co., The, Vacuum Instrument Div., 5
Garwin, Inc.
General Electric Co., Instrument Dept., 1, 2, 3, 4, 5
Genisco, Inc., 4
Claud S. Gordon Co., Sub. Pneumodynamics Corp., 1, 2, 3, 4
Gulton Industries, Inc., 3
Hanlon & Wilson Co., 1, 2
Hawker Siddeley Canada, Ltd., Engineering Div., 1, 2, 4
High Vacuum Equipment Corp., 5
A. F. Holden Co., The, 3
Honeywell, Military Products Group, 1, 2, 3
Hughes Aircraft Co., Vacuum Tube Products Div., 5
ITT General Controls, Inc., 3
International Tel. & Tel. Corp.
Joseph Kaye & Co., Inc., 4
Kinetics Corp., Sub. Waltham Precision Instruments Co., Inc., 1, 2, 3
Leeds & Northrup Co., 1, 3, 4
Lewis Engineering Co., 1, 2, 3, 4
Lockheed Aircraft Corp.
MARTIN CO., DIV. MARTIN-MARIETTA CORP., 2. SEE ADV. P. 224
Martin-Marietta Corp., Nuclear Div., 2
Raymond F. McHugh & Son, Inc., 1, 2, 3
Meco, Inc., 1, 2
MICRODOT, INC., 1, 4. SEE ADV. P. 198
Pace Engineering Co., 4
Pacific Transducer Corp., 3
Pall-Trinity Micro Corp., Sub. of Pall Corp., 1, 2
Physical Sciences Corp., 2
Pyrometer Instrument Co., Inc., 3
Radiation Technology, Inc.
Radio Corp. of America, 2, 4
Revere Corp. of America, Sub. Neptune Meter Co., 1, 4
Royco Instruments, Inc., 3
Servomechanisms, Inc., 4
S. Smith & Sons England, Ltd., Spark Plug & Ceramics Div., 3
Thermo Electric Co., Inc., 1, 2, 3, 4
Thermo Electric Canada, Ltd., 1, 2, 3, 4
Thermovolt Instruments, Ltd., 1 ,2, 3, 4, 5
United Sensor & Control Corp., 1
Vactek, Inc., Sub. Geophysics Corp. of America, 5
Vacuum Electronics Corp., 5
West Instrument Corp., 1, 2, 3
Weston Instruments & Electronics Div., Daystrom, Inc., 1, 2, 3, 4, 5

Thermoelectric Devices

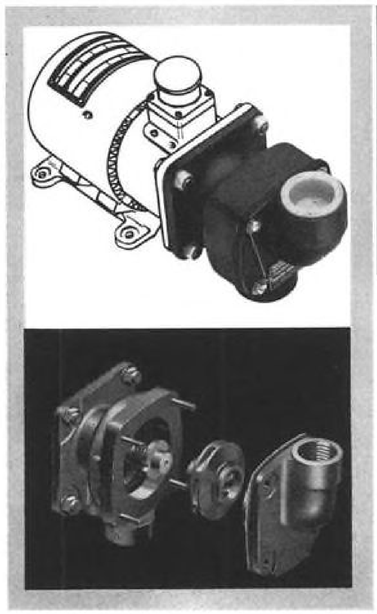
ACEC
Aero Geo Astro Corp.
Astropower, Inc., Sub. Douglas Aircraft Co., Inc.
Atlee Corp.
Auto Control Laboratories, Inc.
Block Engineering, Inc.
CSF-Compagnie Generale de Telegraphie Sans Fil
Cambridge Systems, Inc.
Cambridge Thermionic Corp.
Cannon Electric G B, Ltd.
Carrier Corp.
Catalyst Research Corp.
Central Dynamics, Ltd.
Electro-Optical Systems, Inc.
Engel & Gibbs, Ltd.
General Devices, Inc.
General Instrument Corp., Defense & Engineering Products Group, Radio Receptor Div.
Genisco, Inc.
Goodyear Aerospace Corp.
Gulton Industries, Inc.
Hi-G, Inc.
Lewis Engineering Co.
Lockheed Aircraft Corp.
Lumen, Inc.
MARTIN CO., DIV. MARTIN-MARIETTA CORP. SEE ADV. P. 224
Martin-Marietta Corp., Nuclear Div.
Minnesota Mining & Mfg. Co., New Product Liaison
North American Aviation, Inc., Atomics International Div.
Pall-Trinity Micro Corp., Sub. of Pall Corp.
PESCO PRODUCTS DIV., BORG-WARNER CORP. SEE ADV. P. 34
Radio Corp. of America
Relco Products
Santa Barbara Research Center
Servomechanisms, Inc.
Societe Alsacienne de Constructions Mecaniques, Dept. Energie Nucleaire Telecommunications-Electronique
Sperry Gyroscope Co., Div. Sperry Rand Corp.
Staver Co., Inc.
Sylvania Electric Products, Inc., Special Products Div.
Talley Corp.
Thermo Electric Canada, Ltd.
Thermovolt Instruments, Ltd.
Westinghouse Electric Corp., Aerospace Electrical Dept.
Westinghouse Electric Corp., Semiconductor Marketing Dept.
Westinghouse Research and Development Center, Westinghouse Electric Corp.
Weston Instruments & Electronics Div., Daystrom, Inc.

Thermometers

1. Cabin Temperature, 2. Electrical Resistance, 3. Electronic Resistance, 4. Fuel Temperature, 5. Oil Temperature, 6. Ram Air Temperature

A. I. R. Corp., 1, 2, 3, 4, 5, 6
Advanced Technology Laboratories, Div. American-Standard
AEROTEC INDUSTRIES, INC., AIRCRAFT EQUIPMENT DIV., 4, 5. SEE ADV. P. 163
Aircraft Components, Inc., 5
Automation Dynamics Corp., 3
Bancroft Industries (62), Ltd.
Barnes Engineering Co., Instrument Div.
Bendix Corp., The, Pioneer-Central Div.
Bristol Co., The, 2
Consolidated Airborne Systems, Inc., 1, 4, 5, 6
Consolidated Ohmic Devices, Sub. Consolidated Airborne Systems, 2, 3, 4, 5, 6
W. C. Dillon & Co., 4, 5
Thomas A. Edison Industries, Instrument Div., 1, 2, 4, 5
Electro Mechanisms, Ltd., 2
Electronic Processes Corp., 3
Fenwal, Inc.
Garwin, Inc., 1, 2, 4
Giannini Controls Corp., 1, 2, 3, 4, 5, 6
Greiner Scientific Corp., 3
Gulton Industries, Inc., 3
Hallikainen Instruments, 2
Hi-G, Inc., 2
Honeywell, Military Products Group, 1, 2, 3, 4, 5, 6
International Tel. & Tel. Corp.
Kahn & Co., Inc., 2
Lewis Engineering Co., 1, 2, 4, 5, 6

CIRCLE ESS BIG
3
Over 180 STANDARD *FLEXIBLE SHAFT COMBINATIONS
Thousands of Pre-Designed *FLEXIBLE SHAFT Special Combinations
Experience to Design a *FLEXIBLE SHAFT Combination for Your Specific Application
Circle Ess Standard used with Servo Motor
Circle Ess Standard used with Variable Speed Motor
* All Circle Ess Flexible Shaft Combinations Available with Mono-Directional or Bi-Directional Cable
Circle Ess Standard used with Hand Held Tachometer
Plus
A Complete Line of
Small Angle Drives
"T" Angle Drive
Right Angle Drive
We Solicit Your Inquiry and the Opportunity to Offer a Quotation
F.W. STEWART CORP.
4311-13 RAVENSWOOD AVENUE · CHICAGO 13, ILL.
WEST COAST PLANT: 3404 So. Grand Ave., LOS ANGELES 7, CALIFORNIA
CIRCLE ESS
Circle Number 254 on Reader Service Card



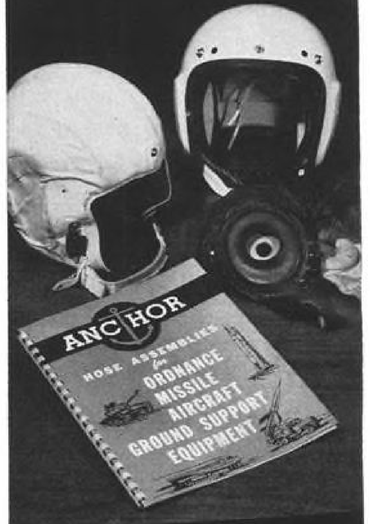
From Roper Aviation:
CENTRIFUGAL BOOSTER & SUPPLY PUMPS

Unit design is simple, compact. Through-flow impeller carries liquid through shaft end of impeller and out finned perimeter. Motor life is prolonged, since power input required by the unit drops as flow is reduced, even though output pressure remains constant. "Fail safe" feature prevents restriction of through-flow should unit become inoperative during operation as booster pump. Discharge rates to 150 gpm and operating pressures to 200 psi can be accomplished. It has served in applications involving handling of jet fuels, oils, water, ethylene glycol solutions, and other liquids.

Write for free folder. For information regarding special designs of the centrifugal booster and supply pumps, contact us today giving as much specific detail as possible.

ROPER AVIATION & SPECIAL PRODUCTS
DIV. OF ROPER HYDRAULICS, INC.
530 BLACKHAWK PARK ROCKFORD, ILLINOIS

MIL-SPECS are Old Hat at Anchor...



We have been designing and manufacturing hydraulic hose assemblies for over 25 years

Today—Anchor Hose Assemblies conforming to MIL-SPECS include HDP* high density polyethylene hose for high pressure transfer of compressed gas; high pressure "Teflon"** Oxygen hose for charging aircraft with breathing oxygen; one-wire and two-wire hose assemblies for medium and high pressure ground support applications; and many others. Anchor Assemblies have proved "A-OK" under all conditions.

Ask for this special catalog

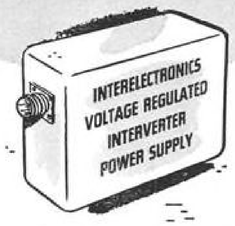
ANCHOR COUPLING CO. INC.

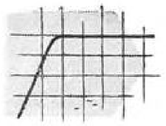
ANCHOR

*Anchor Trademark
**DuPont Trademark

315 North Fourth St.,
Libertyville, Ill.
Branch Plants: Dallas, Tex., Plymouth, Mich., Los Angeles, Calif., Wilmington, Del., Atlanta, Ga.

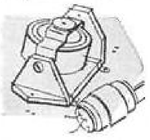
PROVEN RELIABILITY—
SOLID-STATE POWER INVERTERS
over 260,000 logged hours— voltage-regulated, frequency-controlled, for missile, telemeter, ground-support, 135°C all-silicon units available now—











Interelectronics all-silicon thyratron-like gating elements and cubic-grain toroidal magnetic components convert DC to any desired number of AC or DC outputs from 1 to 10,000 watts.

Ultra-reliable in operation (over 260,000 logged hours), no moving parts, unharmed by shorting output or reversing input polarity. Wide input range (18 to 32 volts DC), high conversion efficiency (to 92%, including voltage regulation by Interelectronics patented reflex high-efficiency magnetic amplifier circuitry).

Light weight (to 6 watts/oz.), compact (to 8 watts/cu. in.), low ripple (to 0.01 mv. p-p), excellent voltage regulation (to 0.1%), precise frequency control (to 0.2% with Interelectronics extreme environment magnetostrictive standards or to 0.0001% with fork or piezoelectric standards).

Complies with MIL specs. for shock (100G 11 misc.), acceleration (100G 15 min.), vibration (100G 5 to 5,000 cps.), temperature (to 150 degrees C), RF noise (I-26600).

AC single and polyphase units supply sine waveform output (to 2% harmonics), will deliver up to ten times rated line current into a short circuit or actuate MIL type magnetic circuit breakers or fuses, will start gyros and motors with starting current surges up to ten times normal operating line current.

Now in use in major missiles, powering telemeter transmitters, radar beacons, electronic equipment. Single and polyphase units now power airborne and marine missile gyros, synchros, servos, magnetic amplifiers.

Interelectronics—first and most experienced in the solid-state power supply field produces its own all-silicon solid-state gating elements, all high flux density magnetic components, high temperature ultra-reliable film capacitors and components, has complete facilities and know how —has designed and delivered more working KVA than any other firm!

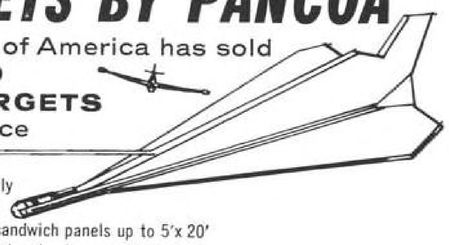
For complete engineering data, write Interelectronics today, or call LUdlow 4-6200 in New York.

INTERELECTRONICS CORPORATION
2432 Grand Concourse, New York 58, N. Y.

Circle Number 259 on Reader-Service Card

TOW TARGETS BY PANCOA

Panel Corporation of America has sold more than **10,000 DART TOW TARGETS** to the U.S. Air Force



We have 30,000 sq. ft. of completely equipped laminating plant, devoted exclusively to the manufacture of sandwich panels up to 5'x 20' and up to 12" thick. We invite your inquiry for special products.

PAN 3-1-

PANEL CORPORATION OF AMERICA
745 SOUTH CHEROKEE STREET • DENVER, COLORADO 80223 • DIAL (303) 744-1353



FLIGHT INSTRUMENTS for Space Science Research

are described in new Keithley Space Science Catalog. It contains full specifications and prices for all standard electrometer amplifiers and dc to dc converters. Our capabilities for designing custom amplifiers, associated circuitry and complete systems are fully described.

Keithley electrometer amplifiers include linear, logarithmic and automatic ranging units capable of measuring to 5 x 10^{-13} ampere full scale. These instruments have helped scientists in rocket and satellite probes since the first Vanguard series. Applications include measurement of ultraviolet light, ion densities, gamma rays and x-ray radiation from solar flares.

SEND FOR NEW CATALOG ON SPACE SCIENCE FLIGHT INSTRUMENTS

K.

KEITHLEY INSTRUMENTS

12415 Euclid Avenue • Cleveland 6, Ohio

Circle Number 260 on Reader-Service Card

Circle Number 261 on Reader-Service Card

Crescent Engineering & Research Co., 1, 3, 4, 6
Datametrics, Inc., 3
Daystrom, Inc., Electric Div.
Decker Corp., The, 1, 2, 3, 4, 5, 6
Del Electronics Corp., 6
Henry G. Dietz Co., Inc., 1, 2
W. C. Dillon & Co., 6
Dynisco Div., American Brake Shoe Co., 1, 3
Edcliff Industries, Sub. General Laboratories, 3
Thomas A. Edison Industries, Instrument Div., 2, 3, 4
Edo Canada, Ltd., 5, 6
Electra Scientific Corp., 6
Electro Mechanisms, Ltd., 1, 3, 4, 6
Electro Products Laboratories, Inc., 5, 6
Electronic Processes Corp., 4
Electronic Systems Div., Antenna Systems, Inc., 5
Electro Technical Labs. Div., Mandrel Industries, Inc., 3
Endevco Corp., 3, 6
Fairchild Controls, 1, 2, 3
Fenwal, Inc., 4
Ferranti, Ltd., 6
Franklin Systems, Inc., 6
Fredericks Co., The, Vacuum Instrument Div., 6
Garrett Corp., The, 1, 3, 4
Garrett Mfg., Ltd., Sub. The Garrett Corp., 1, 4
General Applied Science Labs., 3
General Dynamics/Electronics—Rochester, 2, 3, 5, 6
General Electric Co., Instrument Dept., 1, 2, 3, 4, 5, 6
General Instrument Corp., Defense & Engineering Products Group, Radio Receptor Div., 1
Genisco, Inc., 1
Geortronic Labs., Inc., 6
Geotechnical Corp., The, 3, 4, 6
Giannini Controls Corp., 1, 2, 3, 4, 6
Glassco Instrument Co., 3
Gordon Enterprises, 3, 6
Gow-Mac Instrument Co., 6
Guidance & Control Systems Div., Litton Industries, Inc., 3
Gulton Industries Canada, Ltd., 6
Gulton Industries, Inc., 1, 3, 4, 6
W. & L. E. Gurley, 6
Hamilton Standard Div., United Aircraft Corp.
Hamlin, Inc., 2
Hastings-Raydist, Inc., 3
Hawker Siddeley Aviation, 3, 4, 6
Heliotek, Div. of Textron Electronics, Inc., 6
Hi-G, Inc., 4
Honeywell, Military Products Group, 1, 2, 3 ,4, 6
Houston Engineering Research Corp., 3
Humphrey, Inc., 6
Industrial Measurements Corp., 6
Infrared Industries, Inc., 4
International Resistance Co., 2, 3, 6
Jamieson Industries, Inc., 6
Kaman Nuclear, 1, 2, 3, 5
Kistler Instrument Corp., 3, 6
Kollsman Instrument Corp., Sub. Standard Kollsman Industries, Inc., 3
Leeds & Northrup Co., 4
Wallace O. Leonard, Inc., 1, 2, 3, 4
Lewis Engineering Co., 4
Ling-Temco-Vought, Inc., 6
Liquidometer Corp., The, 2
Lockheed Aircraft Corp.
Lumen, Inc., 5
Magnetic Controls Co., 4, 5, 6
Markite Corp., 6
MARTIN CO., DIV. MARTIN-MARIETTA CORP. SEE ADV. P. 224
McQuiston Associates
Mektron Div., California General, Inc., 6
Meriam Instrument Co., The, 5
Metcut Research Associates, Inc., 1, 3, 4, 6
MICRODOT, INC., 1, 4. SEE ADV. P. 198
Micro Systems, Inc., Sub. Electro Optical Systems, Inc., 1, 3, 4, 6
Minatron Corp., 6
Minco Products, Inc., 4
Molectro Corp., 5
Noller Control Systems, Inc., 5
Northrop Corp.
John Oster Mfg. Co., Avionic Div., 6
Pace Engineering Co., 3
Palomar Scientific Corp., Sub. United Control Corp., 6
Philco Corp., Sub. Ford Motor Co., 5
Photocon Research Products, 3
Physical Sciences Corp., 1, 3, 4, 6
Piezoelectric Div., Clevite Corp., 5
Pioneer Magnetics, Inc., 5
Quantic Industries Inc., Pelmac Div., 3
RDF Corp., 4
Raytheon Co., Government Marketing, 3, 4, 6
Razdow Laboratories, Inc., 6
Remm Co.
Research, Inc., 6
Revere Corp. of America, Sub. Neptune Meter Co., 1, 2, 3, 4
Rhodes & Bloxsom, 3
Riverbank Laboratories, Dept. Engineering
Robertshaw Controls Co., Milford Div., 3, 4
Rosemount Engineering Co., 3, 4, 6
Rotax, Ltd., 3
SANBORN CO., 1, 3, 4, 6. SEE ADV. P. 66
Scanivalve Co., 3
Scientific Advances, Inc., 3
Semi-Elements, Inc.
Servomechanisms, Inc., 1, 2, 3, 4
Servonic Instruments, Inc., 3
Societe Alsacienne de Constructions Mecaniques. Dept. Energie Nucleaire Telecommunications—Electronique, 5, 6
Societe de Fabrication de Instruments de Mesure, 1, 3, 4, 6
Solartron Electronic Group, Ltd., The, 3, 4
Solid State Electronics Corp., 3
Sonobond Corp., Sub. Aeroprojects, Inc., 2, 4
Southern Instruments, Ltd., 3
Space Instrumentation Corp., 6
Sparton Corp., Sparton Electronics Div., 3, 6
Sperry Gyroscope Co., Div. Sperry Rand Corp., 6
Standard Controls, 3
Standard Products, Inc., 2, 3, 4, 6
Statham Instruments, Inc., 1, 3
Stephens-Trusonic, Inc., 3, 6
Strainsert Co., 3, 6
TRG, 6
Taber Instrument Corp., Aero Space Electronics Div., 3
TACTAIR FLUID CONTROLS CORP., 1. SEE ADV. P. 184
Tamar Electronics, Inc., 3, 6
Task Corp., 6
Teddington Aircraft Controls, Ltd., 3
Temtech, Inc., 4
Thermal Systems, Inc., 4
Theta Instrument Corp., 6
Tracerlab Div., Laboratory For Electronics, Inc., 2, 6
Trans-Sonics, Inc., 2, 3, 4
Tylan Corp., 4
United Control Corp., 4, 6
United Electric Controls Co., 3
U. S. Science Corp., 6
Vinson Mfg. Co., Inc., 1, 2, 3, 5, 6
WacLine, Inc., 4, 5
Wang Laboratories, Inc., 6
Westinghouse Electric Corp., 2, 3, 4, 5, 6
Weston Instruments & Electronics Div., Daystrom, Inc.
Wiancko Engineering Co., Div. Tamar Electronics, Inc., 3, 6

Transformers

ACF Industries, Inc.
AMP, INC. SEE ADV. P. 99, 100, 101, 102
A. P. W. Co.
Acme Electric Corp.
Acme Electric Corp., Ltd.
Aero Precision Industries, Inc.
Airpax Electronics, Inc.
Aladdin Electronics
Allis-Chalmers Mfg. Co.
Amplifier Corp. of America
R. B. Annis Co.
Arnold Magnetics Corp.
Artronic Instrument Co.
Astrosystems, Inc.
Bach Simpson, Ltd.
Barwood Electronics, Inc.
Behlman-Invar Electronics Corp.
Bendix Corp., The York Div.
Bulova Electronics Div., Bulova Watch Co., Inc.
Burnell & Co.
CELCO (Constantine Engineering Laboratories Co.)
CLM Industries, McGraw-Edison Canada, Ltd.
CSF-Compagnie Generale de Telegraphie Sans Fil
California Magnetic Control Corp.
Cambridge Thermionic Corp.
CANADIAN MARCONI CO. SEE ADV. P. 18, 19
Central Transformer Co.
Cohu Electronics, Inc., Kin Tel Div.
Coil Co. of America, Inc.
A. C. Cossor, Ltd., Cossor Electronics, Ltd.
Cycle Transformer Corp.
Del Electronics Corp.
Delta Star Electric Div., H. K. Porter Co., Inc.
Dewitt Development Co.
Double "E" Products Co.
Dresser Electric Co.
Dresser Electronics, HST Div.
Dynalectron Corp.
Edgerton, Germeshausen, Grier, Inc.
Electro Development Corp.
Electro Engineering Works
Electronic Research Associates, Inc.
Electro Physics Co.
Electrosolids Corp.
Epco Products, Inc.
Espey Mfg. & Electronics Corp.
Ferranti Electric, Inc.
Ferranti, Ltd., Edinburgh Div.
Ferranti Packard Electric, Ltd.
Fisher Engineering, Inc.
Forbes & Warner, Inc.
Freed Transformer Co., Inc.
Fugle Miller Laboratories, Inc.
General Electric Co., Marine & Defense Facilities Sales Operation
General Precision, Inc., Information Systems Group (Commercial Computer Div.)
General Precision, Inc., Information Systems Group (Librascope Div.)
General Radio Co.
Geortronic Labs, Inc.
Green Rectifier Co.
Gudeman Co. of California, Inc.
Gulton Industries, Inc.
Donald C. Harder Co.
Hevi-Duty Electric Co.
Hi-G, Inc.
A. F. Holden Co., The
ITT General Controls, Inc.
Intercontinental Electronics Corp.
International Tel. & Tel. Corp., ITT Federal Laboratories Div.
JFD Electronics Corp.
Jamieson Industries, Inc.
Kinetics Corp., Sub. Waltham Precision Instrument Co., Inc.
Knopp, Inc.
Kolton Electric Mfg. Co.
Kurz & Root Co., Inc.
Langevin Div., Sonotec, Inc.
Lavoie Laboratories, Inc.
Ling-Temco-Vought, Inc.
Lumen, Inc.
Mace Corp.
Magnetic Circuit Elements, Inc.
Manson Laboratories, Inc.
McGraw-Edison Co., Line Material Industries
MICRODOT, INC. SEE ADV. P. 198
Microtran Co.
Milro Controls Co., Inc.
Moore Associates, Inc.
Morey Corp.
National Coil Co.
Notifier Corp./Notifier Engineering, Inc.
Ohmite Mfg. Co.
Osborne Electric Co., Ltd.
Pearson Electronics, Inc.
Permoflux Corp.
Polyphase Instrument Co.
Power Designs Pacific, Inc.
Products Research Co.
R. B. Pullin & Co., Ltd.
Pulse Engineering
Quam Nichols Co.
Qutronic Transformer Corp.
Raytheon Co., Microwave & Power Tube Div.
Raytheon Canada, Ltd.
Redman Electronics Corp.
Rotax, Ltd.
Sciaky Brothers
Sciaky S.A.
Servomechanisms, Inc.
Siltronics, Inc.
Sola Basic Products, Ltd.
Solid State Electronics Corp.
Sparton Corp., Sparton Electronics Div.
Spectran Electronics Corp.
Sperry Gyroscope Co., Div. Sperry Rand Corp.
Superior Electric Co., The
Sylvania Electric Products, Inc., Sub. General Telephone & Electronics Corp., Lighting Products Div.
Sylvania Electric Products Inc., Special Products Div.
Thermador Electrical Mfg. Co., Electronics Plant
Torwico Electronics, Inc.
Transformer Specialty Co.
Transformer Electronics Co.
Transformers, Inc.
United Transformer Corp.
Varo, Inc.
Virginia Electronics Co., Inc.
WacLine, Inc.
Waltham Precision Instrument Co., Electromechanical Div.
Westinghouse Electric Corp.
Weston Instruments & Electronics Div., Daystrom, Inc.
Wheeler Electronic Co., Div. Sperry Rand
Whiteley Electrical Radio Co., Ltd.

Transistors

American Electronics Labs, Inc.
Amperex Electronic Corp.
AVNET ELECTRONICS CORP. SEE ADV. P. 81, 84, 86, 93, 223, 272
Burroughs Corp., Electronic Components Div.
CSF-Compagnie Generale de Telegraphie Sans Fil
Clark Semiconductor Div., National Semiconductor Corp.
Clevite Corp., Clevite Transistor Div.
Clevite Transistor, Palo Alto Plant
DELCO RADIO DIV., GENERAL MOTORS CORP. SEE ADV. P. 118
Fairchild Semiconductor
Ferranti, Ltd.
General Electric Co., Semiconductor Products Dept.
General Instrument Corp., Semiconductor Products Group
Honeywell, Military Products Group
Hughes Aircraft Co., Semiconductor Div.
Leland Airborne Products, American Machine & Foundry Co.
Motorola, Inc.
Motorola Semiconductor Products, Inc.
National Semiconductor Corp.
Philco Corp., Sub. Ford Motor Co.
Philco Corp., Lansdale Div., Sub. Ford Motor Co.
Radio Corp. of America
Raytheon Co., Semiconductor Div.
Raytheon Canada, Ltd.
SILICON TRANSISTOR CORP. SEE ADV. P. 191
Siliconix, Inc.
Solid State Electronics Corp.
Solid State Products, Inc.
Spasors, Inc., Sub. Silicon Transistor Corp.
Sperry Gyroscope Co., Div. Sperry Rand Corp.
Sperry Semiconductor Div., Sperry Rand Corp.
Sprague Electric Co.
Standard Telephones & Cables, Ltd.
TRW Electronics, Inc., Div. Thompson Ramo Wooldridge, Inc.
Texas Instruments Incorporated, Semiconductor Components Div.
Thompson Ramo Wooldridge, Inc.
Tung-Sol Electric, Inc.
Western Semiconductors, Inc.

Translators

Adler Electronics, Inc.
All Language Services, Inc.
ASTRODATA, INC. SEE ADV. P. 150
Beckman Instruments, Inc., Berkeley Div.
Beckman Instruments, Inc., Systems Div.
Conductron Corp.
A. C. Cossor, Ltd., Cossor Electronics, Ltd.
Datex Corp., Sub. Giannini Controls Corp.
Goodyear Aerospace Corp.
Hewlett-Packard Co., Dymec Div.
Ling-Temco-Vought, Inc.
Physical Sciences Corp.
Radio Corp. of America
Thermovolt Instruments, Ltd.
Wang Laboratories, Inc.

Transmissions

1. Fluid, 2. Mechanical

Advance Gear & Machine Corp., 2
Allison Div., General Motors Corp.
Canadian Curtiss-Wright, Ltd., 1
CATERPILLAR TRACTOR CO., DEFENSE PRODUCTS DEPT., 2. SEE ADV. P. 22
Clark Equipment Co., Development Div.
Curtiss-Wright Corp., Curtiss Div., 2
Curtiss-Wright Corp., Wright Aeronautical Div., 2
Dowty Equipment of Canada, Ltd., 1
Fairchild Stratos Corp., Stratos Div., 1, 2
Falk Corp., The
Fenn Mfg. Co., The, 2
Found Bros. Aviation, Ltd.
General Electric Co., Aircraft Accessory Turbine Dept.
Hewitt-Robins, Inc., 2
Hewitt-Robins, Inc., Foote Bros. Gear Div., 2
Hispano-Suiza, 1, 2
Kelsey Hayes Co., Steel Products Engineering Co., 2
Lawrence Aviation Industries, Inc., 2
Link Belt Co., 1, 2
Lycoming Div., Avco Corp., 2
Messier S.A., 1
Metron Instrument, Inc.
Parker-Hannifin Corp., Parker Aircraft Co. Div.
Paul Munroe Hydraulics, Inc., 1
Perfect Gear & Instrument Corp., 2
Philadelphia Gear Corp., 2
Reliance Electric & Engineering Co., 2
Rockwell Standard Corp., Transmission and Axle Div.
Standard Products, Inc., 2
Sundstrand Aviation-Denver, 1, 2
Szemco, Inc., 1, 2
Technical Oil Tool Corp., 2
Vickers, Inc., Div. Sperry Rand Corp., 1
Vickers, Inc., Tulsa Products Div.
Western Gear Corp., Precision Products Div., 2
York Gears, Ltd., 2
Zurn Industries, Inc., 2

Transmitters

1. Angle of Attack, 2. Fuel Flow, 3. Fuel Pressure, 4. Fuel Quantity, 5. Hydraulic Pressure, 6. Landing Gear Position, 7. Oil Pressure

Acoustica Associates, Inc., 4
Aero Precision Industries, Inc., 4, 6
AEROTEC INDUSTRIES, INC., AIRCRAFT EQUIPMENT DIV., 2, 3, 4, 5, 6, 7. SEE ADV. P. 163
AIRCRAFT POROUS MEDIA, INC., SUB. OF PALL CORP., 3, 5, 7. SEE ADV. P. 157
Barton Instrument Corp., 2
Basic Devices, Inc., 1
Bendix Corp., The, Friez Instrument Div., 2, 3, 4, 5, 7
Bendix Corp., The, Montrose Div., 1, 3, 5, 7
Bendix Corp., The, Pioneer-Central Div., 2, 4
Brooks Instrument Co., Inc., 2
G. L. Collins Corp., 6
Cosmodyne Corp., 1
Cox Instruments Div., Lynch Corp., 2
Crescent Engineering & Research Co.

AVICA
for fluid system components



AVICA-FLEX® Metal Bellows and Bellows Assemblies

are used in both high- and low-pressure liquid and gaseous piping systems. They maintain positive sealing and optimum flow characteristics under conditions of piping misalignment, as well as axial, angular and offset motion. Specified whenever reliable performance is essential.



AVICA® Mechanically Attached Tube Ferrules

For joints of proven reliability under extreme conditions of pressure and vacuum. Simple — dependable — low installation cost. For rigid or flexible metal tube assemblies in fluid or gas transmission.

Developed by Avica to meet the critical needs in the aero-space industries for dependable joints, particularly for fuel systems. Joints formed with AVICA ferrules by Avica tools are quick and simple to make, yet withstand severe operating conditions. A modern method of mechanically attaching joint fittings to rigid or flexible metal tubing assemblies.



AVICA-FLEX® Flexible Metal Tubing Assemblies

Designed for a wide variety of uses in aircraft, jet engine, power plant, guided missile, nuclear, marine and chemical applications, where operational conditions require stainless steel and other alloys to meet extremes of corrosion and temperature.

AVICA PRODUCTS FOR CRYOGENIC APPLICATIONS

Avica is solving increasing numbers of low-temperature liquid- and gas-handling problems by specially engineered applications of its varied products. Available in the three general groups listed above.

WRITE TODAY!

For Free brochures and design check lists on Bellows, Bellows Assemblies, Mechanically Attached Tube Ferrules, Flexible Tubing Assemblies and Avica Products for Cryogenics.



Avica engineered— to meet your requirements.

Inquiries welcome. Prompt delivery of prototype and production quantities.

Contact our representatives or

AVICA CORPORATION

P. O. Box 180 • Newport, Rhode Island
Telephone: VIking 6-9100
TWX Newp. R. I., 564

ENGINEERING AND SALES REPRESENTATIVES:
Air Supply Company
Beverly Hills, California
and offices in principal cities



We've got a crazy balloon!

A balloon with holes! It's made of a very special type of expanded aluminum mesh, laminated between two sheets of a particular plastic. When it's rocketed into space, the balloon inflates through precisely metered action of unique design. The mesh rigidifies. Then the skin melts, condensing in droplets at the mesh junctions. Only the rigid mesh remains—a passive communications satellite. We do it this way because NASA's ECHO satellite showed orbital disturbances due to solar pressure on the surface. Less surface . . . less disturbance. The open configuration also makes for longer life by reducing molecular drag. All this means . . . when you need knowhow in inflatables . . . esoteric expandables . . . or specialized laminates . . . call Viron.

VIRON

A DIVISION OF GEOPHYSICS CORPORATION OF AMERICA
CHAR-GALE BUILDING, ANOKA, MINNESOTA – 612-421-6960

AT HIGH OR CRYOGENIC TEMPERATURES

THE ADVANCED PRODUCTS COMPANY
METAL-O-RINGS

PREVENT CRITICAL SYSTEMS FAILURE . . . LIQUID AND GAS ESCAPE

Extreme environmental and operating conditions encountered in the aerospace industry require sealing methods and products that will perform faultlessly. Advanced Metal-O-Rings, designed to stand up under a wide range of temperatures — and pressures — are today employed on hundreds of aerospace liquid and gas systems to insure positive sealing . . . prevent systems failure.

ADVANCED METAL-O-RINGS

- **SEAL FROM —400°F to 2500°F**
- **RESIST RADIOACTIVITY AND ELECTRONIC CONDITIONS and the corrosive effects of acids and chemicals.**
- **IN DIAMETERS FROM ¼" to 18'**
- **WITHSTAND PRESSURE EXTREMES FROM 10^{-10} mm Hg. to 10,000 psi**
- **PLATED IN SILVER, GOLD, NICKEL, COPPER, ETC.**
- **REPLACEMENT COSTS ARE LOW**
- **MADE IN ALL SHAPES**

SEND US YOUR SEALING PROBLEM AND WRITE FOR FREE 1963 DESIGN MANUAL



THE ADVANCED PRODUCTS COMPANY

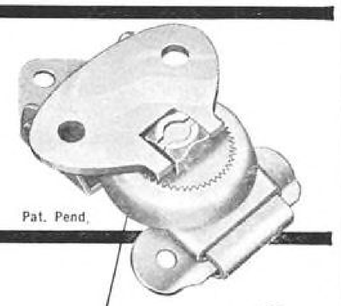
59A Broadway
North Haven, Connecticut

HARTWELL
FINEST IN FASTENERS
RELIABILITY • QUALITY • ECONOMY

Container latches for every application

NEW

DIALATCH . . . The first latch providing adjustment which locks in any position. Dial the tolerances out of your container with the H-444.



Extra Heavy Duty: Ideal for rocket engine containers, the H-315 features "well" construction providing minimum exterior protrusion. Adjustable.

Heavy Duty: For simplicity of installation the H-462 makes provisions for welding the anchor plate prior to assembly of hook and handle. Adjustable.

Intermediate: The H-299 provides a secondary trigger lock, minimized envelope with high tensile properties. Adjustable.

Lightweight: The miniature H-408 affords a full ½" take-up. Concealed handle clears parting plane in unlatched position.

Twenty years of design and manufacturing experience has made possible 6,000 individual latch configurations. Trigger Action, Self Closing, Toggle Hook, Rotary and Missile-Air Latches. Bailatch and Gripwell Handles. Nylatch, Nylatch Clamp, Dialatch, Velcro and Lockwell Pins.



Write on Company Letterhead for complete catalog:

THE HARTWELL CORPORATION

Main Office: 9035 Venice Boulevard, Los Angeles 34, Calif.
Branch Offices: Chicago • Fort Worth • Hackensack • Seattle

Circle Number 268 on Reader-Service Card

Welders

1. Electric, 2. Electron Beam, 3. Gasoline and Diesel Engine, 4. Spot

Ace-Sycamore, Inc., 4
Aerojet-General Corp., Corporate Offices, 1, 2, 4
Air Products & Chemicals, Inc.
Air Reduction Canada, Ltd., 1, 3, 4
Air Reduction Co., Inc., 1, 2, 3
Airline Welding & Engineering, 1
E. W. Bliss Co., 2
Canadian Liquid Air Co., Ltd., 1, 4
Cannon Electric Co., 1
Economics Laboratory, Inc., Aviation & Military Div., 4
John J. Foster Mfg. Co., 4
Gulton Industries, Inc.
Hamilton Standard Div., United Aircraft Corp., 2
Harnischfeger Corp., 1, 3
High Vacuum Equipment Corp., 2
Hughes Aircraft Co., Vacuum Tube Products Div., 1
Kamweld Products Co., 5
Linde Co. Div., Union Carbide Corp., 1
Liquid Carbonic Div., General Dynamics Corp., 1, 4
Marquette Mfg. Co., Inc., 1, 4
Miller Electric Mfg. Co., Inc., 1, 3, 4
MOTOR GENERATOR CORP. (HOBART BROS. AFF.), 1, 3. SEE ADV. P. 269
Murex Welding Processes, Ltd., 1
NRC Equipment Corp., 2
Omark Industries, Inc., 1
Onan Div., Studebaker Corp., 3
Peer, Inc., 1, 4
Physics International Co., 2
Raytheon Co., Commercial Apparatus & Systems Div., Hooksett Plant, 4
Sciaky Brothers, 1, 2, 4
Sciaky Electric Welding Machines, Ltd., 1, 2, 4
Sciaky S. A., 1, 2, 4
Sealol, Inc., 1, 2
A. O. Smith Corp., 1, 3
Stewart Engineering Co., 1, 4
Taylor Winfield Corp., The, 1, 4
Unitek Corp., Weldmatic Div., 1, 4
Vactek, Inc., Sub. Geophysics Corp. of America, 2
Vickers, Inc., Electric Products Div., 1
Western Iron & Foundry Co., Inc.
Westinghouse Electric Corp., 1, 3
Woodwelding, Inc., Cavitron Wood Welder Mfg. Div., 2

Welding Equipment & Supplies

Air Products & Chemicals, Inc.
Air Reduction Canada, Ltd.
Air Reduction Co., Inc.
All State Welding Alloys Co., Inc.
ALUMINUM CO. OF AMERICA. SEE ADV. P. 203, 204
American Optical Co., Safety Products Div.
Ampco Metal, Inc.
BTR Industries, Inc., Engineering & Reinforced Plastics Divs.
Semon Bache & Co.
Behr-Manning Co., Div. Norton Co.
Blowers, Inc.
Canadian Liquid Air Co., Ltd.
Cerro Corp.
Champion Commercial Industries, Inc.
Chemalloy Electronics Corp.
Delaney Gallay, Ltd.
Engelhard Industries, Inc.
Falstrom Co.
Harnischfeger Corp.
Hendrey Relays, Ltd.
Hughes Aircraft Co., Vacuum Tube Products Div.
Huntington Alloy Products Div., The International Nickel Co.
Johnson, Matthey & Mallory, Ltd.
Kamweld Products Co.
Linde Co., Div. Union Carbide Corp.
Liquid Carbonic Div., General Dynamics Corp.
P. R. Mallory & Co., Inc.
Marquette Mfg. Co., Inc.
Metal Removal Co., The
Miller Electric Mfg. Co., Inc.
Mini-Tool Technical Industries, Inc.
MOTOR GENERATOR CORP. (HOBART BROS. AFF.). SEE ADV. P. 269
Murex Welding Processes, Ltd.
Olympic Glove Co., Inc., The
Omark Industries, Inc.
Page Steel & Wire Div., American Chain & Cable Co., Inc.
Plasmadyne Corp.
Raytheon Co., Commercial Apparatus & Systems Div., Hooksett Plant
Sciaky Brothers
Sciaky S. A.
Sellstrom Mfg. Co.
Sippican Corp.
A. O. Smith Corp.
Sonobond Corp., Sub. Aeroprojects, Inc.
Stewart Engineering Co.
Superior Carbon Products, Inc.
Tweco Products, Inc.
Unitek Corp., Weldmatic Div.
Vacuum Specialties, Inc., Sub. Geophysics Corp. of America
Vanadium Alloys Steel Co.
Vickers, Inc., Electric Products Div.
VICTOR EQUIPMENT CO. SEE ADV. P. 29
Weldotron Corp.
Weltronic Co.
Westinghouse Electric Corp.

Welding Service

AGC, Inc.
Advanced Dynamics, Inc.
Aerospace Products, Inc.
Ainslie Corp.
Air Reduction Co., Inc.
Aircraft Tools, Inc.
Airline Welding & Engineering
Airtek Dynamics, Inc.
Albion Welding & Mechanical Works, Ltd.
Alloy Products Corp.
Arnolt Corp.
ARROWHEAD PRODUCTS DIV., FEDERAL-MOGUL-BOWER BEARINGS, INC. SEE ADV. P. 145
Astral Electronics, Inc.
BTR Industries, Inc., Engineering & Reinforced Plastics Divs.
Basic Industries, Inc.
Bell Aerosystems Co., Div. Bell Aerospace Corp., A Textron Co.
Bigelow Co., The
E. W. Bliss Co.
BROOKS & PERKINS, INC. SEE ADV. P. 20
Canadian Liquid Air Co., Ltd.
CATERPILLAR TRACTOR CO., DEFENSE PRODUCTS DEPT. SEE ADV. P. 22
Chrysler Corp., Defense Space Group
Chrysler Corp., Missile Div., Florida Missile Operations
Clevite Corp., Aerospace Div.
Curtiss-Wright Corp., Wright Aeronautical Div.
DK Mfg. Co.
de Havilland Aircraft of Canada, Ltd.
Delaney Gallay, Ltd.
Douglas Aircraft Co., Inc., Missile & Space Systems Div.
Dynamic Industries, Inc.
Electron Beam Techniques
Electronic Parts Mfg. Co., Inc.
Elzee Metal Products Co., Inc.
Ex-Cell-O Corp. of Canada, Ltd.
Falstrom Co.
Federal Machine Co., Inc.
Fleet Mfg., Ltd.
Flight Equipment & Engineering Corp.
G. W. Galloway Co.
Hanlon & Wilson Co.
Hawker Siddeley Canada, Ltd., Engineering Div.
Hayes Corp., The
Helio Aircraft Corp., Mid-States Mfg. Div.
Herlo Engineering Corp.
C. E. Johansson Gage Co., Swedish Gage Co. Affiliate
C. B. KAUPP & SONS, INC. SEE ADV. P. 169, 170
Kellett Aircraft Corp.
Kinetics Corp., Sub. Waltham Precision Instrument Co., Inc.
Otto Konigslow Mfg. Co.
Lukens Steel Co.
Magna Electronics Corp., Ltd.
McGregor Mfg. Corp.
McKay Co., The
Meco, Inc.
Michigan Dynamics, Inc.
Micro Craft, Inc.
Micro Precision Corp.
Midway Co., The
Morfax, Ltd.
MOTOR GENERATOR CORP. (HOBART BROS. AFF.). SEE ADV. P. 269
National Annealing Box Co.
Nooter Corp.
Northrop Corp., Norair Div.
Phoenix Products Co., Inc.
Regent Jack Mfg. Co., Inc.
Rhein Flugzeugau G.m.b.H.
Rockwell Standard Corp., Stamping Div.
Rohr Corp.
Saffran Engineering Co.
Sciaky Brothers
Shawnee Industries, Inc.
Sippican Corp.
Speedway Machine & Tool Co., Inc.
Henry Spen & Co., Inc.
Superweld Corp.
Tate Engineering Co.
Unitron Engineering Co.
Universal Match Corp., Unidynamics Div.
Vertol Div., Boeing of Canada, Ltd.
Victory Tool & Machine Co., Ltd.
Washington Aluminum Co., Inc.
Washington Technological Associates, Inc.
Westinghouse Electric Corp.
Westport Development & Mfg., Inc.
White & Riches, Ltd.
Henry Wiggin & Co., Ltd.

Wheels

1. Aircraft, 2. Cutting, 3. Ground Equipment

Aerol Co., Inc., 3
Aircraft Equipment Co., 3
Allison-Campbell Div., American Chain & Cable Co., Inc., 2
Behr-Manning Co., Div. Norton Co., 2
Bendix Corp., The, Bendix Products Aerospace Div., 1
Craig Systems, Inc., 3

Bowty Equipment of Canada, Ltd., 1
Dunlop Rubber Co., Ltd., 1
Elgin National Watch Co., Industrial Group, 2
Fairbanks Co., The, 3
Faultless Caster Corp., 3
Firestone Tire & Rubber Co. of Canada, Ltd., 1
General Tire & Rubber Co., Government & Aviation Div., 1, 3
Gichner Iron Works, 3
B. F. Goodrich Aerospace & Defense Div., B. F. Goodrich Co., 1, 2, 3
B. F. Goodrich Canada, Ltd., 1
Goodyear International Corp., Aviation Products Div., 1
Goodyear Tire & Rubber Co., Aviation Products Div., 1, 3
Hadco Engineering Co., 3
Hamilton Caster & Mfg. Co., 3
Harper Trucks, Inc., 3
Hispano-Suiza, 1
Kelsey-Hayes Co.
Messier S. A., 1
Minnesota Mining & Mfg. Co., 2
Navan Products, Inc., Sub. North American Aviation, 2
M. Neushul Co., Inc., 3
Pekay Abrasives, Inc., 2
Raybestos-Manhattan, Inc., 2
Saginaw Products Corp., 3
Scott Aviation Corp.
UNITED MFG. CO., 3. SEE ADV. P. 244
U. S. STEEL CORP., 3. SEE ADV P. 110, 111

Winches

Advance Gear & Machine Corp.
Aircraft Armaments, Inc., AE Industrial Div
Aircraft Equipment Co.
Anderson, Greenwood & Co.
Baldwin-Lima-Hamilton Corp., Industrial Equipment Div.
Commercial Engineering Corp.
Dowty Equipment of Canada, Ltd.
E-Z Way Towers, Inc.
Fulton Co.
Garrett Corp., The
Hoover Electric Co.
Hyster Co.
Kelsey-Hayes Co.
Lake Shore, Inc.
Little Giant Products, Inc.
McKiernan-Terry, Div. of Litton Industries
Silent Hoist & Crane Co.
Systems Engineering Div., Pneumodynamics Corp.
Szemco, Inc.
Unit Crane & Shovel Corp., Unit Coles Div.
Vickers, Inc., Tulsa Products Div.
Wadell Equipment Co., Inc.
Welin Davit & Boat Div., Continental Copper & Steel Ind., Inc.
Western Gear Corp., Precision Products Div.
Yale & Towne Mfg. Co., Yale Materials Handling Div.

Wind Socks & Cones

Aerospace Products, Inc.
Aircraft Components, Inc.
BREEZE CORPORATIONS, INC. SEE ADV. P. 277
Cooper Industries, Inc.
C. R. Daniels, Inc., Aviation Div.
General Tire & Rubber Co., Government & Aviation Div.
IRVING AIR CHUTE CO., INC., IRVIN RESEARCH AND DEVELOPMENT CENTER. SEE ADV. P. 223
Security Parachute Co.

Winders, Tape

ACEC
Black Clawson Co., The
Boesch Mfg. Div., Waltham Precision Instrument Co., Inc.
J. H. Bunnell Co.
General Kinetics, Inc.
Holub Industries, Inc.
Prestoseal Mfg. Corp.
Rucker Co., The
Saroban Engineering, Inc.

Windows

1. Aircraft, 2. Infrared, 3. Radiation Shielding, 4. Spacecraft, 5. Synthetic Sapphire

Aerospace Products, Inc.
Aircraft Components, Inc., 1
Atkins & Merrill, Inc., 1
BTR Industries, Inc., Engineering & Reinforced Plastics Divs., 3
Barnes Engineering Co., Defense & Space Div., 2
Barnes Engineering Co., Instrument Div.
Bausch & Lomb, Inc., 2, 3, 5
Ceramaseal, Inc., 5
Corning Glass Works, 1, 2, 3, 4
Fabri-Form Co., The, 1
Farrand Optical Co., Inc., 1, 2
Ferson Optics, Inc., 1, 2, 4
Fluorocarbon Co., The, 2
General Precision, Inc.
Goodyear Aerospace Corp., 1, 4
Goodyear Aerospace Corp., Arizona Div., 1
Harshaw Chemical Co., The, 2
Homalite Corp., 1, 2, 3, 4
Howard Aero, Inc., Mfg. Div. Business Aircraft Corp., 1
Infrared Industries, Inc., 2
Isomet Corp., 2
Itek Corp., 1
Kollmorgen Corp., 2
Libbey-Owens-Ford Glass Co., Liberty Mirror Div., 1, 2
Modern Plastics, 1
Moser Jewel Co., 2, 5
D. Napier & Son, Ltd., 1, 2, 3
Narmco Research & Development Div., Telecomputing Corp., 1, 2, 4
Northrop Corp., Norair Div., 1
Optical Coating Laboratory, Inc., 2, 3, 4
Perkin-Elmer Corp., 3
Pittsburgh Plate Glass Co., 1, 3, 4
Plastic Age Sales, Inc., 1
Polacoat, Inc.
Republic Lens Co., Inc., 2
Republic Steel Corp., Manufacturing Div.
ROHM & HAAS CO., 1. SEE ADV. P. 10
Safetee Glass Co., 1
Sierracin Corp., 2, 3, 4
Swedlow, Inc., 1, 2
Sylvania Electric Products, Inc., Chemical & Metallurgical Div., 2
Te Co., The, 2
Texstar Corp., The, Texstar Plastics Div., 1, 4
Varo, Inc., 2

Windshield Wipers

Acushnet Process Co.
American Bosch Arma Corp., American Bosch Sales Div.
BTR Industries, Inc., Engineering & Reinforced Plastics Divs.
Canadian Curtiss-Wright, Ltd.
Curtiss-Wright Corp., Marquette Div.
Dowty Equipment of Canada, Ltd.
Dunlop Rubber Co., Ltd.
Hispano-Suiza
Hydra-Power Corp.

Windshields

Aerospace Products, Inc.
Aircraft Components, Inc.
Cooper Industries, Inc.
Duplate Canada, Ltd.
Fabri-Form Co., The
Goodyear Aerospace Corp., Arizona Div.
Homalite Corp.
Libbey-Owens-Ford Glass Co., Liberty Mirror Div.
Modern Plastics
D. Napier & Son, Ltd.
Narmco Research & Development Div., Telecomputing Corp.
Pittsburgh Plate Glass Co.
Plastic Age Sales, Inc.
Safetee Glass Co.
Sierracin Corp.
Swedlow, Inc.
Telecomputing Corp.
Texstar Corp., The, Texstar Plastics Div.

Windshields, Electrically Heated

Duplate Canada, Ltd.
Goodyear Aerospace Corp., Arizona Div.
Homalite Corp.
Libbey-Owens-Ford Glass Co., Liberty Mirror Div.
Magnetic Controls Co.
D. Napier & Son, Ltd.
Pittsburgh Plate Glass Co.
Sierracin Corp.
Swedlow, Inc.

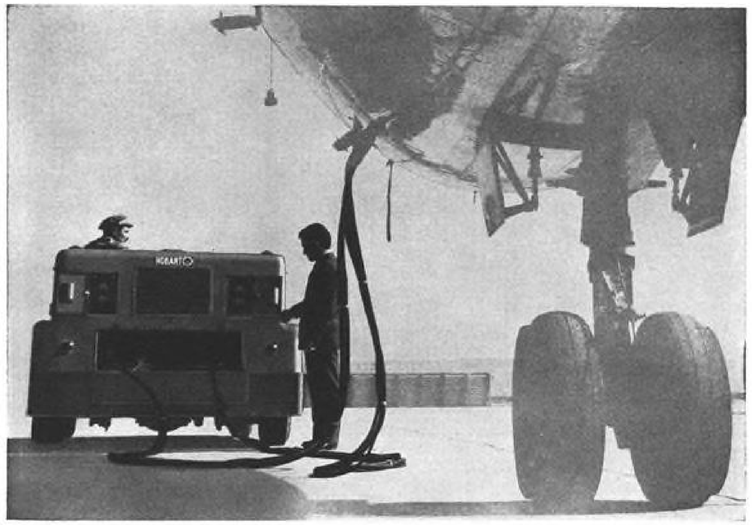
Wipers

1. Cloth, 2. Paper

Anti-Corrosive Metal Products, 1, 2
Canadian Industries, Ltd., 1
Chicopee Mfg. Co., 1, 2

madrid, spain

IBERIA LINEAS AEREAS DE ESPANA GETS RELIABLE MULTI-GROUNDPOWER* SERVICE WITH HOBART JETMOBILES



This apron-eye view shows a Caravelle getting Jetmobile groundpower. Because Jetmobiles can be made to service every type of aircraft electrical system, the modern air carrier can economically use them at both high and low density facilities. Iberia Air Lines of Spain found them ideal for energizing their DC-8's, DC-4's, DC-3's, 440's, Bristols, Constellations, and Caravelles.

***Multi-Groundpower:** AC, 400 Cycle @ 120/208 Volts; DC, 28.5 Volts @ 1500 Amps and 112 Volts @ 250 Amps*

the accepted symbol for the products, service, and capabilities of MGC!
MOTOR GENERATOR CORPORATION
A Hobart Brothers Affiliate
Box AW-123, Troy, Ohio, 45373 Cable: Mogen

Circle Number 269 on Reader-Service Card

Kimberly Clark Corp., 2
Milburn Co., 1
Worklon, Inc., 1

Wire (Also See Metals)

1. Antenna, Airborne, 2. Antenna, Spaceborne, 3. Electrical, 4. Lock, 5. Magnetic, 6. Superconducting

Aircraft Components, Inc., 3
Alpha Wire Corp., 1, 3, 5
ALUMINUM CO. OF AMERICA. SEE ADV. P. 203, 204
AVNET ELECTRONICS CORP., 3. SEE ADV. P. 81, 84, 86, 93, 223, 272
Berkshire Electric Cable Co., 3
J. Bishop & Co., Platinum Works, 3
Boston Insulated Wire & Cable Co., 3
Bram Metallurgical Chemical Co., 3, 4, 6
Brand-Rex Div., American Enka Corp., 3
British Insulated Callenders Cables, Ltd., 3
Cannon-Muskegon Corp.
Cerro Corp., 3
Chester Cable Corp., Sub. Tennessee Corp., 1, 2, 3
Collins Radio Co., 1, 2
Cooper Industries, Inc., 3, 4
Copperweld Steel Co., Wire & Cable Div., 1, 3
A. C. Cossor, Ltd., Cossor Electronics, Ltd., 3
Dayton Aircraft Products, Inc., 1, 2
Wilbur B. Driver Co., 3
Driver-Harris Co., 3
Electric Autolite Co., The, Aero/Space Div., 3, 5, 6
Engelhard Industries, Inc., 3, 5
General Cable Corp., 3, 4
General Insulated Wire Works, Inc., Sub. General Cable Corp., 3
General Wire And Cable Co., Ltd., 3
W. L. Gore & Associates, Inc., 3
Gulton Industries, Inc., 3
Hackensack Cable Corp., 1
Hatfield Wire And Cable Div., Continental Copper & Steel Ind., Inc., 3
Haveg Industries, Inc., 3, 5
HiTemp Wires Co., Div. Simplex Wire & Cable Co., 3, 5
Holyoke Wire & Cable Corp., 3
Illumitronic Engineering Corp., 3, 5
Inso Electronic Products, Inc., Wire & Cable Div., 3
Kaiser Aluminum & Chemical Corp., 3
Lewis Engineering Co., 3
Loral Electronics Corp., 1, 2, 3, 5
L. Frank Markel & Sons, 3
McGraw-Edison Co., Line Material Industries, 3
National Electric Div., H. K. Porter Co., Inc., 3
National Research Corp. Research Div., 6
National Standard Co., Reynolds Wire Div., 4
Packard Electric Div., General Motors Corp., 3
Page Steel & Wire Div., American Chain & Cable Co., Inc., 4
Phalo Plastics Corp., 3
Phelps Dodge Copper Products Corp., 3
Philadelphia Insulated Wire Co., 3
Physical Sciences Corp., 5
Qualified Air Components, 4
Radio Corp. of America, 6
RADIOTRONICS, INC., 1, 2. SEE ADV. P. 214
Republic Steel Corp.
Revere Corp. of America, Sub. Neptune Meter Co., 3
Reynolds Metals Co., 3
Riverside Alloy Metal Div., H. K. Porter Co., Inc., 4, 5, 6
Rome Cable, Div. of Alcoa, 3
Simplex Wire & Cable Co., 3
Southwire Co., 3
Special Metals, Inc., 3, 5, 6
Spectra-Strip Wire & Cable Corp., 3
Superior Cable Corp., 3
Surprenant Mfg. Co.
Sylvania Electric Products, Inc., Chemical & Metallurgical Div.
Sylvania Electric Products, Inc., Parts Div., 6
Tensolite Insulated Wire Co., Inc., 1, 2, 3
Vanadium Alloys Steel Co., 5
Wandleside Cable Works, Ltd., 3
Warren Wire Co., 3
Western Insulated Wire Co., 3
Westinghouse Electric Corp., 3
Westinghouse Research And Development Center, Westinghouse Electric Corp., 5, 6
Westwood Cable Corp., 1, 2, 3
Whitaker Cable Corp., 3

Wire Products

Accessories Manufacturers, Ltd.
Alpha Wire Corp.
J. Bishop & Co. Platinum Works
Bram Metallurgical Chemical Co.
Buffalo Wire Works Co., Inc.
Carpenter Steel Co., The
Chester Cable Corp., Sub. Tennessee Corp.
Copperweld Steel Co., Wire & Cable Div.
Dynamic Filters Div., Michigan Dynamics, Inc.
Eitel-McCullough, Inc.
Engelhard Industries, Inc.
Essex Mfg. Co., Inc.
General Wire And Cable Co., Ltd.
Gilbert & Bennett Mfg. Co., The
Gulton Industries, Inc.
Gunnar Laboratories, Inc.
Hamilton Watch Co., Industrial Div.
Hanlon & Wilson Co.
Hanover Wire Cloth Div., Continental Copper & Steel Ind., Inc.
Hatfield Wire And Cable Div., Continental Copper & Steel Ind., Inc.
Hitemp Wires Co., Div. Simplex Wire & Cable Co.
Huntington Alloy Products Div., The International Nickel Co.
Illumitronic Engineering Corp.
Lab-Tronics, Inc.
Loral Electronics Corp.
MACWHYTE WIRE ROPE CO. SEE ADV. P. 276
Meco, Inc.
National Standard Co., Reynolds Wire Div.
Reliable Spring & Wire Forms Co., The
Reynolds Metals Co.
Rome Cable Div. Of Alcoa
Skyron Corp.
Steel Co. Of Canada, Ltd., The
Sweet Industrial, Div. Of EMA
Sylvania Electric Products, Inc., Chemical & Metallurgical Div.
Sylvania Electric Products, Inc., Parts Div.
Tensolite Insulated Wire Co., Inc.
Times Wire & Cable Div., The International Silver Co.
W. S. Tyler Co.
Unique Wire Weaving Co., Inc.
U. S. STEEL CORP. SEE ADV. P. 110, 111
Vanadium Alloys Steel Co.
Westinghouse Electric Corp.
Henry Wiggin & Co., Ltd.

Wiring, Printed

Allegri-Tech, Inc., Western Div.
Dorsett Electronics, Inc.
Ferranti, Ltd., Edinburgh Div.
Garlock, Inc.
Gulton Industries, Inc.
Harris Mfg. Co., Inc.
MARTIN CO., DIV. MARTIN-MARIETTA CORP. SEE ADV. P. 224
McMichael Radio, Ltd.
Methode Electronics, Inc.
Micro-Circuits
Monroe Industries, Inc.
Morey Corp.
Packard Electric Div., General Motors Corp.
Radio Corp. of America
Radium Dial Corp.
Sanders Associates, Inc.
G. T. Schjeldahl Co.
Telephonics, Div. of Instrument Systems Corp.
Westinghouse Electric Corp.

Wrappings

Farwest Mfg. Div., Inc.
Plastic Age Sales, Inc.

Wrenches, Universal

Bonney Forge & Tool Works
Canadian Curtiss-Wright, Ltd.
Curtiss-Wright Corp., Marquette Div.
Proto Tool Co., Div. Pendleton Tool Industries, Inc.
Schick Products, Inc.
Snap-On-Tools Corp.

X-Ray

Academy Testing Laboratories, Inc.
BTR Industries, Inc., Engineering & Reinforced Plastics Divs.
Balteau Electric Corp.
Canadian Curtiss-Wright, Ltd.
Canadian Steel Improvement, Ltd.
Dynalectron Corp.
Engis Equipment Co.
Field Emission Corp.
High Voltage Engineering Co.

Guaranteed Protection with Performance Tested

ENVIRONMENTAL MODULES

AIR CONDITIONERS • WATER CHILLERS

AC-60 or 400 cycles DC-28V



Electronic Checkout Equipment
Personnel or Equipment Vans
Computers
Ground Support Air Conditioners

Protect your electronic equipment from overheat—prevent hot spots. Improve reliability and life of components with Environmental Modules. In the past 10 years Hokanson has designed and built more specialized military air conditioning equipment for a wider variety of applications than any other company. This experience is immediately available to solve any of your temperature control problems.

Consult Your VSMF Microfilm Catalog File

Hokanson
SPECIALIZED AIR CONDITIONING
C. G. HOKANSON COMPANY, INC.
2140 Pontius Avenue • Los Angeles 25, Calif. • BRadshaw 2-3268

Circle Number 270 on Reader-Service Card

George W. Klein Aviation Engines & Parts, Inc.
Laboratory For Electronics, Inc.
New York Testing Laboratories, Inc.
St. John X-Ray Laboratory
Sperry Products Div. of Automation Industries, Inc.
Tracerlab Div., Laboratory For Electronics, Inc.
Ultrasonic Research & Testing Laboratories
Westinghouse Electric Corp.

X-Ray Flash Systems

Field Emission Corp.
MB Electronics, Div. Textron, Inc.
Northrop Corp.
Physics International Co.
Westinghouse Electric Corp.

Yokes, Cable & Wire

American Chain & Cable Co., Inc., Automotive & Aircraft Div.
American Chain & Cable Co., Inc., Wire Rope Sling Dept.
Cooper Industries, Inc.
Lab-Tronics, Inc.
MACWHYTE WIRE ROPE CO. SEE ADV. P. 276
McGraw-Edison Co., Line Material Industries
Qualified Air Components
Syntronic Instruments, Inc.
U. S. STEEL CORP. SEE ADV. P. 110, 111

For more information about products and services advertised in the

1964

BUYERS GUIDE ISSUE

fill out the

READER SERVICE CARDS

on pages 255-258

Turn to page 67
for
an alphabetical listing
of
CORPORATION
NAMES & ADDRESSES

SINCE 1883

M. STEINTHAL AND COMPANY INC.

PARACHUTES

engineering and production in the following categories

MISSILE • PERSONNEL • CARGO • DECELERATION
TROOP • WEATHER • RECOVERY
PARACHUTE COMPONENTS
AIR-SEA SURVIVAL EQUIPMENT • LIFE RAFTS
INFLATABLE VESTS • TIE DOWN DEVICES

235 EAST 42ND ST. • NEW YORK 17 NEW YORK • TN 7-4300

M. STEINTHAL & CO., INC.

Circle Number 271 on Reader-Service Card

INDEX OF PRODUCTS

Aviation Week Buyers' Guide Issue

A

Ablative fabrications ... 89
Ablative materials 89
Abrading equipment 89
Acceleration test equipment 89
Accelerators 89
Accelerometers 89
Accumulators 89
Acoustical equipment ... 89
Actuators 90
Adapters, cable & hose... 90
Adhesives 90
Aerial applicating 91
Aerial applicating equipment 91
Aerial surveying 91
Air conditioning equipment 91
Aircraft 91
Aircraft exchange service 91
Alarm systems 91
Alternators 91
Altimeters 92
Ammeters 92
Ammunition 92
Amplidynes 92
Amplifiers 92
Analyzers, chemical 93
Analyzers, electronic 93
Anemometers 93
Annunciators 93
Anodes 96
Anodizing equipment ... 96
Anodizing service 96
Antennas 96
Anti-icing chemicals 96
Anti-icing equipment 96
Anti-skid systems 97
Anti-static equipment ... 97
Anti-vibration equipment. 97
Arming systems 97
Armor 97
Arresting systems, aircraft 97
Asbestos fabrications ... 97
Asbestos materials 97
Asphalt 97
Attenuators, avionic 97
Autopilots 97
Axle materials 97
Axles 97

B

Baffles 97
Baggage conveyance systems 97
Bags 97
Balancing equipment 97
Ballistic devices 97
Balloons 98
Barographs 98
Barometers 98
Barrel finishing equipment.. 98
Barrel finishing service.. 98
Batteries 98
Battery servicing equipment 98
Beacons 98
Beading equipment 98
Bearings 98
Bellcranks 103
Bellows 103
Bellows assemblies 103
Belting 103
Bench test setups..... 103
Benches 103
Bending equipment 103
Bending service 103
Bezels 103
Binoculars 103
Bins, storage 103
Bits 103
Blades, helicopter rotor.. 103
Blades, turbine engine... 103
Blankets 104
Blisters, transparent 104
Blocks, electrical 104
Blow molding equipment. 104
Blow molding service.... 104
Blowers 104
Boards, circuit 104
Boards, flight information 104
Boards, graphic visual control 104
Boards, plotting 104
Boats 104
Bobbins 104
Bolts 104
Books, aerospace subjects 105
Booms 105
Boosters, rocket..... 105
Boots, dust excluder..... 105
Boresights 105
Boring equipment 105

New flexible detonating cord for controlled cutting of any material!



Jetcord, a new detonating cord of seamless continuous metal sheath surrounding an explosive core, cuts metal or any material along a well-defined line. A relatively small amount of explosive in the specially formed metal jacket gives maximum cutting action. Mechanically flexible, the cord can be formed into intricate shapes. Jacket material of lead, copper or aluminum in combination with various explosive cores cuts steel up to ⅝" thick, aluminum alloys up to 1¼" thick or magnesium up to 2" thick. Sizes from 5 grains/foot to over 400 grains/foot.

Write for circular

JETCORD®
Mfg. by Explosive Technology Inc. • 3015 Copper Road, Santa Clara, California

Circle Number 272 on Reader-Service Card

Specify the newest
SEMICONDUCTORS
Semiconductor devices

On-time delivery of Semiconductors by Sperry, U.S. Semcor, Silicon Transistor Corp, Hoffman

All products available
AVNET
From most Local Avnet Headquarters

San Diego, 714-279-1550; Los Angeles; 213 UPO 6141; Sunnyvale, Calif., 408-RE 6-0300; Bellevue, Wash., 206-GL 4-4911; Phoenix, Ariz., 602-271-1261; Salt Lake City, Utah, 801-486-7566; Chicago, Ill., 312-GL 5-8160; Syracuse, N. Y., 315-454-3238; Westbury, L. I., N. Y., 516-ED 3-5800; Burlington, Mass., 617-BR 2-3060

For the best Semiconductor Service
LOCAL
The Avnet System Coast to Coast

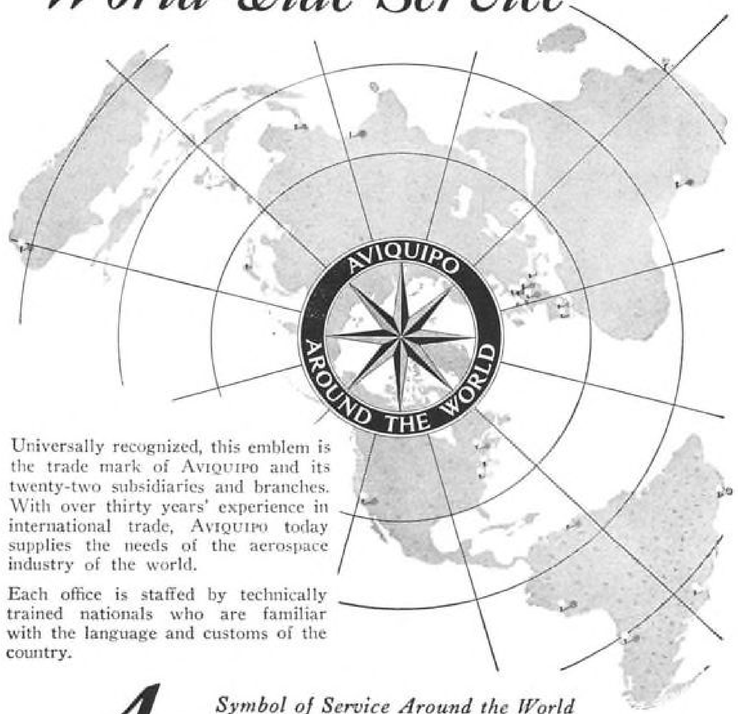
Circle Number 79 on Reader-Service Card

Boring service 105
Boroscopes 105
Boxes, metal 105
Brackets 105
Brake parts 105
Brakes 105
Brazing equipment 105
Brazing service 105
Breadboards 108
Breakers, circuit 108
Breathers 108
Broaching equipment ... 108
Brushes 108
Buckles 108
Buffers 108
Buffing compounds 108
Buffing equipment 108
Buildings 108
Bumpers, protective 108
Burners 108
Bus bars 108
Bushings 108
Business systems, electronic 108
Business systems, mechanical 108

C

Cabinets, metal 108
Cable 109
Cable assemblies, electrical 109
Calibration equipment .. 109
Calibration service 112
Cameras 112
Cams 112
Cannon, airborne 112
Canopies, transparent ... 112
Cans, transistor 112
Canvas 112
Capacitor disks 112
Capacitors 112
Caps 112
Capsules, escape 113
Carburetors, aircraft 113
Carpeting, aircraft 113
Cartridges, starter 113
Carts, ground service ... 113
Cases, protective 113
Cases, rocket motor 113
Casters 113
Catapults 113
Catches 113
Centrifuges 113
Ceramic fabrications 113
Ceramic materials 113
Chains 116
Changers, frequency 116
Channels 116
Chargers 116
Charts 116
Chassis 116
Checkout equipment 116
Chemicals 117
Chocks, wheel 117
Choppers 117
Chronographs 117
Chronometers 117
Chutes, ammunition 117
Circuits, electronic 117
Clamps 119
Clean room equipment... 119
Clean room facilities—service 119
Cleaners, chemical 119
Cleaning, aerospace systems 119
Cleaning equipment 119
Cleaning, maintenance—service 121
Clevises 121
Clips 121
Clocks 121
Cloth 121
Clothing 121
Clutches 121
Coatings 121
Coding equipment 122
Coiling equipment 122
Coils 122
Collimators 122
Columns, control 122
Command equipment 122
Command systems 125
Commutators 125
Comparators 125
Compasses 125
Compressor assemblies .. 125
Compressors 126
Computer programming—service 126
Computer time—service. 126
Computers, analog 126
Computers, digital 127
Conduits 127
Conical fabrications 127
Connector accessories .. 127
Connectors 127
Consoles 129
Constant speed equipment 129
Construction vehicles.... 129
Contact materials 129
Contacts, electrical 129
Containers 131
Control equipment, electronic 131
Control equipment, non-electronic 132
Converters, direct energy. 132

Symbol of World-wide Service



Universally recognized, this emblem is the trade mark of AVIQUIPO and its twenty-two subsidiaries and branches. With over thirty years' experience in international trade, AVIQUIPO today supplies the needs of the aerospace industry of the world.

Each office is staffed by technically trained nationals who are familiar with the language and customs of the country.

Symbol of Service Around the World

AVIQUIPO INC.

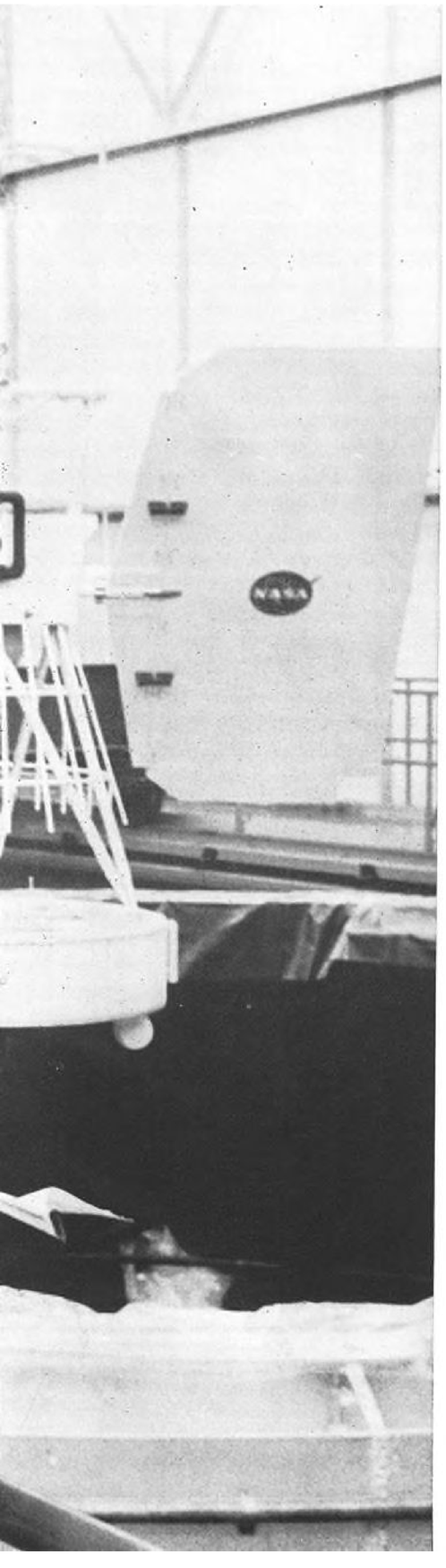
90 BROAD STREET • NEW YORK 4, NEW YORK

Cable: AVIQUIPO NEW YORK Telephone: WHitehall 3-6580 Telex: 212-571-1095

AMSTERDAM Aviquipo Holland N.V. • **BANGKOK** Aviquipo of Thailand, Ltd. • **BRUSSELS** Aviquipo Belgique, S.A. • **BUENOS AIRES** Aviquipo de la Argentina, S.A. • **CALCUTTA** Aviquipo of India (Private) Ltd. • **CARACAS** Aviquipo de Venezuela, S.A. • **FRANKFURT** Aviquipo of Germany GmbH • **LIMA** Aviquipo del Peru, S.A. • **LISBON** Aviquipo de Portugal, Lda. • **LONDON** Aviquipo of Britain, Ltd. • **LOS ANGELES** Aviquipo, Inc. • **LOURENCO MARQUES** Aviquipo de Portugal, Lda. • **LUANDA** Aviquipo de Portugal, Lda. • **MADRID** Aviquipo, Inc. • **MILAN** Aviquipo Italia S.p.A. • **MONTREAL** Aviquipo of Canada, Ltd. • **PARIS** Aviquipo-France • **RIO DE JANEIRO** Aviquipo do Brasil, S.A. • **SANTIAGO** Aviquipo de Chile, Lda. • **SYDNEY** Aviquipo of Australia Pty., Ltd. • **TOKYO** Nihon Aviquipo K.K. • **WASHINGTON,** D.C. Aviquipo, Inc.

Circle Number 273 on Reader-Service Card





BASIC TEST FOR MEDIA SELECTION:

In the world-wide aerospace market

Ask anyone, anyone you're trying to sell what publication he reads and respects most.

A powerful editorial force is a powerful selling force.

Aviation Week & Space Technology

A McGraw-Hill Publication, 330 West 42nd St., New York 36, N. Y.

ABC PAID CIRCULATION 86,219

NASA's Nimbus & Space Simulator—General Electric, MSVD

Converters, electronic ... 132
Converters, liquid gas ... 133
Conveyors 133
Coolants 133
Cooling equipment 133
Copying equipment 133
Cords 133
Cores 133
Cork fabrications 133
Cork material 133
Counterbalances 133
Counters 133
Countersinks 134
Counterweights 134
Couplers 134
Covers 134
Cranes 134
Crayons, marking 134
Cryogenic equipment ... 134
Crystals, electronic 134
Cushioning materials ... 137
Cushions, seat 137
Custom manufacturing .. 137
Cutters, cable 137
Cutting equipment 137
Cycling equipment 137
Cylindrical fabrications.. 137

D

Dampers, control 137
Damping material 137
Damping structures 138
Dashpots 138
Data processing equipment 138
Data processing service.. 138
Deboosters 138
Deburring compounds ... 138
Deburring equipment ... 138
Decalcomanias 139
Decoders 139
Decommutation equipment 139
Decontamination equipment 139
Defrosters, windshield .. 139
Degreasing chemicals ... 139
Degreasing equipment .. 139
Dehumidifying equipment 139
Dehydrating equipment . 139
De-icing chemicals 139
De-icing equipment 139
Delay lines 139
Delays 141
Demagnetizing equipment 141
De-mineralizing equipment 141
Demodulators, electronic. 141
Demonstrators 141
Densitometers 141
Desiccating equipment... 141
Destruct systems 141
Detectors 141
Detergents 143
Dials 143
Diaphragms 143
Dies 143
Differentials 143
Diffusers 143
Digital systems 143
Dimpling equipment 144
Dimpling service 144
Diodes, semiconductor .. 144
Direction finders, automatic 144
Directors, flight 144
Dischargers, static 144
Disconnects 144
Discriminators 144
Disk fabrications 144
Disks, rupture 144
Dispensing equipment ... 144
Display equipment 144
Distance measuring equipment 146
Distributing equipment .. 146
Dividers, flow 146
Docks, service 146
Dollies 146
Doors 146
Dopes 146
Drafting equipment 146
Drill fixtures 146
Drilling attachments ... 147
Drilling equipment 147
Drilling, ultrasonic, service 147
Drills 147
Drivers 147
Drives 147
Drones 147
Drying equipment 147
Ducts 147
Dynamometers 149
Dynamoters 149

E

Earphones 149
Ejection systems 149
Elastomers 149
Electrical discharge equipment 149
Electrodes 149
Electrodialysis 149
Electroforming 149
Electroluminescent equipment 149



NASA REPORTS:

The following letter has been received from the National Aeronautics and Space Administration, Manned Spacecraft center, Houston, Tex.:

"The Mercury Project office has verified that Macwhyte Wire Cable is used to attach the drogue parachute assembly to the Mercury Spacecraft . . . This cable provides a most important link to the drogue parachute riser . . ."

Not only has Macwhyte aircraft cable been used in the Mercury Spacecraft, Macwhyte Cable Assemblies have locked down the helmets of Astronauts Shepard, Grissom, Glenn, Carpenter, Shirra, and Cooper. In fact, Macwhyte aircraft products have been used in most every history-making aircraft and aerospace achievement.

The know-how gained through the years from the Jennies to the jets is built into aircraft cable, terminals, assemblies, and tie rods shown in Macwhyte's Aircraft Catalog A-4 — and available through distributors and fixed-base operators. Write for catalog today.

MACWHYTE

MACWHYTE Wire Rope COMPANY

2900 FOURTEENTH AVENUE • KENOSHA, WISCONSIN

Wire Rope Manufacturing Specialists Since 1896

Circle Number 276 on Reader-Service Card

Electron beam equipment. 149
Electronic countermeasures equipment 149
Electroplating equipment. 151
Electroplating service ... 151
Electrostatic spray equipment 151
Elevators, lifting 151
Encapsulating materials . 151
Enclosures 151
Encoder disks, optical ... 151
Encoders 151
Engineering—service ... 151
Engines 152
Engraving & profiling—service 152
Equalizers, audio 153
Erasers 153
Erectors 153
Escutcheons 153
Evaporators 153
Exciters 153
Exhaust equipment, ground-based 153
Exhaust systems, engine. 153
Expanders, cryogenic ... 153
Expanding equipment ... 153
Exploding bridgewire systems 153
Explosive equipment 153
Explosive forming—service 153
Eyelets 153
Eyes, cable 153

F

Faceplates, helmet 153
Facsimile transmission equipment 153
Fairleads 153
Fans 153
Fasteners 153
Fastening equipment 154
Fastening tools 154
Feed systems, electronic. 154
Feedbacks, mechanical .. 154
Felt 154
Fencing 154
Ferrite components, microwave 154
Ferrites 154
Ferrules 154
Fiber parts 154
Fiber, vulcanized 154
Fiberfaced materials 154
Fiberglass fabrications . 154
Fiberglass materials 155
Files, material-removing. 155
Films 155
Filter arrays 155
Filters, electronic 155
Filtration equipment 155
Filtration material 156
Fire extinguisher chemicals 156
Fire extinguisher equipment 156
Fire extinguishers, portable 156
Firearms 156
Firewalls 156
First aid equipment 156
Fittings 156
Flange assemblies 156
Flares 156
Floats 156
Flocked paper 156
Flooring 156
Flotation gear 156
Fluxes 158
Flywheels 158
Foil 158
Foil, magnetic 158
Food service equipment.. 158
Forgings 158
Forklifts 158
Forks, cable, wire..... 158
Forks, tuning 158
Forming equipment 158
Forming—service 158
Frequency measuring service 158
Frequency multipliers ... 158
Friction materials 158
Fuel systems & equipment 158
Fueling service 159
Fuels, aircraft 159
Fuels, missiles/space vehicles 159
Furnaces 159
Furniture 159
Fuse holders & accessories 159
Fuses 159
Fusing systems 159

G

Gages 159
Galvanometers 160
Gantries 160
Garnet 160
Gases, chemical 160
Gaskets 160
Gear assemblies 160
Gears 160



Know how to pack a 2,000 lb. capacity into a 40lb. winch?

Breeze does . . . and adds plenty of extras!

When certain helicopter specs called for a hoist that could raise a ton of cargo at 35 ft. per minute, or — for rescue work — lift 600 lbs. at 100 ft. per minute, Breeze produced this rugged little unit in 90 working days! An industrial hoist of like capacity would weigh close to 200 lbs. *This weighs only 40* — and has other important features as well.

For example, in addition to being durable, smooth-operating, and virtually corrosion-proof, this Breeze unit can be shifted, while operating, to either speed range; the cable can't snarl with or without load, as reel-in and reel-out is controlled by powered rollers; and the cable itself is a non-rotating type that prevents spinning of personnel or cargo.

Creating such a special unit takes ingenuity and experience. Breeze has "off the shelf" hoists and winches that answer most requirements of airborne or G.S.E. installation. But if necessary, Breeze can design, manufacture, and test the "problem child" you need . . . effectively and fast.



Write for information

BREEZE CORPORATIONS, INC. BREEZE MARK

705 LIBERTY AVENUE, UNION, NEW JERSEY • CABLE ADDRESS: BREEZE, UNION, N.J.

Circle Number 277 on Reader-Service Card



WE'VE BEEN THERE...

THROUGH our scripts, technical animation and stop motion.

We can meet your need for photographic reports, engineering presentations, orientation films, graphics and slidefilms.

Call or Write

Government Services BR 5-1200

WILDING INC.

1345 Argyle St., Chicago 40, Ill.

Circle Number 274 on Reader-Service Card

LEAR SIEGLER, INC.

Electronic Instrumentation Division
Bogen Communications Division
Data and Controls Division
Power Equipment Division
Astro Structures Division
Instrument Division
Astronics Division

AVIATION PRODUCTS DISTRIBUTED EXCLUSIVELY OVERSEAS BY

American Avitron

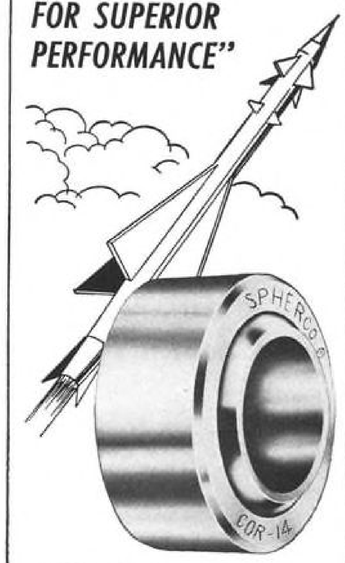
Rye, New York · Tel. 914-937-5300 · Cable: Avitron

World-wide Distributors For Aerospace Products

SPHERCO®

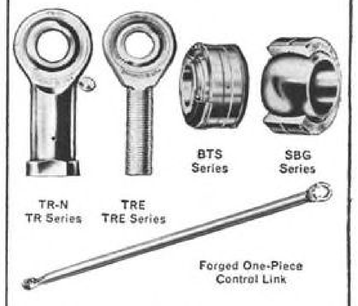
SPHERICAL BEARINGS & ROD ENDS

"PRECISION BUILT FOR SUPERIOR PERFORMANCE"



FEATURING...

- Quality engineered and produced
- Solid inserts
- Swage staking of 3-piece rod end
- Wide range of metals for races



WRITE FOR BULLETIN 560

SPHERCO

A PRODUCT OF SEALMASTER BEARING DIVISION STEPHENS-ADAMSON MFG. CO.

54 RIDGEWAY AVE. • AURORA, ILL.

Circle Number 275 on Reader-Service Card

Generating equipment .. 161
Generator sets 161
Generators 161
Generators, electrical ... 161
Glands, hydraulic 161
Glass fabrications 161
Glass materials 165
Gliders, Rogallo-type 165
Gliders & sailplanes 165
Gloves 165
Goggles 165
Governors 165
Graphite 165
Grinding machines 165
Grips 165
Grommets 165
Ground effect vehicles... 165
Guard equipment & systems 165
Guidance systems 165
Gussets 165
Gyroscopes 166

H

Handles 166
Handsets, interphone, radio 166
Hangars 166
Harnesses 166
Headers 166
Headlining materials ... 166
Headrest covers 16
Headrests 166
Headsets 166
Heat exchangers 166
Heat treating equipment. 167
Heat treating service.... 167
Heaters 167
Heating equipment 167
Helicopters 167
Helmets 167
Hinges 167
Hoists 167
Honeycomb assemblies, brazed 167
Honeycomb core materials 167
Honeycomb sandwich fabricators 167
Honing equipment 168
Honing service 168
Honing tools 168
Hoods 168
Hoods, IFR 168
Horns, acoustic 168
Horns, antenna 168
Hose 168
Hose assemblies 168
Hub assemblies, rotary.. 168
Humidistats 168
Hydraulic fluids 168
Hydraulic systems & equipment 168
Hydrofoils 171
Hydroforming 171
Hydrogen 171
Hydrophones 171

I

Igniters 171
Ignition systems 171
Illuminizing materials ... 171
Illuminizing—service ... 171
Image projection equipment 171
Impellers 171
Inclinometers 171
Increasers, speed 171
Indicators 172
Inductances 172
Inductors 172
Inflation gear 172
Information services 172
Infrared equipment 172
Inhalators 173
Inhibitors, corrosion 173
Injection systems 173
Injector systems 173
Inserts 173
Inspection equipment ... 173
Instrument landing systems 173
Instrument overhaul & repair 173
Instruments 173
Insulation 175
Insulators 175
Insurance, aviation 176
Integrators 176
Intercoolers 176
Interiors, aircraft 176
Intervalometers 176
Inverters 176

J

Jack panel assemblies... 176
Jack strips 176
Jacks 176
Jigs 176
Joints 177
Jumpers 177

K

Keyers 177
Keys 177
Knobs 177

L

Labels 177
Lacing 177
Lacquers 177

RELIABILITY

is a by-product of
EXPERIENCE

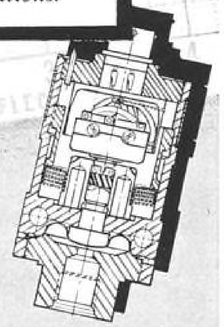
That is why Frebank's engineering capability is unmatched in the pressure sensing and fluid control fields.

Frebank products are vibration resistant and designed to operate efficiently in extreme environmental conditions.

Advanced engineering and modern manufacturing techniques coupled with Frebank's "Quick Reaction Capability," assure you of a progressive, dependable source for specialized components that meet your exact specifications.

Frebank offers complete research, engineering, development and manufacturing facilities. Write for data on specific applications.

☆ PRESSURE SWITCHES
☆ REGULATORS
☆ RELIEF VALVES
FOR AEROSPACE APPLICATIONS



FREBANK COMPANY

A PIONEER IN THE DEVELOPMENT OF PRESSURE SENSING DEVICES FOR THE AIRCRAFT AND AEROSPACE INDUSTRIES . . .

711 W. BROADWAY • GLENDALE 4, CALIF.
245-6558 (AREA CODE 213)

Circle Number 279 on Reader-Service Card



Investment Opportunity

The hand holding the hammer will someday make products for you.

Long years of training will have to go into making those chubby fingers productive. Much care, much love, much planning and money.

But no matter how lean and hard and skillful they become, it will signify little if the fruits of their skill are produced in anything but a free society.

You have an investment in those hands. To protect your investment, you can join with other leading American businessmen to promote the Treasury's Payroll Savings Plan for United States Savings Bonds. The Treasury Department's Plan works for soundness in our economy, strength in our defenses, and thriftiness and self-reliance in our thinking.

When you bring the Payroll Savings Plan into your plant—*when you encourage your employees to enroll*—you are investing in the hands of tomorrow's tool makers and tool users. You are investing in America's next generation of machine operators, mechanics, metal workers—in all of America's skilled labor force. You are investing in America's future. In freedom itself.

Don't pass this investment opportunity by. Call your State Savings Bonds Director. Or write today to the Treasury Department, U.S. Savings Bonds Division, Washington 25, D.C.

in your plant...promote the PAYROLL SAVINGS PLAN for U.S. SAVINGS BONDS

The U. S. Government does not pay for this advertisement. The Treasury Department thanks, for their patriotism, The Advertising Council and this magazine.

Ladders 177
Laminating equipment .. 177
Laminations 177
Lamp assemblies 177
Lamps 177
Landing gear 177
Lanyards 178
Lapping equipment 178
Lapping service 178
Lapping slurries 178
Lasers (optical masers) .. 178
Latches 178
Lathes 178
Launching equipment ... 178
Lavatory equipment 178
Lavatory service equipment 178
Leads 178
Leather 178
Lenses 178
Life preservers 178
Life rafts 178
Life support systems.... 179
Lifts 179
Lightning arresters 179
Lightning protection systems—aircraft 179
Lights 179
Limiters, current 179
Line selectors 179
Liner materials 179
Lining fabrication 179
Litters 179
Loads 179
Locaters 179
Lockers 179
Locks 179
Louvers 179
Lubricants 179
Lubricating equipment .. 180
Lugs, cable 180

M

Machine attachments ... 180
Machine parts, precision. 180
Magnet materials, permanent 180
Magnetic powder 180
Magnetic systems 180
Magnetically soft materials 180
Magnetizing equipment.. 180
Magnetometers 180
Magnetos & parts..... 180
Magnetostriction equipment 180
Magnets 181
Magnifiers 181
Maintenance equipment. 181
Maintenance service 181
Management consulting—service 181
Manifolds 181
Manometers 181
Manostats 181
Manuals 181
Maps 181
Markers 181
Marking, electrochemical 181
Marking equipment 181
Masers 182
Masks 182
Materials handling equipment 182
Mathematical service ... 182
Mats 182
Measuring equipment ... 182
Mechanisms, moving coil. 183
Medical equipment 183
Medical supplies 183
Membranes 183
Memories, magnetic core. 183
Metal annealing 183
Metal finishing equipment 183
Metal finishing service... 183
Metal hardening treatment 183
Metal parts fabricators.. 183
Metal spraying equipment 185
Metal stress relieving treatment 185
Metals—alloy steel, excl. stainless 185
Metals—aluminum 185
Metals—carbon steel, incl. wrought iron 185
Metals—cobalt base alloys 186
Metals—copper & alloys. 186
Metals—iron 186
Metals—iron base alloys. 186
Metals—magnesium 186
Metals—miscellaneous ... 186
Metals—nickel alloys ... 186
Metals—nickel base alloys, corrosion-resistant ... 187
Metals—nickel base alloys, high strength 187
Metals—nickel base alloys, high-temperature 187
Metals—special applications 187
Metals—stainless steel, nickel bearing 188
Metals—stainless steel, non-nickel 188
Metals—titanium & alloys 188
Meteorological equipment 188
Meter coil forms..... 189
Meters 189
Microcircuits 189
Micrometers 189
Microphones 189
Microwave equipment... 190
Milling, chemical 190
Milling equipment 190
Milling service 190
Mirrors 190
Miss-distance indicators.. 190
Missiles 190
Mixers, microwave 192
Mockups 192
Models 192
Modulators 192
Moisturepreofing materials 192
Molding 192
Molds 192
Monitoring equipment, radiation 193
Monitoring systems 193
Monitors, frequency 193
Mooring equipment, aircraft 193
Motor-generator sets ... 193
Motors 193
Mountings 194
Mounts 194
Mufflers 194
Multicoders 194
Multicouplers 194
Multimeters, ditital—hybrid 194
Multiplexers 194
Multipliers 195

N

Nameplates 195
Navigation equipment, electronic 195
Navigation equipment, non-electronic 195
Netting 195
Networks 195
Nipples 197
Nitrogen 197
Nozzles 197
Nuts 197

O

"O" Rings 197
Oiling equipment 197
Optical equipment 197
Optical parts 199
Oscillators 199
Oscillographs 199
Oscilloscopes 199
Oscilloscopes, storage ... 199
Ovens 199
Oxygen 199
Oxygen systems 199

P

Packaging consultants .. 199
Packaging materials 199
Packaging services 199
Packings 199
Pads 200
Paging systems 200
Panels 200
Paper 200
Paper fabrications 200
Paper materials 200
Parachute openers, automatic 200
Parachutes 200
Pedestals 200
Phase shifters, microwave 200
Photoelectric equipment . 201
Photoelectric materials .. 201
Photographic equipment. 201
Photometers, micro 201
Photomultipliers 201
Pickups (vibration) 201
Piezoelectric components. 201
Piezoelectric materials... 201
Pigments 201
Pillowblocks 201
Pillowcases, disposable.. 201
Pins 201
Pitot tubes 201
Pivots 201
Placards 201
Plastic fabrications 201
Plastic-forming equipment 202
Plastic materials 202
Plates 205
Platforms, guidance system 205
Plating service 205
Playback equipment, recording 205
Platters 205
Plugs 205
Plywood 205
Plywood materials 205
Plywood & metal, bonded 205
Plywood molded parts... 205
Pneumatic equipment ... 205
Pointers 205
Posts 205
Potentiometers 205
Powder metallurgy 206
Powdered metal parts... 206
Power equipment 206
Power supplies 206
Preamplifiers 207
Precipitators 207
Precision fabrications ... 207
Preforms 207
Preheaters 207
Preselectors 207
Preservatives 207
Presses 207
Pressure-limiting equipment 209
Pressurization systems .. 209
Pressurizers 209
Primers, engine 209
Printed circuit card testers 209
Printers, high speed..... 209
Probes, test 209
Programmers 209
Programming 209
Projection equipment ... 209
Propellants, rockets 209
Propellers 210
Propellers, test club..... 210
Proportioners, flow 210
Propulsion systems 210
Public address systems... 210
Publications preparation service 210
Pullers 210
Pulleys 210
Pumps, gaseous systems. 210
Pumps, liquid systems... 210
Punches 213
Punching equipment 213
Punching service 213
Purification equipment .. 213
Pushbuttons 213
Pushrods 213
Pyrometers 213
Pyrotechnic equipment .. 213
Pyro-thermoelectric components 213
Pyro-thermoelectric materials 213

Q

Quadrants, engine control 213

R

Racks 213
Radar equipment 213
Radiators 215
Radio equipment 215
Radiographic equipment.. 215
Radiosondes 215
Radiotelephone equipment 215
Radome testing service.. 216
Radomes 216
Ramps 216
Reactors 216
Readers, paper tape photoelectric 216
Readout equipment, digital 216
Readout instruments 216
Reamers 216
Receivers, avionic 217
Reconnaissance equipment 217
Recorders 217
Recording equipment ... 217
Recovery systems 220
Recovery units, vapor.... 220
Rectifiers 220
Reducers, speed 220
Reels 220
References 220
Reflective materials 220
Reflectors, radar 220
Refrigerating systems ... 221
Registers, electrical impulse 221
Regulating equipment ... 221
Relays 221
Release mechanisms 221
Reliefs 221
Remote positioning systems 221
Removers 221
Repeater systems, message 221
Repeaters 222
Rescue equipment 222
Research—service 222
Reservoirs 222
Resins 222
Resistors 222
Resolvers 225
Respirators 225
Restrictors, hydraulic systems 225
Resurfacing service 225
Retainers 225
Reticles, optical 225
Reversers, thrust 225
Rheostats 225
Rings 225
Riveting equipment 225
Rivets 225
Rocket motors 225
Rocket vehicles 225
Rockets, signal 227
Rod ends 227
Roll forming machines... 227
Rollers 227
Rolls 227
Rope 227
Rotators 227
Rotors 227
Rubber 227
Rubber products 227
Running gear, ground equipment 227

S

Safing systems 227
Sand blast equipment.... 227
Sanding equipment 227
Sanding service 227
Sapphire parts 227
Satellites 227
Satin finishing compounds 228
Scales 228
Scaling service 228
Scanners 228
Scintillators 228
Scramblers, electronic ... 228
Screening, wire 228
Screens 228
Screw machine products.. 228
Screws 228
Sealants 228
Seals 228
Search systems 229
Seats, aircraft 229
Security equipment 229
Semiconductor components 229
Semiconductor materials. 229
Sensing units 229
Sensors, voltage 231
Separation systems 231
Separators 231
Servos 231
Sets, rivet 231
Sextants 231
Shackles 231
Shafts 231
Shakers, control stick.... 231
Shaping equipment 231
Shaping service 231
Shearing equipment 231
Shells, munitions 233
Shelters 233
Shielding 233
Shifters 233
Shims 233
Shock absorbers 233
Shot peening equipment.. 233
Shot peening service.... 233
Shrinkers 233
Shunts 233
Shutters 233
Sights 233
Signaling equipment 233
Silicones 233
Silver chloride, water-activated 234
Simulators 234
Sinks 234
Ski retraction mechanisms 234
Skin sculpturing service.. 234
Skis, aircraft 234
Sled propulsion units.... 234
Sleds, test 234
Sleeving 234
Slides 234
Slings 234
Slipring assemblies 234
Snaps 234
Snow removal equipment. 234
Snubbers 235
Sockets 235
Soldering equipment 235
Soldering service 235
Solders 235
Solenoids 235
Solvents 235
Sonar equipment 235
Sound suppressors 235
Sound systems 235
Sounding equipment 235
Sounding systems, ionosphere 235
Space suits 235
Spacecraft 236
Spacers 236
Spark plugs 236
Speakers 236
Spectrometers, mass 236
Speech compression equipment 236
Speed increaser units.... 236
Spiders 236
Spinners, propeller 236
Spinnings, metallic 236
Splicers, cable 236
Splines, ball bearing..... 236
Spray painting equipment 236
Spray equipment, aerial.. 236
Springs 236
Sprockets 236
Squibs 236
Stabilization equipment.. 236
Stabilizers 239
Stacks, exhaust 239
Stall warning systems... 239
Stamping equipment 239
Stamping equipment, hot. 239
Stampings 239
Stanchions 239
Standards, frequency ... 239
Stands, work 239
Starters, aircraft 239
Starting systems 239
Stepping systems 239
Straighteners 239
Straightening machines .. 239
Strainers, fluid 239
Strapping 239
Streamers, warning 240
Stretchers 240
Stretch-wrap forming machines 240
Strippers, wire, mechanical 240
Strippers, wire, thermal.. 240
Stripping equipment 240
Stripping service 240
Strips, terminal 240
Stroboscopes 240
Structural fabrications .. 240
Struts 240
Stud setters 240
Studs 240
Submarines & systems... 240
Sumps, oil 240
Superchargers 240
Superfinishing equipment. 240
Suppressors, transient .. 240
Survival equipment 240
Swaging equipment 241
Swaging machines 241
Sweepers, runway 241
Switches 241
Switching systems, crossbar 243
Synchronizers 243
Synchronizing systems, propeller 243
Synchros 243

T

Tables 243
Tachometers 243
Tanks 243
Tape 245
Tape decks 245
Taps 245
Target scoring systems.. 245
Targets 245
Tarpaulins 245
Tees 245
Telemetry equipment ... 245
Telescopes 247
Television, closed circuit. 247
Templates 247
Tension devices 247
Tents, engine 247
Terminal strips 247
Terminals 247
Test equipment, electrical 247
Test equipment, electronic 248
Test equipment, non-electrical 249
Testing services 249
Textbooks 251
Theodolites 251
Thermionic devices 251
Thermistors 251
Thermocouple accessories. 251
Thermocouples 251
Thermo-electric devices .. 251
Thermometers 251
Thermopiles 253
Thermopiles, miniature .. 253
Thermostats 253
Thimbles 253
Thinners 253
Thread anti-seize compounds 253
Thread locking compounds 253
Thread repair kits..... 253
Threading equipment ... 253

Tiedown equipment 253
Timers 253
Timers, digital 253
Tinning services 253
Tire changing equipment. 253
Tire retreading 253
Tires, aircraft 253
Titration equipment 253
Tool kits 254
Tool materials 254
Tooling 254
Toroids 254
Towbars 254
Towels 254
Towers 254
Track, cargo handling... 254
Trackers, star 254
Tracking equipment 254
Trailers 259
Training equipment, electronic 259
Training equipment, non-electronic 259
Transceivers 259
Transducers 259
Transformers 261
Transistors 261
Translators 261
Transmissions 261
Transmitters 261
Transmitters, radio 263
Transparent fabrications 263
Transparent materials ... 263
Transponders, radar 263
Transportation, motor truck 263
Transporters, data tape.. 263
Trucks 263
Tube assemblies, ignition cross 263
Tube parts, electron..... 263
Tubes, display 264
Tubes, electron 264
Tubing 264
Tumbling equipment 264
Tumbling service 264
Tuners 264
Tuning equipment 264
Tuning units, antenna... 264
Turnbuckles 265
Turning equipment 265
Turnstiles 265
Turntables 265
Turrets 265
Turrets, gun 265
Twisters, wire 265

U

Ultrasonic equipment ... 265
Upholstery 265

V

V-blocks 265
Vacuum cleaners 265
Vacuum equipment 265
Vacuum processes 265
Valves, gaseous systems.. 265
Valves, liquid systems... 266
Vans 266
Vapor blast equipment... 266
Vaporizers 266
Varistors 266
Ventilators 266
Vibrators 266
Vibratory finishing equipment 266
Vises 266
Visors 266
Voltage regulators 266

W

Washers 267
Water conditioning equipment 267
Waveguide equipment ... 267
Weatherstripping 267
Webbing 267
Weighing equipment 267
Welded fabrications 267
Welders 268
Welding equipment & supplies 268
Welding service 268
Wheels 268
Winches 269
Wind socks & cones..... 269
Winders, tape 269
Windows 269
Windshield wipers 269
Windshields 269
Windshields, electrically heated 269
Wipers 269
Wire (also see metals)... 270
Wire products 270
Wiring, printed 270
Wrappings 270
Wrenches, universal 270

X

X-ray 270
X-ray flash systems..... 271

Y

Yokes, cable & wire..... 271

FROM DUREZ®
HIGH-TEMPERATURE PHENOLICS

Phenolic Molding Compounds for Temperatures up to 6000°F

We make a number of formulations providing extremely high heat resistance for such components as rocket motor liners, blast tubes, and nozzles. Molded parts show minimum erosion when exposed to high-velocity gas streams at temperatures up to 6000°F. Strength and thermal insulation are excellent.

For areas subjected to high temperature and low-velocity gas flow, we offer asbestos-filled or quartz-asbestos-filled compounds. The molded material has excellent thermal insulation to heat or flames from rocket motors.

Phenolic Elastomer Insulation Systems

Designed for flexible ablation-resistant insulation, this series of compounds helps protect rocket motor surfaces and similar hardware from flame temperatures as high as 6000°F.

Any formulation can be modified for a specific application.

We also supply phenolic resins designed for approval under MIL 9299A. Others are compatible and reactive with synthetic and natural elastomers, for making proprietary mixes.

Technical Help

Write to us, describing your application. We'll be glad to work with you and may be able to formulate compounds for your special needs.

We will also send you technical literature on physical properties of various molded materials, special properties, torch test data and other information. Also available is technical information on fire-retardant polyester resins and polyurethane foams. Durez Plastics Division, Hooker Chemical Corporation, 7900 Walck Road, Tonawanda, New York 14121.

DUREZ PLASTICS DIVISION

HOOKER CHEMICALS PLASTICS

Circle Number 283 on Reader-Service Card

CLASSIFIED SECTION

1964 AVIATION WEEK & Space Technology BUYERS' GUIDE

CLASSIFIED ADVERTISERS INDEX

Classification of products and services offered by CLASSIFIED advertisers in this issue

PRODUCTS

1—Accessories, Aircraft
2—Aids, Training
3—Aircraft Alloy Bars
4—Aircraft, Executive, Personal
5—Antennas & Radiating Equipment
6—Bearings
7—Bolts, Alloy (grade 8), others
8—Brushes, Carbon
9—Cables, Assemblies, Swaging, Terminals
10—Capacitors
11—Carburetors
12—Chargers, Battery
13—Coatings, Protective
14—Components, Jet
15—Condensers, Mica, etc.
16—Connectors, AN, Coaxial
17—Engines, Parts
18—Equipment, Aircraft, Ground
19—Fasteners, AN, MS, NAS
20—Fiberglas, Cloth, Tape, Mat, Woven Roving, Milled Glass, Chopped Strands
21—Fittings and Clamps
22—Generators
23—Gyros, Altitude, Directional, Horizon
24—Handbooks, Manuals, Technical Publications
25—Hardware Supplies
26—Ignition, Parts
27—Instruments, Engine, Flight, Pressure, Test, Measuring & Precision
28—Inverters, Inverter Parts
29—Lamps
30—Lights, Assemblies, Cockpit
31—Machine Tools, Used and Rebuilt
32—Materials
33—Meters (Test and Panel)
34—Motors, Servo, Synchro, etc.
35—Nuts, Alloy (grade 8), others
36—Parts, Magneto
37—Plastic, Sheets, Rods, Tubes, Films
38—Potentiometers
36A—Potting & Encapsulating Dispensers
39—Radar, Test Equipment
40—Radio, Aircraft
41—Receivers
42—Rectifiers, Silicone, etc.
43—Relays, Timers
44—Resistors
45—Rings, Moulded Rubber "O" Backup
46—Rivets, Tubular
47—Screws, Miniature
48—Solenoids
49—Speed Indicators
50—Superchargers
51—Switches
52—Tape, Adhesives, Asbestos
53—Telephones
54—Terminals, Boards, Hardware
55—Tires
56—Tools, Portable
57—Transistors
58—Transmitters
59—Tubes, Electronic
60—Tubing, Steel
61—Valves, Check
62—Washers, Special
63—Wire

SERVICES

64—Aerial Surveys
65—Aircraft
66—Aircraft Brokers
67—Carburetor, Overhaul, Parts, Repair
68—Charter, Air Cargo
69—Engine, Build-up, Changes, Inspections, Repair, Starter
70—Equipment, Installations, Repair
71—Flight Test Support
72—Inspections, Aircraft Engine, Equipment, Instrument
73—Instruments, Installation, Repair, Testing
74—Insurance, Aircraft
75—Interiors, Design, Modification
76—Maintenance, Aircraft, Engine
77—Overhaul Services
78—Photogrametry
79—Propeller
80—Radar, X and C Bands
81—Radio, Electronic Installations, Repair, Testing
82—Repair, Aircraft, Airframe
83—Survival Equipment

ADVERTISER	PAGE NO.	KEY TO PRODUCTS AND SERVICES (see classifications above)
A & A ELECTRONICS CORP	288	5, 10, 15, 16, 22, 28, 38, 39, 40, 41, 42, 43, 44, 48, 51, 53, 54, 57, 58, 59
A & J MACHINERY CORP	286	18, 22, 27, 33, 34, 38
AIRCRAFT ELECTRONICS, INC.	286	40, 41, 58, 80, 81
AIRCRAFT PARTS CORP.	286	1, 6, 11, 17, 18, 22, 26, 27, 28, 33, 36
AIRCRAFT PROPELLER SERVICE, INC	288	79
AIRCRAFT RADIO INDUSTRIES, INC	286	5, 9, 16, 51, 54
AIRCRAFT TURBINE SERVICE, INC	287	50, 70, 72, 76, 77, 82
AIR-RESCO INC.	287	5, 8, 15, 16, 28, 39, 40, 41, 58, 63, 81
ALDEN SALES CO.	285	1, 2, 14, 16, 18, 23, 27, 28, 34, 40, 41, 70, 72, 73
AVITRONICS ASSOCIATES, INC.	288	1, 7, 9, 16, 17, 18, 19, 21, 22, 23, 25, 27, 28, 33, 34, 35, 43, 45, 46, 47, 48, 49, 51, 54, 59, 60, 61, 62, 63
BAUCO	288	75
BERLOW & CO., RICHARD J.	288	75
BOWSTEEL DISTRIBUTORS CORP.	288	3
C & H SALES CO.	286	1, 15, 16, 23, 27, 28, 33, 34, 39, 40, 41, 42, 43, 48, 57, 58, 59, 63
ESSE RADIO	287	9, 17, 23, 33, 40, 41, 58, 59
FAIR RADIO SALES	286	5, 10, 15, 16, 21, 22, 24, 28, 33, 34, 40, 41, 42, 44, 48, 51, 53, 57, 58, 59, 63
FISHMAN CO., PHILIP	286	25, 38A
GROBAN SUPPLY CO.	285	9, 22, 25, 31
ILLINOIS MFG. & SUPPLY CO.	288	22, 25, 32
INTERNATIONAL ATLAS SERVICES	285	1, 7, 9, 16, 17, 18, 19, 21, 22, 25, 27, 33, 35, 54, 56, 63
JSH ELECTRONICS	288	59
LONG ISLAND AIRWAYS, INC.	287	64, 65, 68, 71, 73, 76, 78, 81
LOU-TRONICS	288	10, 15, 33, 34, 38, 39, 40, 41, 42, 43, 44, 51, 53, 57, 58, 59
MICRO SPECIALTIES	285	51
R. W. ELECTRONICS, INC.	287	27, 39, 59
RADIO RESEARCH INSTRUMENT CO.	288	39
RAWAY BEARING CO., INC.	288	6
SURPLUS SAVINGS CENTER	288	53
THERMOELECTRIC DEVISES	286	22, 23, 27, 33, 41, 49, 58
TRANS AIR PARTS CO.	286	1, 4, 5, 6, 8, 9, 11, 12, 16, 17, 18, 20, 21, 22, 23, 25, 26, 27, 28, 29, 30, 32, 33, 34, 36, 37, 40, 41, 43, 44, 45, 48, 50, 51, 52, 54, 55, 59, 61, 63
UNIVERSAL RELAY CORP.	287	43, 48
WEINER COMPANY, E. D.	286	4, 18, 23, 27, 33, 39, 40, 41, 58, 77
WOLD ASSOCIATES, WILLIAM C.	288	4, 66

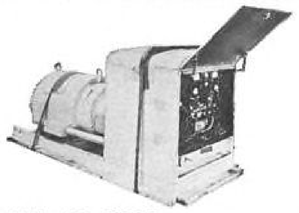
SURPLUS BARGAINS GENERATOR SETS

5 KW, 400 CYCLE MOTOR GENERATOR SET



10 H.P., 3 phase, 60 cycle, 220/440 volt motor, direct connected to 5 KW, 6.3 KVA, 120 volt, 400 cycle, single phase generator, 3428 RPM, 0.8 PF. Made by Master Electric and others. Shpg. wt. 650 lbs. F.O.B. Chicago.

No. BY-G763 .....$450.00



50 KW, 400 CYCLE MOTOR GENERATOR SET

Ideal Electric Type F-1. Rated 62.5 KVA, 50 K.W., 120/208 volts, 3 phase, 400 cycles, 0.8 PF. Powered by 60 cycle, 3 phase, 220/440 volt motor. Complete with instrument and control panel. Overall dimensions: 85" L, 34" W, 41" H. Shpg. wt. 2100 lbs. F.O.B. Chicago.

No. BY-G964 .....$1,250.00



MOTOR—GENERATOR, AC TO DC

Motor: 5 H.P. 3510 RPM, 220/440 volts, 60 cycles, 3 phase. Type OGX, Frame 225, Class G, Form B. Generator: 28 volts, 100 amperes D. C. Model No. 60. Made by Motoresearch Co. Equipped with motor starter box and generator control panel. Complete assembly mounted in tubular frame for portability. Shpg. wt. 250 lbs. F.O.B. Chicago.

No. BY-G764 .....$175.00



ENGINE DRIVEN HYDRAULIC TEST STAND DENISON MODEL D-1

Lycoming four cylinder air cooled engine, driving a Denison variable volume hydraulic pump, rated 5000 PSI, 13 GPM, at 1200 RPM, and a Vickers 1000 PSI rotary vane boost pump. The test stand is equipped with engine instrument panel and hydraulic gauge panel. The entire unit is enclosed in a sheet metal housing with access doors. Overall dimensions: 82" L x 40" W. x 42½" H. Government Surplus—Used, Serviceable. Shpg. wt. 3000 lbs. F.O.B. Chicago.

No. BY-960 .....$595.00

FREE CATALOG!

Write today for Groban's NEW 72 page Equipment Catalog and Hydraulic Reference Manual. Tremendous Savings on hundreds of items.



GROBAN SUPPLY CO., INC.
1139 S. Wabash Ave., Dept. BY-12 Chicago 5, Ill.
WEbster 9-3793 • Cable: GROBANCO — Chicago

CIRCLE 500 ON READER SERVICE CARD

INDUSTRY AIRCRAFT ELECTRONICS ELECTRICAL



Micro Specialties

1896 Walton Ave. New York 53, N. Y. CY 4-1525

ALWAYS SELLING *ALWAYS BUYING*

CIRCLE 503 ON READER SERVICE CARD

INTERNATIONAL ATLAS SERVICES

a Division of Atlas Corporation



Cable: Intairserv Oakland

Specialists in Maintenance and Logistics Support

for Commercial and Military Aerospace Activities

Aerospace Products & Parts

Aircraft Sales

P.O. Box 6188, Oakland, Calif.
Tel: Area 415-562-5900

DOMESTIC & INTERNATIONAL PRINCIPAL OFFICES
WASHINGTON, D. C.
NEW YORK, N. Y. PARIS, FRANCE
LONDON, U. K. LIMA, PERU
RIO DE JANEIRO, BRAZIL
ST. JOHNS, QUE.

CIRCLE 501 ON READER SERVICE CARD

LEAR • BENDIX • SPERRY AUTOPILOTS - COMPASSES BRAND NEW



- Lear Model 118 Servo with latest type 99960 clutch for L-2 or L-5. Brand New. $70.
- Lear Model 913B-4 drum for L-2 or L-5 autopilot. New. $10.
- Model 2203 Altitude Control for L-2, L-5 or M-4. New. $175.
- Sperry C-4 test set 1000-548 for bench or line work, complete with flux valve simulator. Details on request. New. $195.
- Sperry A-12 pilots controller p/n 656536 or 670724. New. $45.
- Sperry C-1 Gyrosyn Indicators. AFOH. $30.

HEADQUARTERS FOR LEAR L-2, L-5, F-5, MB-2 COMPLETE AUTOPILOTS, NEW PARTS AND TEST EQUIPMENT. Sperry A-12, Bendix F-1, P-1, PB-10, Gyrosyn Compass Systems G-2, C-2, C-4 and Polorpath. Lear B-1A, MM-2, K-48 Vertical Gyro Indicating Systems. Wholesale quantities available on all late type instrument equipment, pressure transmitters, inverters and nav equipment.

Your Inquiries Solicited

ALDEN SALES CO.

Box 7062, Richmond, Va. 23221 • Tel. 272-5414

CIRCLE 502 ON READER SERVICE CARD

U. S. GOVT. ELECTRONIC SURPLUS

New Remote Reading Magnesyn Compass System



Includes Indicator, Transmitter and Inverter. Available for 12 Volt or 24 V. D.C. System. Complete Set with Instruction Manual.

New - $33.50 Postpaid

MINNEAPOLIS-HONEYWELL RATE GYRO (Control Flight)



Part no. JG7005A, 115 volts A.C., 400 cycle, single phase potentiometer take off resistance 530 ohms. Speed 21,000 r.p.m. Angular momentum 2½ million, CM²/sec. Weight 2 lbs. Dimensions 4-7/32 x 3-29/32 x 3-31/64. **Price $22.50**

8-Day Aircraft Clock



24-hr. dial and civil date indicator. Center sweep second hand. Luminous figures and hands on black face. Case is made of black plastic 3⅛" mounting. Mfd. by Waltham Watch Co.

Price $20.95 ea. ppd.

8-Day Elapsed Time Surplus Aircraft Clock



Here's an accurate time-control center that'll help you win your next rally. It not only tells you the date and time of day right to the second. It's a stop watch that gives you elapsed time in seconds, minutes and hours! The 24-hour clock simplifies adding and subtracting elapsed time for your navigator. Manufactured by Elgin Watch Co. to military exacting specifications, it will remain accurate in spite of road bumps and vibrations. Uses no electrical connections. Does the job of high-cost equipment. Jewelled/Sweep Second Hand/Luminous Hands and numerals/24-hr. Dial, Black face and plastic Case, 3⅛" mounting. Cost the Gov't $185.

Postpaid Only..... **$39.95**

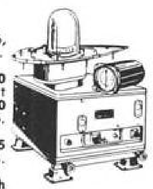
Magnetic Compass #AN-5732-1



Mfgd. by Bendix-Pioneer. Compass is a light, compact, direct-reading magnetic compass. This panel-mounted, pilot's type instrument has a medium-short period with very little overswing and is steady in operation, thus giving the kind of response required by a pilot. Approx. dimensions: 3¼" high; 3½" wide; 3½" deep. Approx. weight: 1¾ lbs. Luminous dial. Full floating card, compensating magnets, and dial light available in 12 or 24 volt bulbs.

Price - $8.50 Each. Postpaid

TYPE AN/ARN-6 RADIO COMPASS



Receiver R/101/ARN-6, 100-1750 kc in four bands. Excellent condition.
Price $39.50
Loop A5313-B. Excellent condition. Price...$27.50
Indicator ID91B/ARN-6. Excellent condition.
Price $9.95
Mounts MT-273 or MT-274. Excellent condition.
Price.....$14.95 each
C149A control box.$15.00

MANUAL

Handbook of operating instructions, general installation adjustment plus 15 pages of diagrams & schematics. Price.....$3.50

C & H SALES CO.

2178 E. COLORADO ST. • PASADENA, CALIF.

CIRCLE 513 ON READER SERVICE CARD

Your Headquarters For Test Equipment

★ SHOP EQUIPMENT ★

VARIABLE SPEED DRIVES
ENVIRONMENTAL TEST STANDS
ACTUATOR TEST STANDS
FUEL PUMP TEST STANDS
VACUUM PUMP TEST STANDS
HYDRAULIC PUMP TEST STANDS
HYDRAULIC ACCESSORY STANDS
GENERATOR TEST STANDS
INVERTER TEST STANDS
ALTERNATOR TEST STANDS
PROPELLER GOVERNOR STANDS
HEATER TEST STANDS

★ FLIGHT LINE EQUIPMENT ★

GENERATOR SETS
PORTABLE HYDRAULIC STANDS
SELF PROPELLED GENERATOR SETS
JACKS

★ INSTRUMENT TEST EQUIPMENT ★

GYRO BALANCERS
INSTRUMENT TESTERS

★ SEND US YOUR INQUIRIES ★

Aircraft Parts Corp

74 Rome Street, Farmingdale, L. I., N. Y.

Telephone: HAmilton 7-3331 Code 516 From N.Y.C. TU 6-4554

CIRCLE 504 ON READER SERVICE CARD

TRANS AIR PARTS . . . YOUR BEST BET FOR . . .

- Douglas & C-46
- Twin Beech: C-45, D-18
- Electrical Supplies
- Pratt & Whitney Parts
- Hamilton Standard Propellers & Governors
- Bosch & Scintilla
- Fuel Injection Pumps
- Stromberg Carburetors
- Starters & Generators
- Fuel, Vacuum & All Hydraulic Pumps

"We carry a full supply of component parts for all the above listed items"

Now...CONNECTORS & PLUGS—AN-MS-E-K-DPD-PLP and PLQ—*AMPHENOL—BENDIX—CANNON*

TRANS AIR PARTS CO. 155 W. 46TH ST. NEW YORK, N. Y. 10036 CI 7-0190

CIRCLE 505 ON READER SERVICE CARD

FREE Catalog

OF THE WORLD'S FINEST ELECTRONIC GOV'T SURPLUS BARGAINS



HUNDREDS OF TOP QUALITY ITEMS — Receivers, Transmitters, Microphones, Inverters, Power Supplies, Meters, Phones, Antennas, Indicators, Filters, Transformers, Amplifiers, Headsets, Converters, Control Boxes, Dynamotors, Test Equipment, Motors, Blowers, Cable, Keyers, Chokes, Handsets, Switches, etc., etc. Send for Free Catalog—Dept. ABG.

FAIR RADIO SALES
2133 ELIDA RD. • Box 1105 • LIMA, OHIO

CIRCLE 506 ON READER SERVICE CARD

AIRLINE STANDARD INSTRUMENT, COMMUNICATION and NAVIGATION EQUIPMENT

In stock at all times, immediate delivery:

FOR DC-6, 7, 8; CONSTELLATION, ELECTRA, 707, CONVAIR, LODESTAR, DC-3, 404, C-2A, C-4A, C-6A SPERRY GYROSYN
A-12, SP-20 SPERRY AUTOPILOT
P-1, PB-10, PB-20 BENDIX AUTOPILOT
COLLINS, BENDIX, ARC NAV/COM
H-5, H-6A, H-6B, 1460B HORIZONS
36102, 36105, 36106, 36109 RMI
MN-97F, G, H OMNIMAGS

Will supply FAA approved overhauled/certified or used/serviceable. Excess stocks of the above accepted in trade or purchased at all times.

In stock for immediate flyaway:

T-33A JET, B-17, B-25, B-26, F-51D, Lodestar, T-28A.

The E. D. Weiner Company
8619 West Third St., Los Angeles 48, California
OL 2-1007 24 hours

CIRCLE 507 ON READER SERVICE CARD

AIRCRAFT RADIO EQUIPMENT AND COMPONENTS

IMMEDIATE DELIVERY FROM ONE OF THE LARGEST STOCKS IN THE COUNTRY

ARC-1, ARC-3, ARC-5, ARN-1
ARN-5, ARN-7, ART-13, BC-348, BC-733
BC-1333, BC-433, LP-21, SCR-274N.
ANTENNAS, DYNAMOTORS, HEADSETS, MICROPHONES, BENDIX, COLLINS PARTS

AIRCRAFT RADIO INDUSTRIES, INC.
85 ST. JOHN ST. TEL. UN 5-0163 NEW HAVEN, CONN.
NEW YORK CITY TEL. LExington 2-6254

CIRCLE 508 ON READER SERVICE CARD

FREE CATALOG—GOV'T SURPLUS OPTICAL AND ELECTRONIC EQUIPMENT

★ AERIAL CAMERAS - LENSES - AUTO-COLLIMATORS - COLLIMATORS - TRACKING UNITS - TELESCOPES - PRISMS - EYEPIECES - MIRRORS - PERISCOPES - STEREOSCOPES ETC.

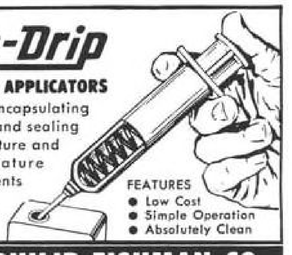
★ RECEIVERS - TRANSMITTERS - OSCILLOSCOPES - VOLTMETERS - PULSE GENERATORS - FREQUENCY METERS - CONVERTERS - AMPLIFIERS

THERMOELECTRIC DEVICES, INC.
SURPLUS SALES DIVISION
239 Massachusetts Ave. Cambridge 39, Mass.
617-UN 4-8644

CIRCLE 509 ON READER SERVICE CARD

No-Drip
POTTING APPLICATORS

For encapsulating potting and sealing of miniature and subminiature components



6 cc
12 cc
30 cc

FEATURES
- Low Cost
- Simple Operation
- Absolutely Clean

PHILIP FISHMAN CO.
7 CAMERON ST., WELLESLEY 81, MASSACHUSETTS
PHONE: 237-0133 AREA CODE: 617

CIRCLE 510 ON READER SERVICE CARD

AIRCRAFT ELECTRONICS, INC.

Sales, Installation, & Service

F.A.A. approved Repair Station
#4146 Radio Class 1 & 2 L-R

WESTCHESTER COUNTY AIRPORT
White Plains, New York
Hanger D—WH9-5375

CIRCLE 512 ON READER SERVICE CARD

Environmental Test Equipment: Humidity Chambers; Vibration Units; Hyd. Test Stands; Hi-Pressure Dennison & Vickers Radial Piston Pumps; Ovens; Flowmeters; Dynamometers; Balancers; Motor Generators; Rectifiers Tensile & Compression Testers. "Bought, Sold, Trade-Ins".

A & J MACHY. CORP.
130-32 JACKSON ST., BROOKLYN 11, N. Y.
EV 8-3277

CIRCLE 511 ON READER SERVICE CARD

1. AIRCRAFT BATTERIES—NEW SURPLUS



A. 12V, 17 A. H. at 5 hour rate N.A.F. Part #1062-17A. Size 8½"H x 7¾"W x 5¼"D with 7¼" x 2¼" x 2½" connector box. Lead acid dry charge type. Shipped not filled. To put in service, fill with 1.275 sp.g. sulphuric acid. Wt. filled 27 lbs. Mfgd. by Exide. Price ea. $12.99.

B. 24V, NICKEL-CADMIUM—$95.00

30 A. H. Non-refilling nickel-cadmium. Comes filled but not charged. Replacement on C-45 Beech and other types aircraft. Size approx. 10"x10"x10". wt. 80 lbs. BAUER part #MS53A3A906, Mfgd. by S.A.F.T.

2. AUTOPILOT GYRO — $7.95

C-1 Type—If not usable on aircraft you have a very interesting toy. You may get it rotating by applying 110V, AC or 24V, DC (operates approx. 7 minutes after energizing). Put in a suitcase and watch the fun when the unexpecting party picks up to go. May be used in its gimbol mounted aluminum case with to al wt. 12½ lbs. or remo ed and reduce wt. to 9½ lbs. Ship. wt. 20 lbs. approx.



3. B-16 MAGNETIC COMPASS — $9.95



Aircraft compass by "Airpath". Illuminated card. Fits standard 3¼" round hole. Built in compensators. Used but checked and guaranteed. Ship wt. 2 lbs.

All merchandise guaranteed for satisfaction or money back.

ESSE RADIO CO.
40 W. South St.
Indianapolis 25, Indiana

CIRCLE 519 ON READER SERVICE CARD

Aircraft Turbine Service, Inc.

EXCLUSIVE

AUTHORIZED AIRESEARCH OVERHAUL FACILITY

FAA #3956 L.A.C.

★ SUPERCHARGERS ★ REFRIGERATION TURBINES ★

CONVAIR
(ALL SERIES)

LOCKHEED
CONSTELLATIONS

MARTIN
404

DOUGLAS
DC6 and DC7

TURBOJET and TURBOPROP
PNEUMATIC COMPONENTS
GAS TURBINE ENGINES

"SERVICE IS OUR PRODUCT"

1300 SHAMES DR. • WESTBURY, L. I., N. Y. • ED. 3-1300

CIRCLE 514 ON READER SERVICE CARD

FLIGHT TEST

Aircraft and facilities available for large or small scale flight tests of airborne electronic equipment. Photogrametric proving of navigational system track or position data.

Complete aerial survey and photogrametric mapping facilities.

LONG ISLAND AIRWAYS, Inc.
P. O. Box 248, MacArthur Airport
Ronkonkoma, L. I., New York
Tel: JUniper 8-2344

CIRCLE 518 ON READER SERVICE CARD

FREE CATALOG — LARGE STOCK
COMMUNICATION EQUIPMENT, RADAR TEST INSTRUMENTS & TUBES AT LOW PRICES
MAGNESYN COMPASS SYSTEM FOR 12 VDC $24.95

R. & W. ELECTRONICS, INC.
2430 So. Michigan, Chicago, Ill. 60616
CAlumet 5-1281

CIRCLE 517 ON READER SERVICE CARD

Aircraft Radio Replacement Parts and Equipment for

COLLINS
BENDIX

Immediate Delivery

DC-3 DC-4 DC-6 DC-7
RA-18 MN-42 51R3 MN-36-C MN-58
18S4 180K 17-L-4-6 MN-62 51X
180L CRT-3 618S-1 51Y-3

Spare parts and accessories for above
We supply hard-to-get items.
Overnight delivery in many cases

CALL COLLECT

638-6370, area code 415

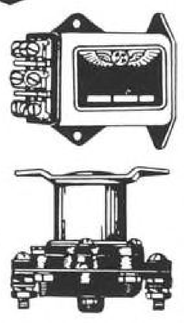
AIR-RESCO, INC.

RADIO ELECTRONIC SERVICE CO.
Bldg. 739, Oakland International Airport
Oakland 14, Calif.

CIRCLE 516 ON READER SERVICE CARD

LARGEST STOCK OF
RELAYS
IN THE WORLD

Also included are large supplies of
A-N
and
M-S
APPROVED
AIRCRAFT
RELAYS



SEND FOR COMPLETE
RELAY CATALOG
AB

Universal RELAY CORP.

42 WHITE ST., NEW YORK 13, N.Y. • WAlker 5-6900

CIRCLE 515 ON READER SERVICE CARD

WILLIAM C. WOLD ASSOCIATES
551 Fifth Ave., New York 17, N. Y.
Telephone: Mu 7-2050
Cable: Billwold New York
Specialists in the sale of Transport Aircraft

CIRCLE 520 ON READER SERVICE CARD

RAWAY BEARING CO., INC.



141G CHRYSTIE ST.
New York, N.Y. 10002
212 WAlker 5-8150
AERONAUTIC BEARINGS
Reliable Suppliers of Aircraft, Accessory, and Instrument Bearings — For Precision Applications.
YOUR INQUIRIES SOLICITED!

CIRCLE 521 ON READER SERVICE CARD

TOPS IN PROPS
Complete Repair Facilities For All Makes & Models.
Auth. Dealer: Harn • Standard • Beechcraft • Hartzell • McCauley. FAA Approved Repair Station
AIRCRAFT PROPELLER SERVICE, INC.
Sky Harbor Airport, Northbrook, Ill.
Crestwood 2-1688

CIRCLE 522 ON READER SERVICE CARD

$10.95 Complete



Color Dial Telephones
Factory rebuilt Western Electric in white, beige, ivory, pink, green or blue. If 4 prong plug is required add $2.00. Fully guaranteed. Write for free list. All shipments FOB.
SURPLUS SAVING CENTER
Waymart Dept. AW1223 Penna.

CIRCLE 523 ON READER SERVICE CARD

CUSTOM INTERIORS for AIRLINES or EXECS
• headliners • seats
• sidewalls • carpeting

Centrally located between Newark, Teterboro, LaGuardia and Idlewild Airports.
BAUCO
26 Glen Road
Rutherford, N. J.
Geneva 8-8900

CIRCLE 524 ON READER SERVICE CARD

RADIO RESEARCH INSTRUMENT CO.
AUTO-TRACK & TELEMETRY ANTENNA PEDESTALS
3 & 10 CM. SCR. 584 AUTOTRACK RADARS.
AN/TPS-1D SEARCH, AN/TPS-10 HT. FINDERS
AN/FPN-32GCA, AN/APS-10 NAVIG. & WEATHER
AN/APS-15B PRECISION, AN/APQ-35B PRECISION
AN/APS-31A SEARCH, DOZENS MORE.
5-1-2 MEGAWATT HIGH POWER PULSERS.
RADIO RESEARCH INSTRUMENT CO.
550 Fifth Ave., New York Judson 6-4691
RADAR SYSTEMS & COMPONENTS/ IMMEDIATE DELIVERY

CIRCLE 526 ON READER SERVICE CARD

ELECTRON TUBES
KLYSTRONS • ATR & TR • MAGNETRONS
SUBMINIATURES • C.R.T. • T.W.T. • 5000-6000 SERIES
• SEND FOR NEW CATALOG A2 •
A & A ELECTRONICS CORP.
1063 PERRY ANNEX
WHITTIER, CALIF.
AN 92865 OR 943-2829

CIRCLE 527 ON READER SERVICE CARD

NEED ELECTRONIC TUBES?
Send for America's most complete
WHOLESALE Electronic Tube Catalog "A"
LOU-TRONICS, Inc.
1318 Lawrence St. ULster 5-2615-6-7
Brooklyn 1, N. Y.

CIRCLE 528 ON READER SERVICE CARD

STAINLESS STEEL TANKS



Brand New in original cartons. Oxygen Cylinders. Type 304, 400 P.S.I. ¼" pipe thread openings at each end. J-1, 24x48", 80 gal., 10 gauge, 18,000 cu. in. Wt. 150 lbs., ship wt. 250 lbs., F.O.B. Baton Rouge, La., $300 value **$95.00**
G-1, 12x24", 2100 cu. in. 16 gauge, wt. 35 lbs., F.O.B. Chicago **$20.50**
ILLINOIS MFG. & SUPPLY CO.
1829 S. State St., Chicago 16, Ill., Dept. MH

CIRCLE 529 ON READER SERVICE CARD

AVIATION INSURANCE
NORTHEASTERN U. S.
18 years of Aviation specialization
RICHARD J. BERLOW & CO., INC.
Teterboro Airport, N. J. Telephone Atlas 8-1091

CIRCLE 530 ON READER SERVICE CARD

EXPORT DISTRIBUTORS

sps STANDARD PRESSED STEEL (One of the World's Largest Manufacturers of Aircraft Fasteners)

DAGE ELECTRIC COMPANY, INC. (Manufacturers of Special Connectors for the Jet Age)

KH K&D INDUSTRIES, INC. (Shielded Fluorescent Safety Lamp)

AVITRONIC ASSOCIATES, INC.
294 E. 3rd St., Mount Vernon, N. Y.
MO 7-3122

CIRCLE 531 ON READER SERVICE CARD

BOWSTEEL
The Most Complete Stock Of
AIRCRAFT ALLOY STEEL BARS
"THE Alloy Steel Specialists"
BOWSTEEL DISTRIBUTORS CORPORATION
601 East Linden Ave., Linden, N. J.
TELEPHONES: HU 6-4000 • MA 4-4000

CIRCLE 532 ON READER SERVICE CARD

Your Inquiries to Advertisers Will Have Special Value . . .

—for you—the advertiser—and the publisher, if you mention this publication. Advertisers value highly this evidence of the publication you read. Satisfied advertisers enable the publishers to secure more advertisers and—more advertisers mean more information on more products or better service—more value—to YOU!

Jsh ELECTRONICS CO.

ELECTRONIC TUBES—DIODES & TRANSISTORS
Leading Suppliers to the Aviation and Electronics Industry the World Over
ONE MILLION TUBES TO DRAW FROM
All Inquiries Replied To Promptly. We quote only on material available from stock for immediate delivery.
P.O. Box 407, 8549 Higuera Street
Culver City, Calif.
• Ve 7-0177 •
TWX 213 836 0487
Telegraph FAX
Cable JASHELEC

CIRCLE 525 ON READER SERVICE CARD

SEARCHLIGHT Equipment Locating Service

NO COST OR OBLIGATION

This service is aimed at helping you, the reader of "SEARCHLIGHT", to locate Surplus new and used aviation equipment and components not currently advertised. (This service is for USER-BUYERS only.)

How to use: Check the dealer ads to see if what you want is not currently advertised. If not, send us the specifications of the equipment wanted on the coupon below, or on your own company letterhead to:

Searchlight Equipment Locating Service
c/o AVIATION WEEK & SPACE TECHNOLOGY
P. O. Box 12, NY, NY, 10036

Your requirements will be brought promptly to the attention of the equipment dealers advertising in this section. You will receive replies directly from them.

Searchlight Equipment Locating Service
c/o AVIATION WEEK & SPACE TECHNOLOGY
P. O. Box 12, N. Y., N. Y., 10036
Please help us locate the following equipment components

.....
.....
.....

NAME .....
TITLE .....
COMPANY .....
STREET .....
CITY ..... BG '64

Index of Products Advertised

A special service designed to provide readers with a quick guide to the product information contained in advertisements throughout this Buyers Guide.

Actuators, Hydraulic ... 8, 14, 94, 95, 224
Adhesives ... 21
Air Conditioning Equipment ... 4, 14, 148, 270
Amplifiers ... 26, 150, 260
Antennas ... 31, 196, 214, 232
Axles ... 244

Balloons ... 262
Bearings, Ball ... 278
Bellows ... 145, 198, 214
Bolts ... 128, 237
Boring Equipment ... 169, 170

Cable, RF-Coaxial ... 33, 99, 100, 101, 102, 196, 276
Cable Assemblies, Electrical ... 276
Carts, Ground Service ... 244
Cases, Rocket Motor ... 31
Chemicals ... 283
Clamps, Metallic ... 268
Cleaning Equipment, Ultrasonic ... 145
Clocks, Electric ... 13, 223
Compressors ... 4, 14
Computers, Analog ... 18, 19, 150, 230
Computers, Digital ... 18, 19
Connectors, Electronic ... 35, 99, 100, 101, 102
Connectors, Hermetic Seal ... 33, 99, 100, 101, 102, 198
Construction Vehicles ... 12
Containers, Non-metallic ... 163
Control Equipment, Electronic ... 224
Control Equipment, Non-electronic ... 17, 38, 250, 279
Converters, Electronic ... 260
Cords, Non-electric ... 272
Counters, Electric ... 13
Couplers ... 106, 107, 252
Cutting Equipment ... 169, 170

Dampers, Control ... 8
Data Processing Equipment ... 66, 150, 212, 230
Detectors, Magnetic Chip ... 250
Disconnects, Electrical ... 35
Disconnects, Mechanical ... 106, 107, 163
Distributors ... 81, 84, 86, 93, 223, 242, 272, 273
Drives, Angle ... 252
Drives, Electric ... 94, 95
Drives, "T" ... 252
Ducts ... 106, 107, 145

Engineering-Service ... 27, 208, 278
Engines, Gas Turbine ... 22
Engines, Ramjet ... 28, 142
Explosive Forming—Service ... 272

Fans ... 37
Fasteners ... 4th Cover, 128, 237, 268
Films ... 278
Filters, Electronic ... 23, 157, 226
Filtration Equipment, Air ... 23
Filtration Equipment, Gases ... 3rd Cover
Filtration Equipment, Liquids ... 23, 157, 3rd Cover
First Aid Equipment ... 212
Fittings, Metallic ... 3, 33, 106, 107
Foil, Magnetic ... 232
Forgings ... 24
Fuel Systems & Equipment ... 164, 244
Fuels, Aircraft ... 32

Gages, Pressure Measuring ... 232
Galvanometers ... 150
Gears ... 244
Generating Equipment ... 94, 95
Graphite ... 211
Guidance Systems ... 2nd Cover

Handles ... 268
Harnesses, Safety, Personnel ... 163
Heat Exchangers ... 4, 214
Heat Treating Service ... 24
Heaters ... 148, 218, 219
Heating Equipment ... 148, 218, 219
Helmets ... 145
Hoists, Ground-based ... 277
Honeycomb Assemblies, Brazed ... 31, 246
Honeycomb Sandwich Fabricators ... 31, 246
Hose, Metallic, Flexible ... 3, 106, 107
Hose, Metallic, Rigid ... 33
Hose Assemblies, Metallic ... 3, 106, 107, 252
Hydroforming ... 169, 170

Inserts ... 278
Integrators ... 150
Intervalometers ... 13
Inverters ... 260

Joints, Ball ... 106, 107
Joints, Swivel ... 106, 107
Joints, Universal ... 15

Ladders ... 244
Laminations ... 262
Lasers (Optical Masers), Gaseous Type ... 208
Latches ... 268
Lathes ... 169, 170
Life Preservers ... 271
Life Rafts ... 271
Lubricants, Oil ... 32

Machines, Wire Backing ... 242
Machines, Filament Winding ... 16
Markers ... 230
Memories, Magnetic Core ... 13
Metal Parts Fabricators ... 9, 20, 120, 130, 169, 170, 208, 211
Metals—Alloy Steel ... 264
Metals—Aluminum ... 203, 204
Metals, Tungsten ... 124
Metals, Nickel Alloys ... 124
Metals, Stainless Steel ... 110, 111, 130
Metals, Titanium Forgings ... 9, 120, 169, 170
Microwave Equipment ... 214
Milling Equipment ... 169, 170
Modulators ... 135, 136, 270
Motors, D.C. ... 6, 26, 230
Motors, Servo ... 6, 94, 95, 114, 115, 164
Multiplexers ... 150

Navigation Equipment, Electronic ... 2nd Cover, 238

"O" Rings ... 262
Optical Equipment ... 226

Panels, Non-metallic ... 260
Parachutes ... 223, 271
Photographers ... 25
Photographic Equipment ... 278
Pins ... 268
Plastic Materials, High-temperature ... 21, 283
Plastic Materials, Transparent ... 10, 21, 283
Platforms, Guidance System, Gyro-stabilized ... 230
Power Equipment, Auxiliary ... 269
Power Supplies ... 14, 30, 260, 269
Presses ... 24, 169, 170
Programming ... 99, 100, 101, 102
Propellant, Rockets, Solid ... 36
Pumps, Gaseous Systems ... 164
Pumps, Liquid Systems ... 14, 34, 252
Punching Equipment ... 140

Radiators ... 27
Radio Equipment ... 118
Radomes ... 31
Readers, Paper Tape ... 140
Real Estate Agency ... 250
Receivers, Avionic ... 118
Recovery Systems ... 223
Rectifiers, Transformer ... 30
Reels ... 277
Refrigerating Systems ... 148
Regulating Equipment ... 29, 279
Resolvers ... 114, 115
Rivets ... 128
Rocket Instruments ... 226
Rod Ends ... 276, 278

Satellites ... 162, 163, 262
Screws ... 237
Sealants ... 21
Seals ... 196
Seats, Aircraft ... 163
Sensing Units ... 279
Sensors, Voltage ... 38
Shafts, Flexible ... 246, 252
Shearing Equipment ... 169, 170
Showers, Decontamination ... 212
Silicones ... 21
Simulators ... 226
Solenoids ... 184, 218, 219
Space Suits ... 145, 218
Spacecraft ... 162, 163
Splicers, Cable ... 99, 100, 101, 102
Stands, Work ... 12, 244
Starters, Aircraft ... 94, 95
Strapping, Metallic ... 106, 107
Stretchers ... 163
Switches, Float ... 163
Switches, Liquid-actuated ... 163
Switches, Pressure ... 163, 279
Synchros ... 6, 114, 115

Tachometers ... 6
Tape, Magnetic, Recording ... 123
Targets, Tow ... 260
Telemetry Equipment ... 150
Terminals ... 99, 100, 101, 102, 276
Test Equipment, Electrical ... 145, 184
Thermometers, Electrical Resistance ... 232
Thermometers, Fuel Temperature ... 232
Tiedown Equipment ... 271, 276
Timers ... 13, 211
Tooling ... 99, 100, 101, 102
Towers, Servicing ... 12
Transformers ... 114, 115
Transistors ... 7
Transmitters, Radio ... 118, 246
Trucks ... 11
Tube Parts, Electron ... 174
Tubes, Electron ... 174
Tubing, Metallic ... 33, 106, 107, 264

Vacuum Processes, Arc Melting ... 9, 24, 120
Valves, Liquid Systems ... 14, 29, 38, 184, 214, 218, 219, 224, 232, 279

Washers, Metallic ... 4th Cover
Waveguide Equipment ... 33
Welders, Spot ... 169, 170
Winches ... 277

ADVERTISERS IN THIS ISSUE

AVIATION WEEK & SPACE TECHNOLOGY, MID-DECEMBER, 1963

AC SPARK PLUG, THE ELECTRONICS DIVISION OF GENERAL MOTORS ... 2nd Cover
ADEL DIVISION, GENERAL METALS CORPORATION ... 14
ADVANCED PRODUCTS COMPANY, THE ... 262
AEROFLEX LABORATORIES, INC. ... 230
AEROQUIP CORPORATION ... 106-107
AEROTEC INDUSTRIES, INC., AIRCRAFT EQUIPMENT DIVISION ... 163
AIR-MAZE DIVISION, ROCKWELL-STANDARD CORPORATION ... 3rd Cover
AIRCRAFT POROUS MEDIA, INC. ... 157
AIRWORK CORPORATION ... 242
ALBANO CO., INC., HONEYCOMB STRUCTURES DIVISION ... 246
ALUMINUM COMPANY OF AMERICA ... 203, 204
AMP INCORPORATED ... 99-102
AMERICAN AIR FILTER COMPANY, INC., DEFENSE PRODUCTS GROUP ... 148
AMERICAN AVITRON ... 278
ANCHOR COUPLING COMPANY, INC. ... 252
ANDREW CORPORATION ... 196
ANGLO AMERICAN AVIATION COMPANY ... 242
APEX MACHINE & TOOL COMPANY, THE ... 15
ARENS CONTROLS, INC. ... 250
ARROWHEAD PRODUCTS, DIVISION OF FEDERAL-MOGUL-BOWER BEARINGS, INC. ... 145
ASTRODATA INC. ... 150
AVICA CORPORATION ... 262
AVIQUIPO, INC. ... 273
AVNET ELECTRONICS CORPORATION ... 81, 84, 86, 93, 223, 272

BARBER-COLMAN COMPANY, AIRCRAFT & MISSILE PRODUCTS DIVISION ... 224
BLACK, SIVALLS & BRYSON, INC., FILAMENT STRUCTURES DIVISION ... 16
BRAEBURN ALLOY STEEL DIVISION CONTINENTAL COPPER & STEEL INDUSTRIES, INC. ... 9
BREEZE CORPORATIONS, INC. ... 277
BRILES MANUFACTURING ... 4th Cover
BRISTOL SIDDELEY ENGINES LIMITED ... 142
BROOKS & PERKINS, INC. ... 20
BRUNSWICK CORPORATION, DEFENSE PRODUCTS DIVISION ... 31

CAMERON IRON WORKS, INC., SPECIAL PRODUCTS DIVISION ... 24
CANADIAN MARCONI COMPANY, COMMERCIAL PRODUCTS DIVISION ... 18-19
CATERPILLAR TRACTOR COMPANY ... 22
CHANDLER EVANS CORPORATION ... 164
CHANDLER PRODUCTS CORPORATION ... 237
CHATHAM ELECTRONICS DIVISION OF TUNG-SOL ELECTRIC INC. ... 30
CHERRY RIVET DIVISION, TOWNSEND COMPANY ... 128
CLIFTON PRECISION PRODUCTS COMPANY, INC. ... 114, 115, 193, 243
COMPUTING DEVICES OF CANADA LIMITED ... 238
CONSOLIDATED SYSTEMS CORPORATION ... 212

DAVID CLARK COMPANY, INC. ... 218
DELCO RADIO DIVISION OF GENERAL MOTORS ... 118
DI/AN CONTROLS INC. ... 13
DUREZ PLASTICS DIVISION, HOOKER CHEMICAL CORPORATION ... 283

EAGLE SIGNAL DIVISION OF E. W. BLISS COMPANY ... 211
EXPLOSIVE TECHNOLOGY, INC. ... 272

FIRTH STERLING, INC. ... 124
FRANK G. HOUGH COMPANY, THE ... 11
FREBANK COMPANY ... 279

THE GARRETT CORPORATION, AIRESEARCH MFG. DIVISION ... 28
GARSITE PRODUCTS, INC. ... 244
GENERAL ELECTRIC COMPANY, SILICONE PRODUCTS DEPARTMENT ... 21
GENERAL MAGNETICS, INC. ... 135, 136
GITS BROTHERS MANUFACTURING COMPANY ... 196
GRUMMAN AIRCRAFT ENGINEERING CORPORATION ... 162-163

HARRISON RADIATOR DIVISION OF GENERAL MOTORS ... 27
HARTWELL CORPORATION, THE ... 268
HAWS DRINKING FAUCET COMPANY ... 212
HI-TEMP MATERIALS MACHINING COMPANY ... 211
C. G. HOKANSON COMPANY, INC. ... 270
HOUDAILLE INDUSTRIES, INC., BUFFALO HYDRAULICS DIVISION ... 8

INLAND MOTORS CORPORATION SUBSIDIARY OF KOLLMORGEN ... 26
INTERELECTRONICS CORPORATION ... 260
IRVING AIR CHUTE COMPANY, INC. ... 223

JAMES, POND & CLARK, INC. ... 219
JOSEPH L. SMITH & ASSOCIATES ... 250
JOY MANUFACTURING COMPANY, INDUSTRIAL DIVISION ... 37

K-ALPHA CORPORATION ... 246
C. B. KAUPP & SONS, INC. ... 169, 170
KEITHLEY INSTRUMENTS, INC. ... 260
KINGSLEY MACHINE COMPANY, AERO/SPACE DIVISION ... 242
KOONTZ WAGNER ELECTRIC COMPANY, INC. ... 218

LAVELLE AIRCRAFT CORPORATION ... 208
LEAR SIEGLER, INC., LASER SYSTEMS CENTER ... 208
LEAR SIEGLER, INC., POWER EQUIPMENT DIVISION ... 94-95
LISLE CORPORATION ... 250
LITTON INDUSTRIES, INC., ELECTRON TUBE DIVISION ... 174

3M COMPANY, MAGNETIC PRODUCTS DIVISION ... 123
MACWHYTE WIRE ROPE COMPANY ... 276
MARSH INSTRUMENT COMPANY DIVISION OF COLORADO OIL & GAS CORPORATION ... 232
MARTIN COMPANY, DENVER DIVISION ... 224
McDONNELL AIRCRAFT ... 230
MICRODOT, INC. ... 198
MIDVALE-HEPPENSTAL COMPANY ... 130
R. A. MILLER INDUSTRIES, INC. ... 232
MOTOR GENERATOR CORPORATION ... 269
MPO PRODUCTIONS, INC., SPECIAL PROJECTS DIVISION ... 25

PANEL CORPORATION OF AMERICA ... 260
PATENT SCAFFOLDING COMPANY, INC. ... 12
PERFECTION MICA COMPANY, MAGNETIC SHIELD DIVISION ... 232
PESCO PRODUCTS DIVISION, BORG-WARNER CORPORATION ... 34
PHELPS DODGE ELECTRONIC PRODUCTS CORPORATION ... 33
PYLE-NATIONAL COMPANY, CONNECTORS DIVISION ... 35

RADIATRONICS INC. ... 214
ROBERTSHAW CONTROLS COMPANY, FULTON SYLPHON DIVISION ... 198
ROHM & HAAS COMPANY ... 10
ROPER HYDRAULICS, INC. ... 252

SANBORN COMPANY, INDUSTRIAL DIVISION ... 66
SCREEN PRODUCTS DIVISION, CONTINENTAL COPPER & STEEL INDUSTRIES, INC. ... 23
SILICON TRANSISTOR CORPORATION ... 191
SINCLAIR REFINING COMPANY ... 37
SPECIAL METALS, INC. ... 120, 183
SPECTROLAB DIVISION OF TEXTRON ELECTRONICS, INC. ... 226
STANDARD-THOMSON CORPORATION ... 214
M. STEINTHAL & COMPANY, INC. ... 271
STEPHENS-ADAMSON MFG. COMPANY, SPHERCO BEARINGS DIVISION ... 278
F. W. STEWART CORPORATION ... 259
STOW MANUFACTURING COMPANY ... 249
STRATOFLEX INC. ... 3
SUPERIOR TUBE COMPANY ... 7

TACTAIR FLUID CONTROLS CORPORATION ... 181
TELETYPE CORPORATION ... 140
THIOKOL CHEMICAL CORPORATION ... 36
TYMETER ELECTRONICS, PENNWOOD NUMECHRON COMPANY ... 223

UNITED AIRCRAFT PRODUCTS ... 4
UNITED MANUFACTURING COMPANY, THE ... 244
UNITED STATES RADIUM CORPORATION ... 230
UNITED STATES STEEL CORPORATION ... 110-111

VAPOR CORPORATION, VAP-AIR DIVISION ... 38
VICTOR EQUIPMENT COMPANY ... 29
VIRON DIVISION, GEOPHYSICS CORPORATION OF AMERICA ... 262

EDWIN L. WIEGAND COMPANY ... 218, 219
WILDING INC. ... 278
WOODWARD GOVERNOR COMPANY ... 17
WRIGHT DIVISION OF SPERRY RAND CORPORATION ... 6

SALES (Tel.: 212-971-3378)

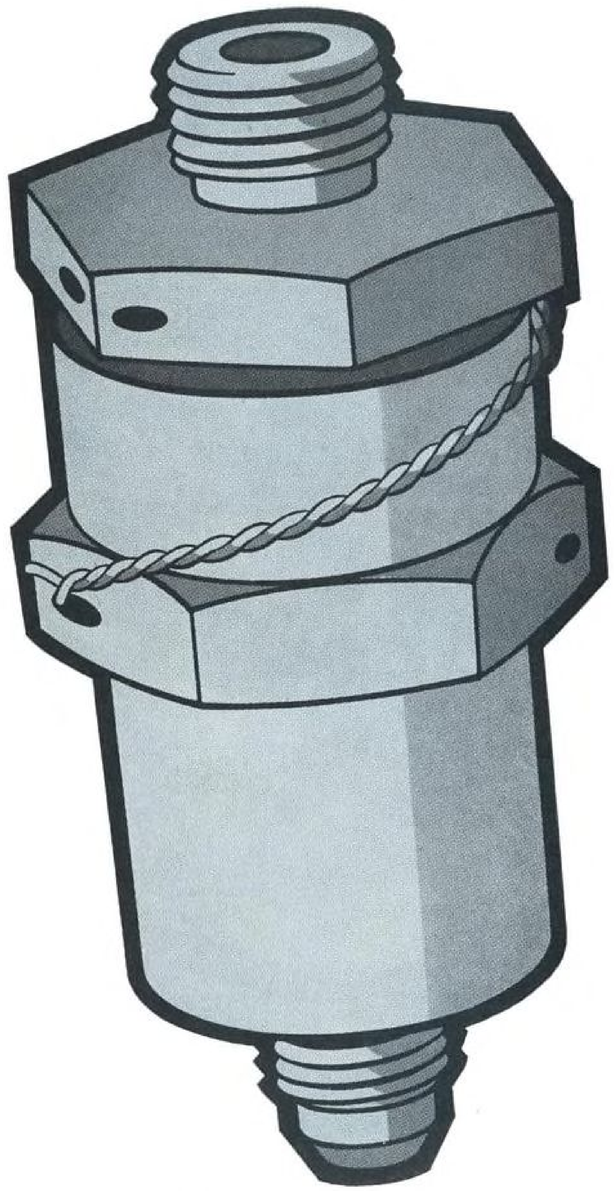
ADVERTISING SALES MANAGER
E. P. Blanchard, Jr.

ATLANTA ... J. A. Lane, Jr.
BOSTON ... D. C. Jackman
CHICAGO ... J. S. Costello
DALLAS ... John Grant
DENVER ... John W. Patten
DETROIT ... M. Hulburd
HOUSTON ... K. George
LOS ANGELES ... C. F. McReynolds, D. T. Brennan, C. A. Ransdell
NEW YORK ... M. J. Storz, R. Wallace, J. D. Warth
PHILADELPHIA ... J. D. Willis, M. Hosmer
PITTSBURGH ... J. R. Pierce
SAN FRANCISCO ... R. R. Butera
ST. LOUIS ... T. H. Hunter, Jr.
GENEVA ... Fulvio Piovano
LONDON ... E. S. Murphy

MARKETING (Tel.: 212-971-2305)
PROMOTION & MARKETING MGR.
C. C. Gersna
RESEARCH MANAGER ... H. M. Raven
ASSOCIATES ... R. Roney, Susan Arthur

BUSINESS (Tel.: 212-971-3288)
BUSINESS MANAGER ... J. G. Johnson
ASST. BUSINESS MANAGER ... W. V. Cockren
PRODUCTION MANAGER ... F. A. Dube

CIRCULATION (Tel.: 212-971-2680)
CIRCULATION MANAGER ... T. J. Lucey



FUEL AND COOLING SYSTEMS HAVE A GOOD THING IN COMMON...FILTERS LIKE THIS

Hydraulic-lubricating systems do, too. It's an in-line filter by Air-Maze, used for everything from anhydrous ammonia and hot gas to MIL-L 7808. Lightweight designs for all capacity requirements and pressures up to 3,000 psi. We build fluid filters for every aircraft and missile application, standard or special. We'll build them to your basic design, using the filter element you specify (pleated—disc—cylindrical—all metal construction) with the filtration you require. For detailed information, write or call Rockwell-Standard Corporation, Air-Maze Division, Cleveland 28, Ohio.

ROCKWELL R STANDARD®

AIR-MAZE FILTERS ARE PRODUCED BY ROCKWELL-STANDARD CORPORATION

Circle Number 291 on Reader-Service Card

DEC 24 1959

NEW



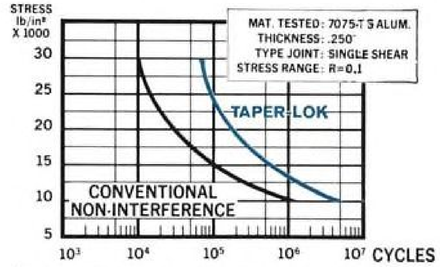
HIGH TENSION
CONTROLLED INTERFERENCE
TAPER·LOK®
FASTENERS



WHY are MS 21250, MS 2000, NAS 144 thru 156 & NAS 624 thru 636 series bolts being replaced with the NEW TL 400 Series TAPER-LOK fasteners?

BECAUSE The high strength TL 400 series TAPER-LOK fasteners not only meet the full strength requirements of MIL-B-8831, they also offer the added **proven advantages** of the TAPER-LOK System including:

- **VALUABLE WEIGHT SAVINGS** up to 20%
- **RIGID STRUCTURAL INTEGRITY** through the positive controlled interference fit.
- **BUILT-IN QUALITY CONTROL** with close tolerance precision drilling at no added cost.
- **POSITIVE SEALING** without the use of supplementary sealants.
- **PHENOMENAL STRUCTURAL FATIGUE LIFE** as proven by over $1,000,000.00 in testing by major aircraft producers.



This SN diagram illustrates the fatigue improvement realized through the use of the TAPER-LOK controlled interference fastener in a typical single shear lap joint. Fatigue improvement realized in other applications:

- Fasteners in path of tensile load . . . up to 2000% improvement.
- Fasteners in path of compressive load . . . up to 300% improvement.



- **MATING** high strength **12-POINT WASHERNUTS** with free-turning, anti-fumble **CAPTIVE WASHERS**



ENGINEERED, MANUFACTURED & SOLD BY

BRILES MANUFACTURING

1415 EAST GRAND AVENUE • EL SEGUNDO, CALIFORNIA

Circle Number 292 on Reader-Service Card