Aviation Week & Space Technology

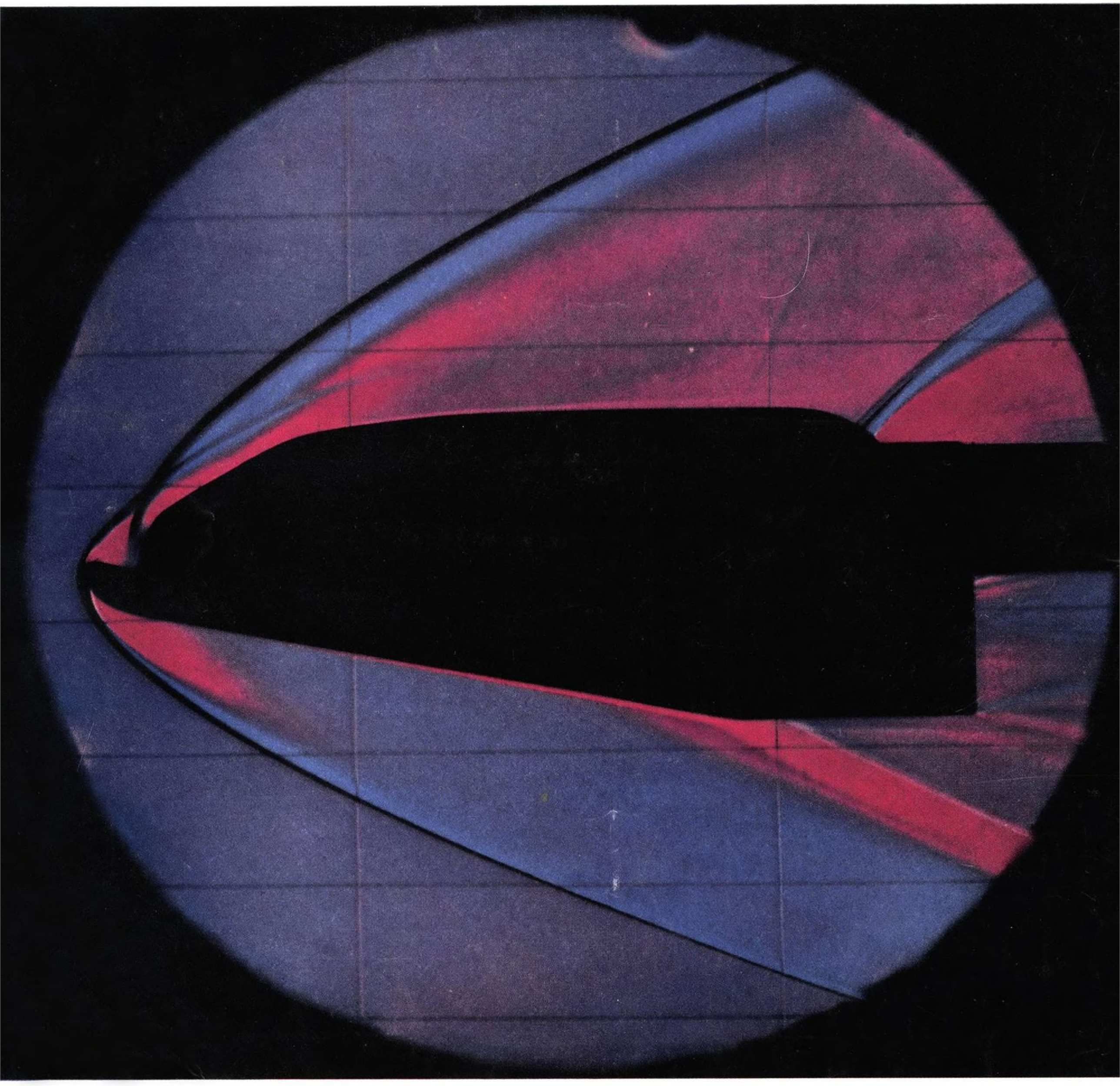
75 Cents

A McGraw-Hill Publication

Mid-December, 1962

NASA Foresees $5.5-$7 Billion Annual Budgets

Grumman GRV-1 Re-entry Vehicle



BUYERS GUIDE ISSUE

Six months of engineering research and development during 1962 have set into motion at Voi-Shan a master plan for one of the largest stocks of all types of Quick Release Pins the aerospace industry has ever known. As the year progresses this stock and product variety will rise to new predictable heights due to Voi-Shan's skillfully planned system of manufacture to meet the aerospace buyers' needs. ■ Less sure, but interesting, are these Voi-Shan expert guesses for major sports through 1963. Compare your scoreboard throughout the seasons, with those shown here.

THE ROSE BOWL

January '63: We call it Southern California over Wisconsin.

Your prediction .....
And a larger stock of Quick Release Pins to order from Voi-Shan.

NFL CHAMPIONSHIP

January '63: Prediction, the Green Bay Packers will easily defeat the New York Giants.

Your choice .....
And still more Voi-Shan Quick Release Pins ready to order in a range of sizes.

VOI-SHAN'S QUICK RELEASE PIN
BUYERS SCOREBOARD

NBA CHAMPIONSHIP

Spring '63: Looks good for the Los Angeles Lakers to defeat the Boston Celtics.

Your selection .....
And the variety and stock of Quick Release Pins goes up at Voi-Shan.

ANNUAL ALL STAR GAME

July '63: Will see the National League edging out the American League due to superior pitching.

Your opinion .....
And leadership in Quick Release Pins grows at Voi-Shan.

WORLD SERIES

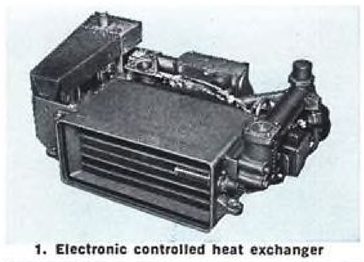
October '63: Draws big crowds to watch the Minnesota Twins defeat the St. Louis Cardinals.

Your prediction .....
And the finest and largest complete Quick Release Pin stocks are found at Voi-Shan.

How will these selections rate? And yours? Let us know through the year when you select Quick Release Pins—a sure thing—from the all-time greatest selection stock at: Voi-Shan Manufacturing Company. Information on this and other precision aerospace fasteners by Voi-Shan is readily available to be sent at your request.

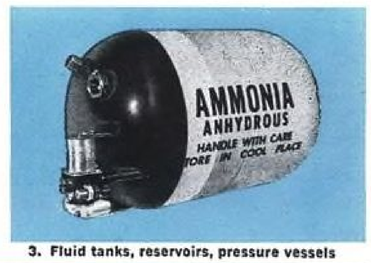
VOI-SHAN MANUFACTURING COMPANY • DIVISION OF VSI CORPORATION • **8463 Higuera St., Culver City, Calif.**

CIRCLE 2 ON READER SERVICE CARD

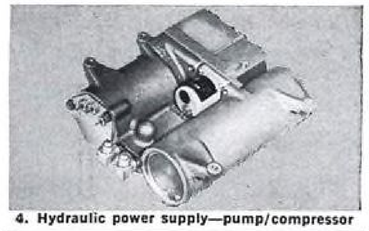


1. Electronic controlled heat exchanger

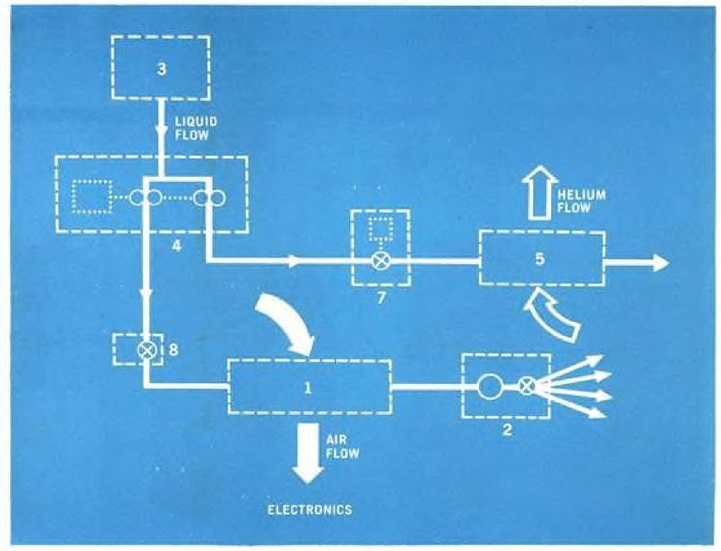
2. All attitude control system

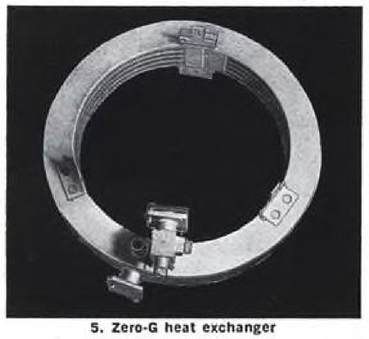


3. Fluid tanks, reservoirs, pressure vessels

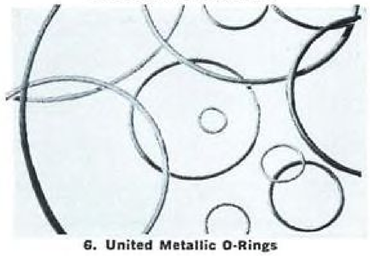


4. Hydraulic power supply—pump/compressor

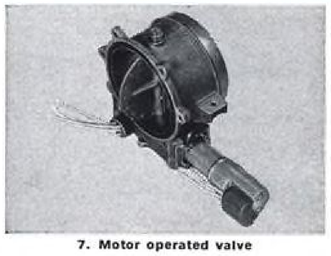




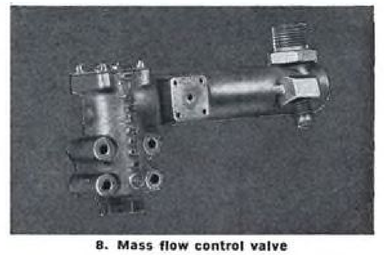
5. Zero-G heat exchanger



6. United Metallic O-Rings



7. Motor operated valve



8. Mass flow control valve

PARTS OR PACKAGES

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UAP

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At B & P that "extra" is found in our *capability* and *experience* in the design, fabrication and assembly of lightweight and space age metal products. May we have the opportunity to work with you?

An example of our capability is shown here in the manufacture of lightweight close tolerance satellites and instrument cans. B & P has made satellites for several space projects.

Write today for your copy of the new 36 page illustrated booklet entitled, "Countdown".

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S-N can recommend a high speed increaser unit from present line for high speed testing from 2-2,000 HP for 80-80,000 RPM. S-N will also design and build to your specification. Information on specific units and applications available.

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Mid-December 1962

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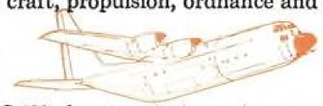
Lundy specializes in *tough* actuation problems—open or closed loop control—electro-mechanical, hydraulic and pneumatic.

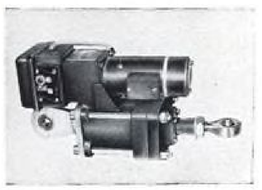
Lundy also has many standardized modular actuator designs for many applications.

Send your actuator and actuation system requirements to Lundy for all types of vehicles and equipment: amphibious, land, GEMS, hydrofoil craft, propulsion, ordnance and others.



AIRCRAFT:
Lockheed C-130 elevator actuator system provides control through primary AC motor drive with DC emergency drive backup. Screwjack *automatic take-up* limits end play *to .010" even after 100,000 cycles.*

HELICOPTER:
Vertol HC-1B/107 unique flight-control actuator imparts longitudinal cyclic pitch control to rotor blades to provide speed trim. Unit features special *non-jammable* mechanical stops.



VTOL:
Lockheed Hummingbird actuator provides both *trim actuation and artificial feel* in a *weather-sealed single package* and has *electro-solenoid free floating feature.*

SATELLITE:
"Sun Shade" hermetically-sealed actuator for Grumman OAO provides 90° nutating motion for *25,000 cycles in a 10^{-7}mm Hg space environment.* Unit controls closure over optical and instrumentation equipment.

MISSILE:
Lundy's actuator-driven IRIS-FLO mixing valves control the synthesizing of air mixtures on the Saturn S-1. Unit operates in *temperature environment of −65°F to 400°F.*

Lundy

LUNDY ELECTRONICS & SYSTEMS, INC.

Glen Head, New York

For further information on *Lundy versatility* write for Catalog L-1.

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Buy the cppc QUALITY LINE

SYNCHROS

Sizes 8, 10, 11, 15, and 22 available. Clifton Precision synchros offer highest accuracy in production quantities (7' max. error is typical), lowest nulls, lowest phase shifts, corrosion resistant construction, stainless steel or aluminum housings. Double ended shafts, BuOrd 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.

SIZE 8 SIZE 10 SIZE 11 SIZE 15

ROTARY COMPONENTS

PANCAKE SYNCHROS & RESOLVERS

Gyro take-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 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 to resist 450°F. Resistive, feedback winding or thermistor compensation. Types for transistor circuitry. BuOrd shafts and Mk 4 Mod O brush block obtainable. Compatible booster amplifier below.

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.

AC & DC SERVO MOTORS

Sizes 8, 10, and 11. AC motors—High torque for size. Will withstand 150°C. Types for transistor circuitry. DC motors—Speed linearly proportional to voltage. 28 or 14 V input. 500 hr. life guarantee. Available with governor which maintains constant speed within ±1%.

MOTOR GENERATORS

Sizes 8 and 10. These units feature minimum length and weight, low power consumption and low inertia. Suitable for simple rate damping of positional servos for high stability. Types for transistor circuitry. High temperature resistant.

GEARHEAD 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.

MOTOR RATE TACHOMETERS

Sizes 8, 10, and 11. These full drag cup type tachometers for damping of high gain servo systems feature high linearity, high output to null ratios and very low inertia. Signal to noise ratios up to 100:1 available. Typical power consumption 1.2 watts. High temperature resistant.

BRAKES & CLUTCHES

These size 5 units offer a guaranteed "no-creep" design (pat. pend.), high torque per watt, no loss of torque during life (in fact torque tends to increase). No torque variation with temperature. Single or double ended shafts.

MINIATURE SERVO ASSEMBLIES

CPPC has built a wide variety of servo packages of which the Flight Control Synchronizer (left) and Servo Gear Train Package (right) are typical. Similar packages can be custom designed and manufactured to your specifications using Clifton Precision QUALITY components and high standards of excellence.

AMP

CPPC's new one cubic inch 28-volt Servo Amplifier features excellent stability in subminiature size. Delivering 5 watts of power at 400 cps, it operates over a temperature range of −55°C to +125°C. Gain is externally adjustable and gains up to 2,000 can be obtained.

When used with a 10K input resistor, the gain is 1000 ±6% and the phase shift is 0° ±6° at 15 V output. The unit is designed to drive a motor having a 35 V center-tapped control phase.

LIFIERS

PRECISE ANGLE INDICATOR

When signalled by a remotely located synchro transmitter, this Precise Angle Indicator reproduces and displays accurately in digital readout any angular displacement. It is an extremely useful piece of test equipment for computer groups and systems engineers. As a laboratory tool for development, experimentation, and substantiation, it has wide application.

The Precise Angle Indicator has a removable face and thus may easily be modified to meet your own panel requirements.

Standard accuracy is ±5 minutes maximum. Repeatability is ±.7 minute, while readability is 0.5 minute. Slewing speed is 25°/sec. nominal. Rigid shock proof construction is used throughout. The internal layout is open to facilitate maintenance and servicing.

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(Price ranges: $4,000.00 to $8,000.00)

Eitronic series instruments with solid state logic switching. Totally transistorized AC and DC voltmeters, ratiometers and ohmmeters in either 4 or 5 digit models. All the inherent advantages of solid-state circuitry—speed, accuracy, reliability and silent operation. Automatic ranging and polarity indication. Electrical outputs for direct printer drive.

SPECIFICATIONS

	4 DIGIT MODELS	5 DIGIT MODELS
DC Voltage Range:	±.0001 to 999.9V	±0.0001 to 999.99V
DC Ratio Range:	±.0001 to 999.9	±0.0001 to 999.99
DC Accuracy:	±1 digit	±0.01% of reading or 1 digit
Average DC Balance Time:	50 msec.	50 msec.
AC Voltage Range:	.0001 to 999.9V	0.0001 to 0999.9V
AC Accuracy:	±0.1% of reading or 2 digits	±0.1% of reading or 2 digits
Average AC Balance Time:	1 sec.	1 sec.
Resistance Range:	.0001KΩ to 999.9KΩ	000.01Ω to 9.9999MΩ
Resistance Accuracy:	to ±.01% of reading	to ±.01% of reading
Average Resistance Balance Time:	200 msec.	200 msec.

ELECTROMECHANICAL

(Price ranges: $1,200.00 to $5,000.00)

Electromechanical AC and DC voltmeters, ratiometers and ohmmeters in either 4 or 5 digits. More than 10,000 now in field use. Solid state circuitry throughout. Higher accuracies, simpler operation, faster speeds and far greater reliability. Automatic ranging and polarity. Direct printer drive capabilities.

SPECIFICATIONS

	4 DIGIT MODELS	5 DIGIT MODELS
DC Voltage Range:	±.0001 to 999.9V	±0.0001 to 1100.0V
DC Ratio Range:	±.0001 to .9999	±.00001 to .99999
DC Accuracy:	±1 digit	±0.01% of reading or 1 digit
Average DC Balance Time:	1 sec.	2 sec.
AC Voltage Range:	.0001 to 999.9V	0.0001 to 0999.9V
AC Accuracy:	±0.1% of reading or 2 digits	±0.1% of reading or 2 digits
Average AC Balance Time:	3 sec.	3 sec.
Resistance Range:		000.01Ω to 9.9999MΩ
Resistance Accuracy:		to ±0.01% of reading
Average Resistance Balance Time:		2 sec.

X-Y and X-YY[1] RECORDERS

(Price ranges: $1,600.00 to $5,000.00)

Feature for feature, the world's most carefully designed and built recorders and accessories. Totally transistorized circuitry. Features plug-in signal amplifier modules in the 400 series instruments. Human engineered operating controls, unparalleled performance and reliability.

SPECIFICATIONS

	300 SERIES	400 SERIES	500 SERIES
Slewing Speeds:	20"/sec.	30"/sec.	25"/sec.
Static Accuracy:	±0.15%	±0.15%	±0.15%
Input Sensitivity:	0.5mv/in. to 50v/in.	See Module Spec.	0.5 mv/in. to 100 v/in.
Input Impedance:	1 megohm	See Module Spec.	1 megohm
Time Base:	.02 to 1.0 in./sec.	See Module Spec.	.02 to 1.0 in./sec.
Reference:	mercury cells	See Module Spec.	Internal Zener diode.
Style:	table or rack mounting	Table or rack mount.	Table or rack mount.

	MODEL 420 PLUG-IN MODULE	MODEL 468 PLUG-IN MODULE
Static Accuracy:	±0.1%	±0.1%
Input Sensitivity:	0.5 mv/in. to 100 v/in.	0.5 mv/in. to 100 v/in.
Input Impedance:	1 to 4 megohms	1 to 4 megohms
Time Base:		0.02 to 2.0 in./sec.
Reference:	Zener diode	Zener diode

NOTE: Numerous other plug-in modules immediately available.

Totally transistorized DC amplifiers featuring plug-in attenuators to accommodate single-ended or differential inputs. Unmatched performance and versatility. High reliability, minimum size, no heat problems. NOTE: Specify basic amplifier and one plug-in attenuator when ordering DC amplifiers.

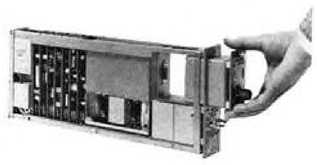
MODEL A-14 Basic Operational and Computer Control Amplifier—Includes basic amplifier specifications. Specify Model A-14GSP or A-14GDP plug-in attenuator.

MODEL A-15 Basic General Purpose Amplifier—Includes basic amplifier specifications. Specify Model A-15GSP or A-15GDP plug-in attenuator.

MODEL A-16 Basic True Differential General Purpose Amplifier—Includes basic amplifier specifications. Specify Model A-16GD plug-in attenuator.

WIDEBAND DC AMPLIFIERS

(Price ranges: $850.00 to $1,500.00)



SPECIFICATIONS

BASIC AMPLIFIER
DC Linearity: to 0.01%
DC Output Impedance: less than 80 milliohms
Output Capability: ±10V to ±100 MA
Capacitive Output Load: to 0.25 μfd

A-14GSP ATTENUATOR
Gain: 1 to 100 with vernier between steps
Input Impedance: 100 meg
Drift: to 2μv
Noise (referred to input): to 5μv P/P
Frequency Response: to 10KC
Common Mode Rejection:
Operation: Single-ended floating

A-14GDP ATTENUATOR
1 to 100 with vernier between steps
100 K
to 4μv
to 50μv RMS
to 10KC
to 100 db
balanced differential

A-15GSP ATTENUATOR
Gain: 10 to 1000 with vernier between steps
Input Impedance: 100 meg.
Drift: to 2 μv
Noise (referred to input): to 1 μv P/P
Frequency Response: to 10 KC
Common Mode Rejection:
Operation: single-ended floating

A-15GDP ATTENUATOR
10 to 1000 with vernier between steps
10 K
to 4 μv
to 7 μv RMS
to 10 KC
to 100 db
balanced differential

A-16GD ATTENUATOR
Gain: 10 to 1000
Input Impedance: 100 megohms
Drift: to 2 μv
Noise (referred to input): to 5 μv RMS
Freq. Response: to 10KC
Common Mode Rejection: to 160 db
Operation: true differential

NOTE: Numerous other plug-in attenuators available.

4 DIGIT MODELS

EITRONIC 848 DC Voltmeter/Ratiometer—Includes all 4 digit DC specifications.

EITRONIC 850 DC Voltmeter/Ratiometer/AC Voltmeter—Includes all 4 digit AC and DC specifications.

EITRONIC 851 DC Voltmeter/Ratiometer/AC Voltmeter/Ohmmeter—Includes all 4 digit AC, DC and resistance specifications.

5 DIGIT MODELS

EITRONIC 880 DC Voltmeter/Ratiometer—Includes all 5 digit DC specifications.

EITRONIC 881 DC Voltmeter/Ohmmeter—Includes all 5 digit DC and resistance specifications.

EITRONIC 882 DC Voltmeter/Ratiometer/AC Voltmeter—Includes all 5 digit AC and DC specifications

EITRONIC 883 DC Voltmeter/Ratiometer/AC Voltmeter Ohmmeter—Includes all 5 digit AC, DC and resistance specifications.

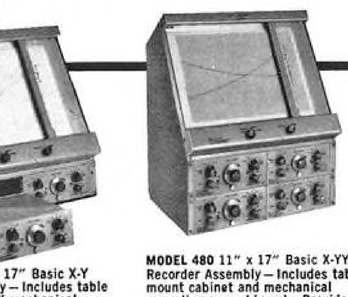
4 DIGIT MODELS

MODEL 4010 Budget Priced Portable DC Voltmeter—Includes all 4 digit DC voltage specifications only, but with ±0.001V minimum sensitivity. Specify Model 4000 for rack mounting.

MODEL 3410A DC Voltmeter/Ratiometer/AC Voltmeter—Includes all 4 digit AC and DC specifications. Specify Model 3400A for DC and DC ratios only.

MODEL 300T 8½" x 11" X-Y Recorder—Includes all 300 series specifications. Specify Model 300 if time base not required. Specify Model 300RA or Model 300TRA for rack mounting.

MODEL 400 11" x 17" Basic X-Y Recorder Assembly—Includes table mount cabinet and mechanical recording assembly only. Specify one plug-in module for each axis. Specify Model 401 for rack mounting only.



MODEL 480 11" x 17" Basic X-YY[1] Recorder Assembly—Includes table mount cabinet and mechanical recording assembly only. Provides two independent Y axes. Specify one plug-in module for each axis. Specify Model 481 for rack mount only.

MODEL 500 11" x 17" Budget Priced X-Y Recorder—Includes all 500 series specifications.

5 DIGIT MODELS

MODEL 3510A DC Voltmeter/Ratiometer/AC Voltmeter—Includes all 5 digit AC and DC specifications. Specify Model 3500A for DC and DC ratios only.

MODEL 3500CR DC Ratiometer—Includes all 5 digit DC ratio specifications only, but with manual rather than automatic polarity.

MODEL 3500AO Ohmmeter—Includes all 5 digit resistance specifications.

DC PRE-AMPLIFIERS

(Price ranges: $1,000.00 to $1,100.00)

Totally transistorized pre-amplifiers to operate in conjunction with digital instruments and X-Y recorders. Single-ended floating input and output. 100 megohm input impedance. ±0.01% gain accuracy. Drift to 2μv/°C. 0 to 1 volt input. ±10 volt output.

MODEL 3020 Pre-Amplifier—Includes basic pre-amplifier specifications and fixed gains of 1 and 10. Specify Model 3020Q for fixed gains of 1, 10 and 100.

SPECIAL PURPOSE INSTRUMENTS

Totally solid state, special purpose instruments for measurement of capacitance, dissipation factor and impedance deviation. A truly new approach to high speed measurement of these parameters in conjunction with production checkout, receiving inspection and quality assurance programs. Measurement times reduced by as much as 75% over conventional techniques. Request Bulletin No. C3.19 for complete Model 6150 Capacitance to DC Converter specifications. Request Bulletin No. C4.19 for complete Model 6100 Impedance Comparator specifications.

DATA SYSTEMS

In addition to the standard instrument line, EI manufactures a wide variety of input scanners, output control units and digital clocks. These items, when combined with standard or special digital instruments, will produce simple data logging or highly complex multi-function systems. Fully 20% of EI's total engineering staff is devoted exclusively to the design and production of digital systems.

NOTE: Specifications subject to change without notice.

Electro Instruments, Inc.
8611 BALBOA AVE., SAN DIEGO 12, CALIFORNIA

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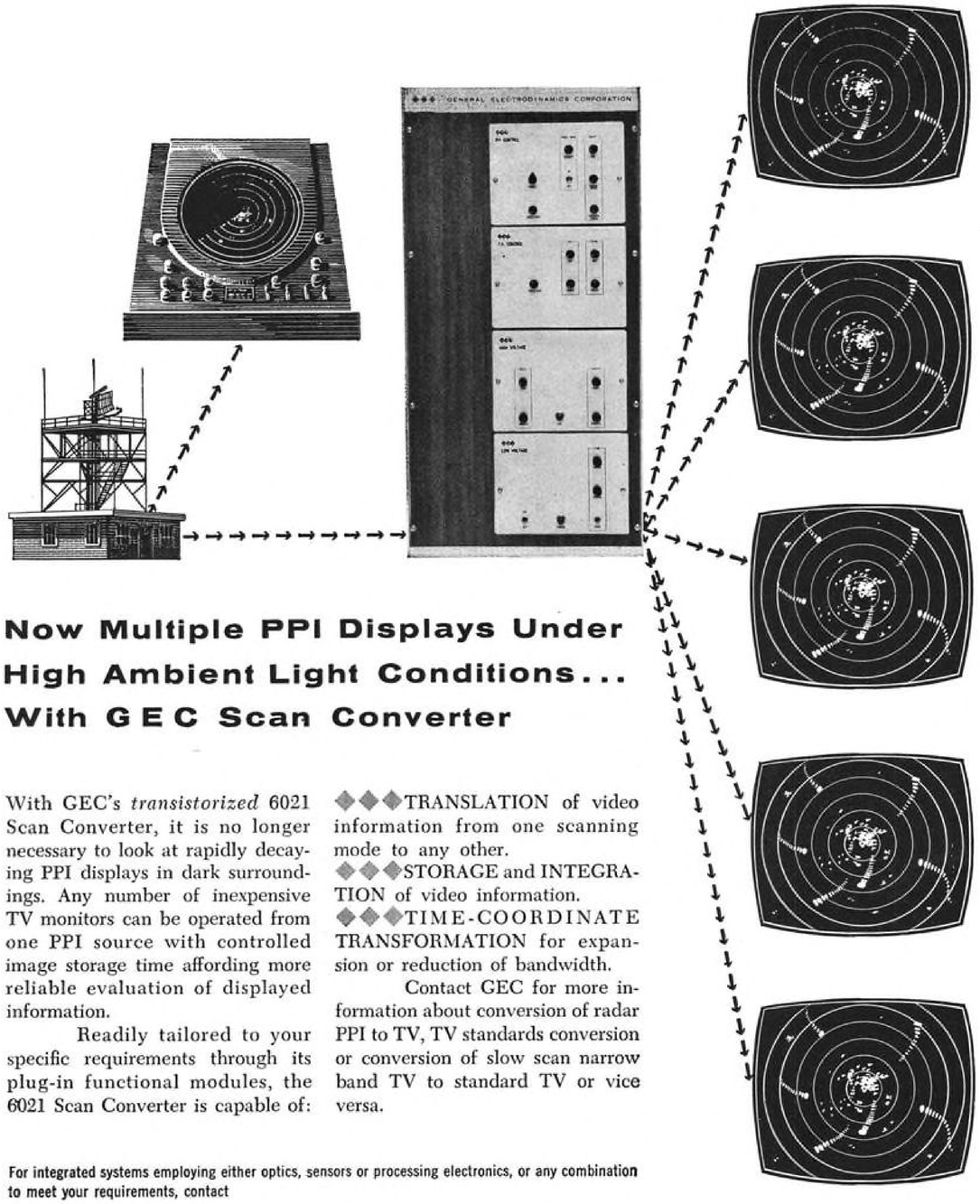

Now Multiple PPI Displays Under High Ambient Light Conditions... With G E C Scan Converter

With GEC's *transistorized* 6021 Scan Converter, it is no longer necessary to look at rapidly decaying PPI displays in dark surroundings. Any number of inexpensive TV monitors can be operated from one PPI source with controlled image storage time affording more reliable evaluation of displayed information.

Readily tailored to your specific requirements through its plug-in functional modules, the 6021 Scan Converter is capable of:

◆◆◆TRANSLATION of video information from one scanning mode to any other.
◆◆◆STORAGE and INTEGRATION of video information.
◆◆◆TIME-COORDINATE TRANSFORMATION for expansion or reduction of bandwidth.

Contact GEC for more information about conversion of radar PPI to TV, TV standards conversion or conversion of slow scan narrow band TV to standard TV or vice versa.

For integrated systems employing either optics, sensors or processing electronics, or any combination to meet your requirements, contact

. . . advanced electronics at work

GENERAL ELECTRODYNAMICS CORPORATION
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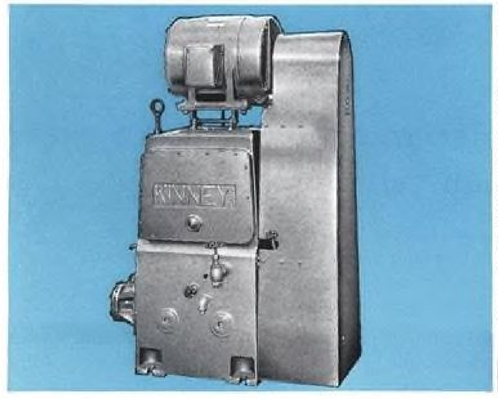
TECHNOLOGY

AND RESEARCH HAS MADE KINNEY THE WORLD'S LARGEST MANUFACTURER OF HIGH VACUUM EQUIPMENT

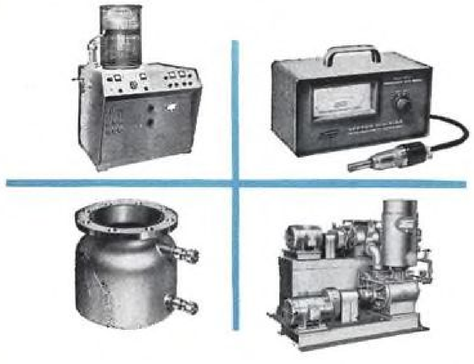
● The technical skill of Kinney Vacuum developed throughout the years; the technology displayed in the advancement of the vacuum pump; high vacuum pumping systems; and the many refinements in high vacuum techniques: all these matured capabilities are employed in the manufacture of each Kinney Vacuum product. Constant research and development plus careful reliability-control guarantee the entire Kinney line of mechanical pumps, diffusion pumps, valves, baffles, gauges, vacuum furnaces, space chambers and complete vacuum systems to be the most modern in design; efficient in operation, and constructed to give the maximum in service.



DYNAMIC DEVELOPMENT
EXTENSIVE RESOURCES • PROVEN STABILITY

TRIPLEX HIGH VACUUM PUMP KT-500

Compact design reduces floor space to minimum. New and original balancing technique makes the pump vibrationless. Theoretical displacement of 530 cfm at 815 rpm; ultimate pressure of 10 microns. Components located for easy servicing. Ample oil supply increases operating period between changes. Kinneyswirl air-oil separator separates oil from gases for cleaner exhaust. Gas ballast feature prevents condensable vapors from contaminating the oil. Maximum efficiency with a minimum of care and maintenance through skillful design and precision craftsmanship. A proven pumping mechanism incorporated in a new configuration.



KINNEY VACUUM DIVISION THE NEW YORK AIR BRAKE COMPANY
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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

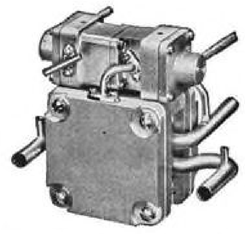
PITOT-STATIC TESTERS

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.

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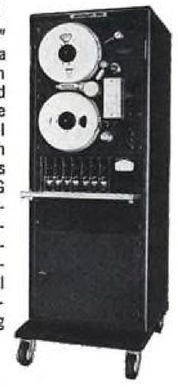
AMPLIFICATION/DISPLAY of TRANSDUCER SIGNALS

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.

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Simplified Power for V/STOL Aircraft

Bristol Siddeley lift/thrust turbofans are the optimum power units for all V/STOL applications, because the total thrust can be used for both lift and forward propulsion. They permit the simplicity of a single-engine installation or, used with separate lift engines, they provide a simpler and more economical solution than can be achieved with any combination of separate lifting and propulsion engines.

SINGLE-ENGINE INSTALLATION

* Simplified installation.
* Simplified aircraft control.
* The resultant thrust and intake drag passes through a fixed point near the aircraft centre of gravity.
* Maintenance and spares requirements are confined to one engine.
* Availability of a large power reserve for acceleration and manoeuvre.

MULTI-ENGINE INSTALLATION

* Fewer specialised lift engines required as the total propulsive power is also available for take-off.

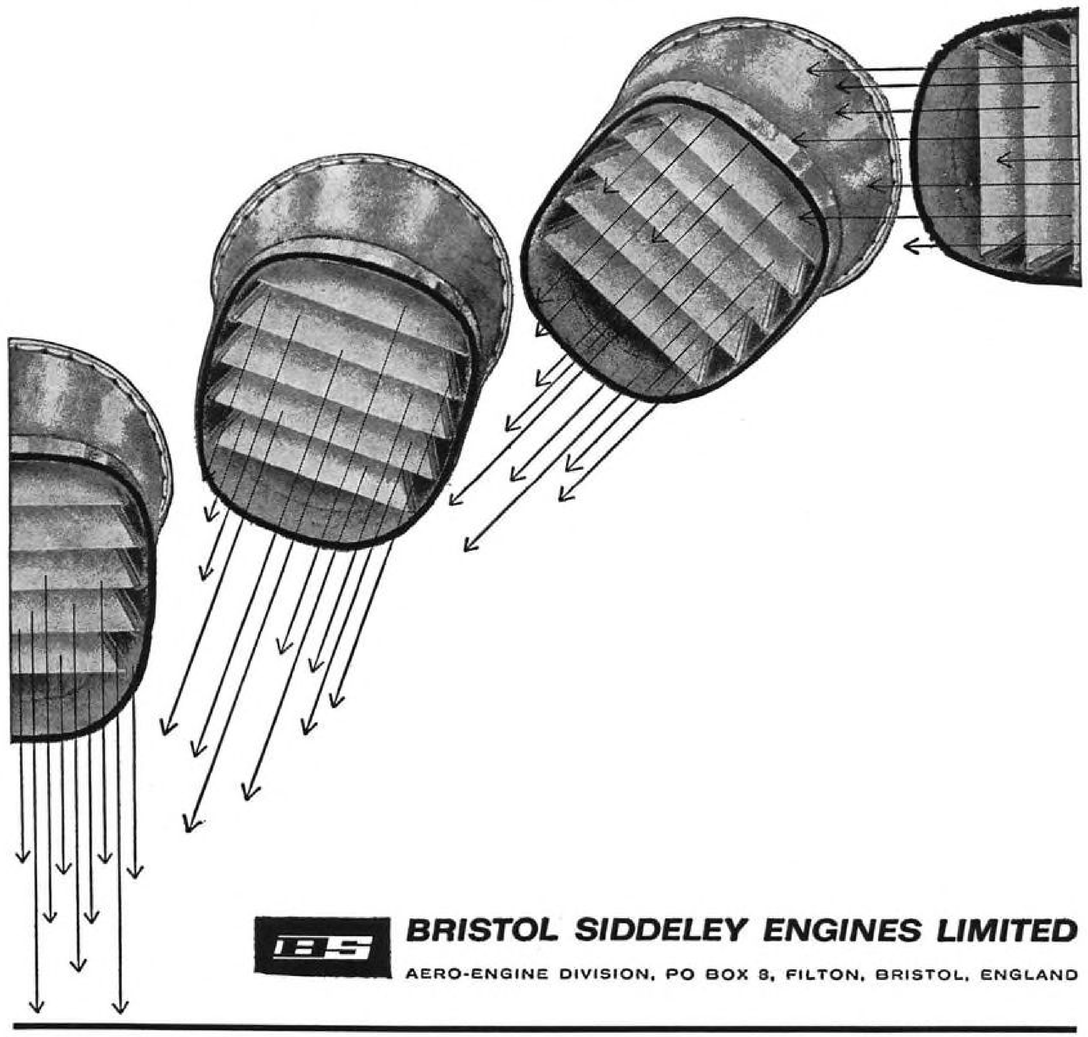
SUPERSONIC FLIGHT

In Bristol Siddeley lift/thrust turbofans fuel can be burned in the by-pass ducting or plenum chamber to give a thrust boost for take-off and supersonic flight. This plenum chamber burning permits:—

* A large thrust boost for supersonic speeds with only a modest increase in specific fuel consumption.
* Engine performance matched to aircraft cruise requirements.
* Greater thrust for transonic acceleration.
* Greater radius of operation.

These thrust boost advantages are achieved more economically by plenum chamber burning than by reheat in the hot exhaust gases.

The development of Bristol Siddeley lift/thrust engines is supported by the US Government through the Mutual Weapons Development Programme.



BRISTOL SIDDELEY ENGINES LIMITED

AERO-ENGINE DIVISION, PO BOX 8, FILTON, BRISTOL, ENGLAND

Flexonics products, services, and facilities for the aerospace industries . . .

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Nowhere will you find a broader background in the design and application of flexible and lightweight tubular components for aircraft and missiles than at Flexonics. Flexonics engineers—both in the field and in the plant—draw on a line of experience that includes participation in most of the United States major aircraft and missile programs. Use this experience to assist in solving your design problems.

METAL HOSE and CONNECTORS

Flexonics offers the broadest line of flexible metal hoses and connectors in corrosion-resistant alloys for aerospace applications—to solve the problems caused by vibration, misalignment, thermal motion, and pressure impluse. Sizes from ¼" I.D. through 12" I.D.; readily adapted for use with MS fittings, flanges, or couplings, or with special terminations.

FLEXIBLE JOINTS and DUCT ASSEMBLIES

Both free-flexing and self-restrained flexible joints for assuring system flexibility under conditions of vibration or thermal change. Proved in many critical applications such as propellant lines, vent and pressurization ducts, cabin air pressure systems, and gas turbine engines. Components or complete ducting systems, including high strength, thin-wall corrosion resistant tubing.

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Here are the facilities—for research, engineering, manufacturing, fabrication, cleaning, and qualification testing—that make possible a single responsibility on aircraft and missile ducting systems. Only at Flexonics will you find this fully-integrated service. To make your own design job easier, submit it to Flexonics as early as possible in the development stage.

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FLEXIBLE METAL HOSE • BELLOWS EXPANSION JOINTS SPECIAL TUBULAR ASSEMBLIES

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Please send me literature on the subject that I have checked:

☐ Metal Hose and Connectors
☐ Cryogenic Cleaning
☐ Flexible Joints and Duct Assemblies
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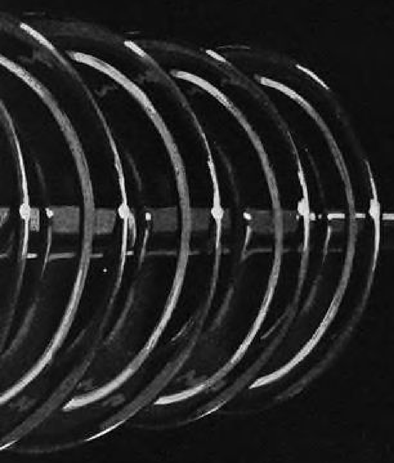
SPACE COMMUNICATIONS



MILLIONS OF CONVERSATIONS...

on a beam of light

A pencil of ruby light will slash across the vast continuum of space carrying millions of conversations on its solitary beam. Philco Research Scientists are busy today developing lasers for the next generation of communications systems . . . learning how to use the virtually unlimited information-carrying capacity of this unique device . . . preparing to provide effective communications for space probes and manned vehicles coasting among the galaxies. Ruby lasers are typical of Philco's unceasing efforts to increase its leadership in all areas of communications for defense and industry.

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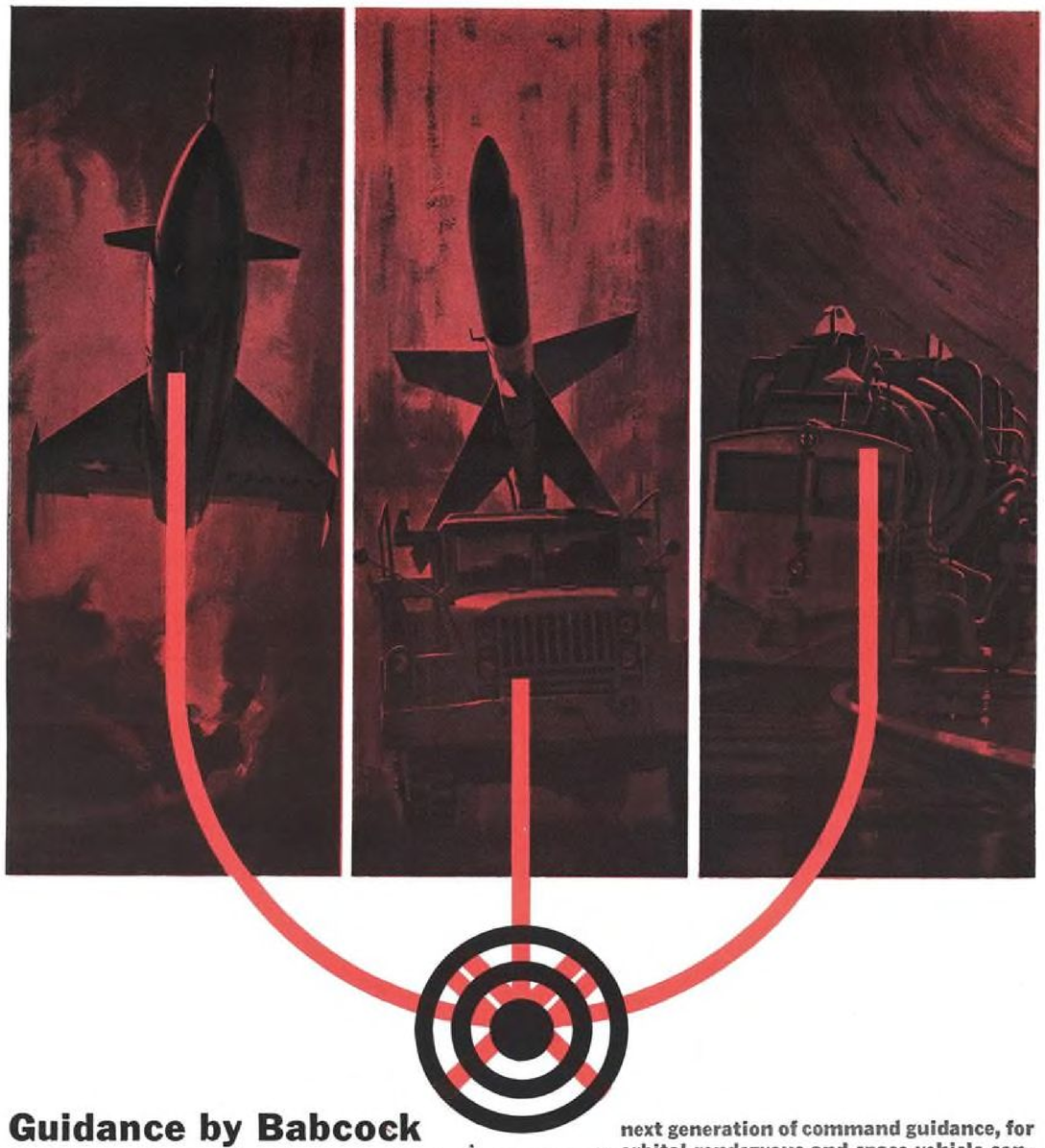

Guidance by Babcock

For 15 years Babcock has been a major supplier of command guidance and control systems for the armed forces. Over 100,000 such systems, of constantly improving sophistication and capability, have guided unmanned aircraft such as the Army/Air Force OQ-19, the Navy KDG-2, KD2R-5, KDB-1, XKD2B and others. Custom-designed Babcock systems control unmanned Signal Corps surveillance aircraft. LaCrosse, DASH, and AEC's remote-controlled locomotives for nuclear experiments use dependable Babcock equipment. Now Babcock is developing the next generation of command guidance, for orbital rendezvous and space vehicle control. At all levels of technical sophistication, Babcock emphasizes light weight, compactness, reliability and economy. For long or short range, analog or digital command, Babcock has the know-how to solve your guidance problem. Contact Marketing Manager, Mailing Station 700.

MILITARY PRODUCTS DIVISION **BABCOCK**

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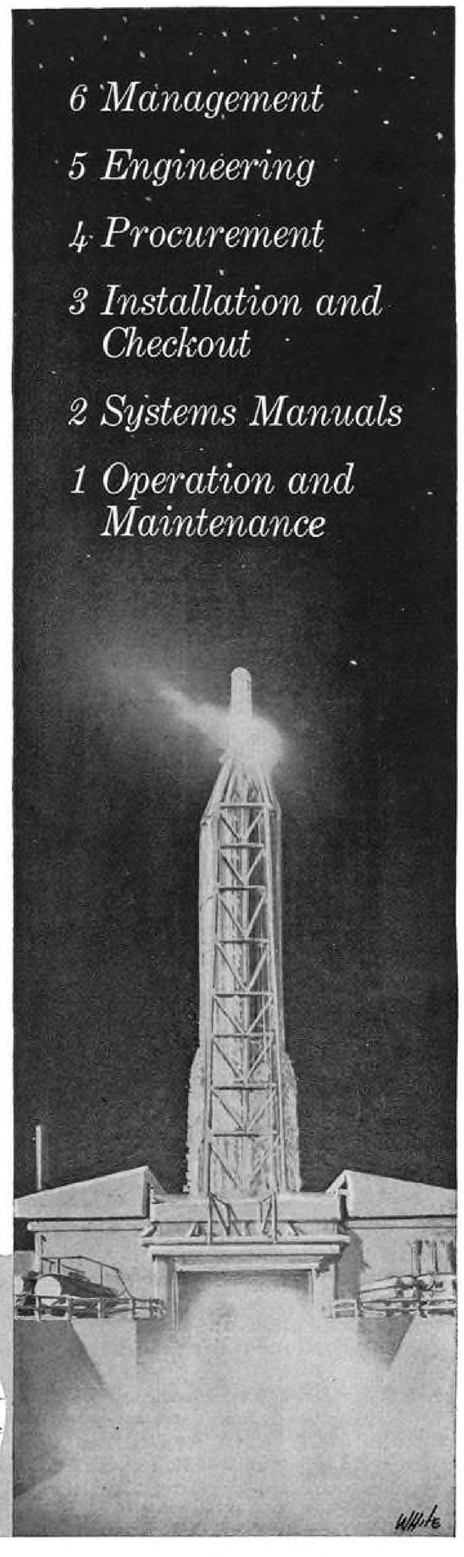
COUNTDOWN ON RELIABILITY

Reliability typifies the Stearns-Roger staff of specialists in the fields of missile, cryogenic and nuclear facilities. Reliability requires the dedicated services of experienced and competent engineering personnel in the areas of criteria development, design, procurement, installation, check-out and operation.

Rely upon Stearns-Roger capability gained over the years in the Atlas, Titan, Minuteman, Saturn and associated programs.

With proven management and dependable, integrated engineering and construction staffs, Stearns-Roger can function under any contract to provide single responsibility for your requirements.



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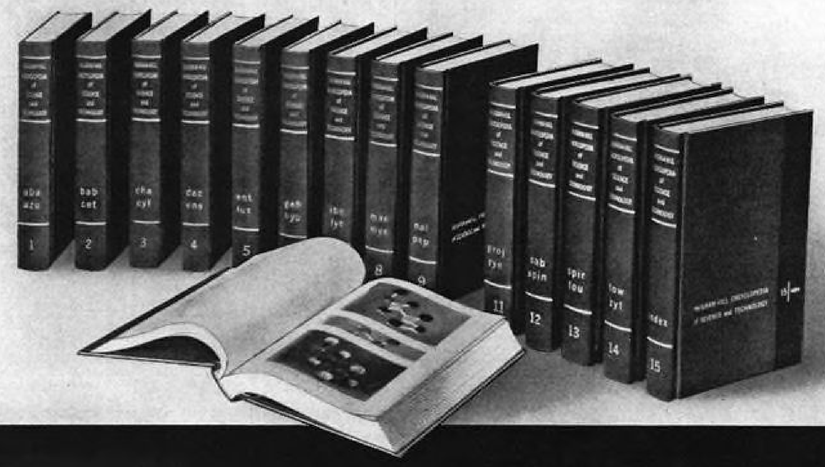
a comprehensive guide to current information on every branch of Science and Technology

. . . a practical new way to bridge the gap between your specialty and other fields into which your work leads you



New from McGRAW-HILL

If you find yourself among the growing number of science and engineering specialists unable to keep up with the explosive pace of developments today, you will see a valuable solution at the top of this page.

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markets these components

BENDIX CONNECTORS: Pygmy types PT and SP; Pygmy crimp types PTCE and PTSE; MS; QWLD: SR rack and panel.

STC· NPN Silicon Power Transistors with isolated collector; PNP Silicon Power Transistors with complementary NPN types.

MICRODOT CONNECTORS and CABLE: Multipin Connectors with power and coaxial contacts; Microminiature coaxial connectors in 50, 70 and 90 ohm types; a complete line of coaxial, twinax, and triaxial cables (RG approved to MIL C-17C).

SPERRY: PNP Silicon alloy junction transistors, and NPN Silicon planar transistors.

U.S. SEMCOR: Zener diodes, rectifier diodes, and tantalum capacitors.

Avnet markets highly specialized lines, in depth. Therefore your requirements on either standard or hard-to-get items can be met on time.

generates this service

Customer service at Avnet, just like components, is available for instant use. Avnet gives you the quickest, most modern marketing service on electronic components.

SPEED OF DELIVERY: Assembled items to meet your requirements, off the shelf items within hours, to any point in the U.S.

INFORMATION DATA: Avnet matches its inventory and assembly facilities with experienced, knowledgeable Sales Engineers.

PERSONALIZED ASSISTANCE: Avnet's 48 field men are ready to assist you on immediate notice. The "service switch" turns ON when you phone Avnet.

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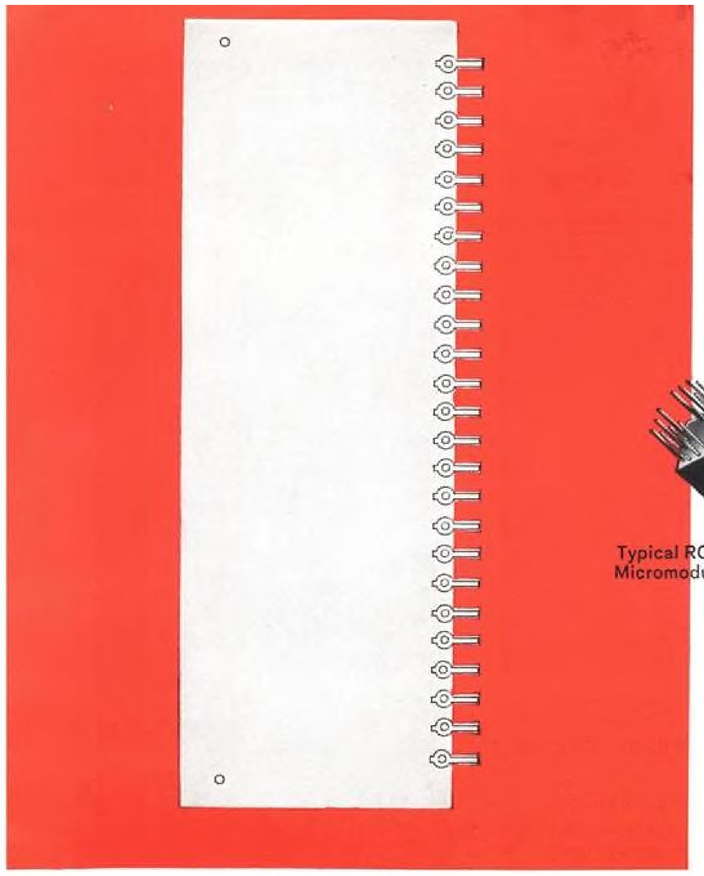

ORIGINAL printed-circuit board set limits for RCA Micromodule Circuits.

MICROMODULE version occupies approximately 50% of the original volume—can provide even further reductions.

Typical RCA Micromodule

MICROMINIATURIZED IN 76 HOURS! with RCA Micromodules

...and backed by over 100,000,000 element hours of life-test experience

...THAT'S THE BREADBOARD-TO-OPERATION RECORD RCA ACHIEVED FOR THIS AVIONICS ASSEMBLY WITH RCA MICROMODULES.

In just 76 hours, RCA engineers—utilizing the broad flexibility of RCA Micromodules and the wide range of available microelements—made the complete conversion from conventional printed board construction to working Micromodule circuits. Here's the background of proof that makes RCA Micromodules today's answer to microminiaturization:

PROVED RELIABILITY: Over 100,000,000 element-hours of testing have been logged under the RCA Micromodule Reliability Program. Operating life tests demonstrate a mean time between failures for RCA Micromodules greater than 560,000 hours for a ten-part Micromodule or a failure rate per part of less than 0.018%/1,000 hours. (All modules were subjected to a series of military-grade temperature-cycling tests.)

BROAD CIRCUIT CAPABILITY: Under RCA's broad experience in Micromodule production over 200 basic circuits have been designed, built and tested. And new circuits are constantly being added. For example, five new computer Micromodules utilizing silicon transistors and diodes are now available from stock. The RCA Micromodule concept is highly compatible with anticipated advances in microminiaturization.

WIDE APPLICATION: RCA Micromodules have been designed into military FM receivers, a general-purpose automatic data processor, airborne digital computers, an inertial guidance platform, a digital differential analyzer, pulse-code modulation telemeter equipment and classified military applications.

LOWER COSTS: If you are looking for cost reductions as well as microminiaturization, RCA Micromodules, can now show you the way.

CALL TODAY: Like to know how fast your circuits can be converted to Micromodules? Call your local RCA Office today for details on RCA Micromodules (and the RCA Micromodule Laboratory Kit for building prototype Micromodules in your own plant). For literature, write RCA Semiconductor and Materials Division, Commercial Engineering, Section MA-12, Somerville, N. J.

RCA Minimodules—miniature packaged circuits utilizing conventional components and transistors—can be supplied in large volume, in the form you need. Consider RCA your packaging headquarters for miniaturized circuits utilizing transistors, rectifiers, diodes. Practically any component you require can be packaged to your specifications by RCA Engineers.

RCA The Most Trusted Name in Electronics

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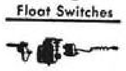
...Aerotec Low Pressure Gas Generator Inflates Flotation Systems

Flotation Systems

Pitot Disconnects

Valves

Float Switches


Composite Disconnects

Pressure Switches

Introduction of the unique Aerotec Flotation System utilizing a low pressure gas generator has obsoleted the heavy air compressor or tank required for inflation. These systems are part of the Navy DASH (Drone Anti-Submarine Helicopter) program. Savings in weight are thus available for additional payload capacity in the drone.

If you require a simple pressure switch or complex system, Aerotec offers you the advantage of a vast experience gained in the development of hundreds of thousands of valves, float switches, disconnects and a variety of components and systems. They are specialists in precision equipment for the aircraft, missile and nuclear industries.

This imaginative approach to new developments can be used by your company to reduce research time in many areas, from aircraft to missile and nuclear components and systems. Write or phone Aircraft Equipment Division, Aerotec Industries, Inc., Greenwich, Conn. In Canada: T. C. Chown Limited, Montreal & Toronto.

AEROTEC INDUSTRIES, INC.
AIRCRAFT EQUIPMENT DIVISION, DEPT.W-1, GREENWICH, CONN.

Other Divisions: **AEROTHERM DIVISION** Aircraft Lounges, Passenger and Crew Seating
INDUSTRIAL DIVISION Dust Collecting Systems, Gas Scrubbers, Fans, Stacks and allied equipment.

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A MAJOR ADVANCEMENT IN HIGH TEMPERATURE MATERIALS COATED PARTICLES & PARTS BY NUMEC

COMMERCIALLY AVAILABLE FROM NUMEC—A LARGE NUMBER OF METALLIC AND NON-METALLIC coatings on base materials.

TYPICAL COATINGS

Cu • Ni • Cr • Nb • V • Mo • Si • Be • W • C(pyrolytic) • BeO • SiO_2 • $A1_2O_3$
(Duplex coatings also available)

TYPICAL BASE MATERIALS

UO_2 • UC • U metal • ThO_2 • WC • BeO • SiO_2 • C • glass • steels • alloys • semi-conductors • carbides • refractory metals • graphite

NUMEC coatings can be applied to base materials including fine powders, spheres, pellets, tubing, plates, sheet, and other more complex configurations. For information on coated particles, nuclear materials or special service contact:

NUMEC®

Nuclear Materials & Equipment Corporation
Apollo, Pa. Phone: GRover 2-8411
Cable: NUMEC TWX: APO-276

NUMEC's growth is constantly creating new and challenging opportunities for scientists and engineers in basis research and development. Write today for information.

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ADEL DIVISION
GENERAL METALS CORPORATION
10777 Vanowen St., Burbank, Calif. or, call TR 7-2611. Sent without salesman attached.

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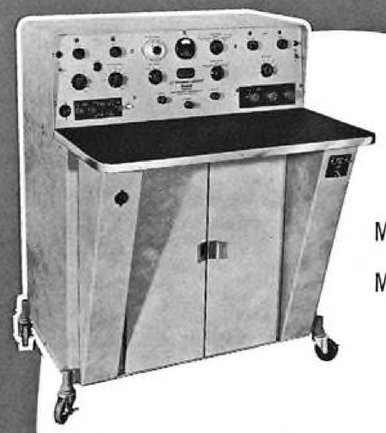
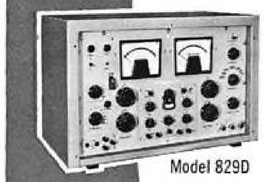
QUALITY CONTROL
Starts with Calibration



Model 1900
and
Model 1967



Model 829D

Models 1605/A

Model 2120

The advantages gained by calibrating and standardizing electrical measuring instruments using self-contained, console type standards are impossible to duplicate using individual components. Their ease of operation, long term stability, accuracy, wide current and voltage ranges, and built-in safety provisions yield economies which result in substantial cost savings over older methods of calibration.

Since development of the original self-contained instrument calibration standard for the U. S. Navy in 1947, RFL has produced many variations and offers the world's widest selection of such equipment. Choice of direct-comparison, regulated-power-supply and AC-DC transfer methods with accuracies to meet all commercial and military requirements for working or reference standards is available. Some of the models currently in production are illustrated. They can be seen at the factory or by arrangement with field representatives in most states and 20 overseas countries.

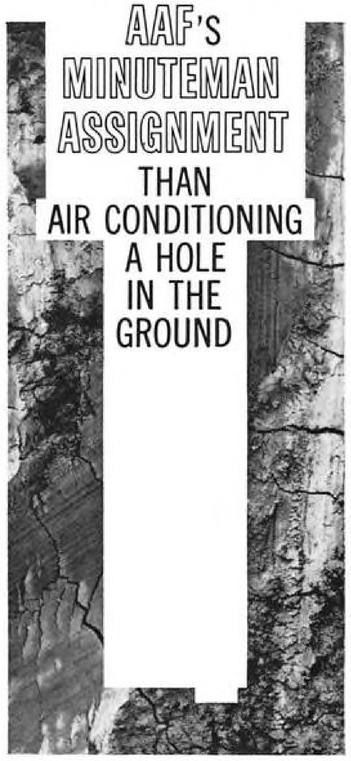
Performance warranty is unequivocal. Calibration certificates for every current and voltage range, on all models, are supplied. Accuracy is traceable to primary standards at the National Bureau of Standards.

SEND FOR TECH. DATA

For additional information, including application data, write or phone DE 4-3100. Demonstrations available by local representatives.

RFL EST. 1922 *Radio Frequency* LABORATORIES, INC. Boonton, New Jersey, U. S. A.

THERE'S MORE TO
AAF'S
MINUTEMAN
ASSIGNMENT
THAN
AIR CONDITIONING
A HOLE
IN THE
GROUND



Untended, isolated, in their underground silos, the Minuteman must remain operational at all times — ready for instant performance. Helping the Air Force Reliability Program meet this challenge, American Air Filter developed and is supplying an integral environmental control system including temperature and humidity controls, heating, cooling, refrigeration and air filtration. Buried with the weapons system, the AAF equipment protects itself as well as the Minuteman. Control center personnel are protected by chemical, bacteriological, and radiological air filters.

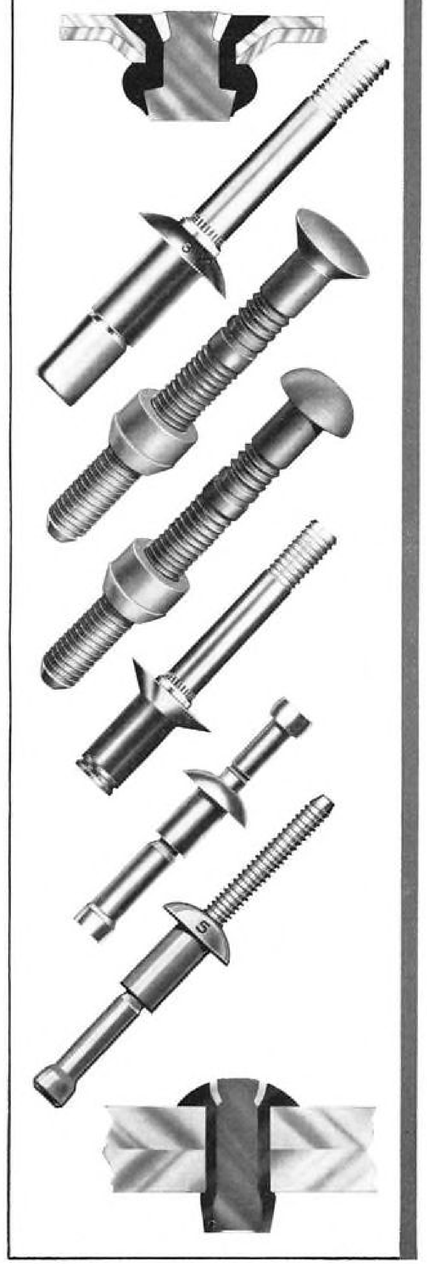
American Air Filter capability is based on years of leadership, with experience in all types of "better air" equipment. Projects include Nike Zeus, Atlas, Titan, Pershing, and the Century Series fighters. Can we help you? Defense Products Division, *American Air Filter Co., Inc., 310 Third St., Rock Island, Ill., Phone 788-9311.*

Write for Bulletin D-164

AAF COMPLETE SYSTEMS CAPABILITY
- Heating
- Ventilating
- Air Filtering
- Refrigeration
- Humidity Control

ENGINEERED ENVIRONMENTAL SYSTEMS

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 RE22,792; 2,114,493; 2,527,307; 2,531,048; 2,531,049; and 2,754,703

Cherry Rivet Division
Santa Ana, Calif.

SEE OUR SPECIFICATIONS IN V.S.M.F. THE MICROFILM CATALOG

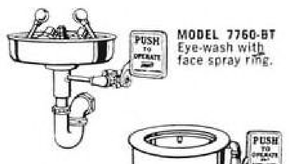
Townsend Company
ESTABLISHED 1816 • BEAVER FALLS, PA. • A textron COMPANY

In Canada: Parmenter & Bulloch Manufacturing Company, Limited, Gananoque, Ontario

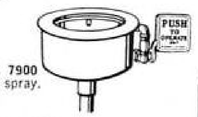
HAWS

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.

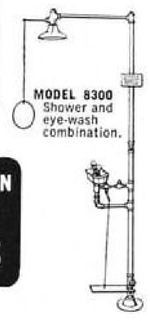
EMERGENCY EYE WASH FACE WASH

Facial areas are instantly flooded with relieving water, from wall or pedestal mounted units.

Both multiple nozzle and single head showers wash away dangerous matter from body and clothing.

MODEL 8162
Over-the-door shower.

MODEL 8600
Fiberglass decontamination booth.



MODEL 8300
Shower and eye-wash combination.

DECONTAMINATION DRENCH SHOWERS

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
Since 1909
1443 Fourth Street • Berkeley 10, California

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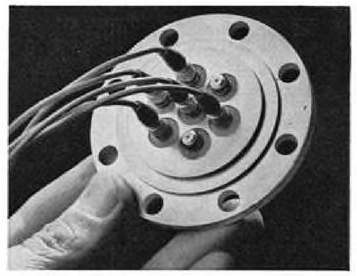

Hermetic Sealing

Complete in-plant capabilities for glass-to-metal sealing — from design through quantity production — are provided by Microdot's Hermetic Seal facility. Specializing in custom sealing, as well as hermetically sealed connectors and terminals, Microdot engineers will work with your engineering department and provide design solutions to your sealing problems. All Microdot hermetic seals receive rigid quality control and inspection, including final test by helium leak detector sensitive to 5×10^{-11} atm cc/sec.

Microminiature Multi-Pin Connectors

Industry's most versatile, truly miniaturized connectors. Only ¼ size, ⅓ weight of current "miniature" types, Microdot Multi-pins contain up to 61 power or 19 coaxial contacts in a 1⅛" shell, are also available in shell sizes down to ¾". Standard line offers many options: interchangeable inserts for straight power, straight coax or combination power-coax layouts; choice of mounts and finishes; quick disconnect or screw-type couplings; assembled with specified Microdot cable or in kit form for bench/field assembly. Hermetically sealed connectors available on special order.

MICRODOT INC.

220 Pasadena Avenue
South Pasadena, California
Overseas: MICRODOT AG, Zug, Switz.

Circle Number 56 on Reader-Service Card

what industrial plastics do you need?

mechanical grades?

Formica has sheets, rods, tubes. High mechanical strength, good punching and mechanical properties. For rocket motor cases, blast tube insulators, gears, pump parts, etc.

electrical grades?

Formica has sheets, rods, tubes. Over 18 grades—we have the combination of properties you need. For use in missiles, computors, TV, radio, radar.

copper clad laminates?

Formica has glass-epoxy, paper-phenolic, nylon-phenolic grades. Clad one or both sides. Flame retardant or non-retardant. Also multi-layer circuitry materials and laminates meeting MIL specs. For missiles, computors, etc.

molded products?

Formica has thermosetting plastics which can be molded in these forms: laminated, macerated, or combination laminated/macerated. Complete molding service available—materials selection, mold design, tooling.

engraving stock?

Formica has 13 standard colors and natural grains. Several thicknesses. Core: white, black, or white sub-core and black core. For nameplates and signs on aircraft components, instrument panels, etc.

CERTIFIED RELIABILITY
LOT 760
INSP. RM

Formica has the grade you need.

for details use this coupon.

AW-62

Gentlemen:
Please send me data on the Formica industrial plastics checked below:

- ☐ Mechanical Grades
- ☐ Electrical Grades
- ☐ Copper Clad Laminates
- ☐ Molded Products
- ☐ Engraving Stock
- ☐ Please have your representative contact me.

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TITLE_____
COMPANY_____
ADDRESS_____
CITY_____ ZONE____ STATE_____
TELEPHONE NO._____ EXTENSION____

FORMICA®
industrial plastics

FORMICA CORPORATION
subsidiary of CYANAMID
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CINCINNATI 32, OHIO

Circle Number 29 on Reader-Service Card

This Film is ALL NEW...
the third one produced by the Technical Film Group at Turco, developer of the Dy-Chek® inspection process... proved most advanced in manufacturing and maintenance.

MORE THAN 10,000 Production and Quality Control engineers and inspectors have now viewed the first two Dy-Chek films. Every man concerned with flaw location and nondestructive testing will want to see this new Film No. 3 from Turco.

ANY GROUP in your plant can learn the new *complete* step-by-step story of positive flaw location with dye penetrants.

WITNESS actual penetrant flaw location procedures *right in your own plant!*

SEE how you can assure greater inspection accuracy and speed at lowest cost using techniques designed for *your* jobs, including detection with portable kits.

YOU ARE INVITED to preview this 20-minute film in a location of your choice... for visual demonstrations of *every* aspect of dye penetrant inspecting... in the lab, on production lines, and in the field!

See this NEW FILM in your plant or any location!

PLAN YOUR FILM SHOWING NOW!
Write today for the "Film Kit" described below. No obligation for this material.

Rush Coupon for FREE "FILM KIT" Now!

YOUR FREE "FILM KIT" will include 3 Important Publications:

1. 4-page folder previews film in detail.
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Please send FREE "FILM KIT" without cost or obligation.

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FIRM _____
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Circle Number 30 on Reader-Service Card

Fiat aviation

over 50 years of activity

so far

167 types of aircraft and 55 types of aviation engines manufactured. 70 international records and raids.

to-day

4 modern factories
3 engineering departments
3 different aircraft models, 1 helicopter end 3 types of jet engines in production
6 aircraft models and 7 different piston and jet engines being overhauled.

construction for the Sud-Aviation of components and parts for "Caravelle" jet plane and for Sikorsky S58 helicopter.

participation to the project and construction of the main mechanical components for the S.E. 3210 "Super Frelon" helicopter.

FIAT—DIVISIONE AVIAZIONE
Corso G. Agnelli 200—TURIN (Italy)

Circle Number 57 on Reader-Service Card

fasteners for high temp use

SOCKET HEAD • HEX HEAD • 12 POINT HEAD • FLAT HEAD • BUTTON HEAD • AN-NAS & M.S.

MAT—A 286 (AMS 5735)
1300° Effective Temperature Range

Certified to government specifications, Mercury High Temperature Fasteners, available in a wide variety of aircraft and missile standards, provide dependable, accurate performance. Quality Control at Mercury is second to none. We welcome the opportunity to serve you, regardless of quantity. Also available in High Strength 17-4 PH (AMS 5643) 180 000–200.000 PSI.

Write for Catalog No. 286

Mercury air parts co., inc.
9310 West Jefferson Blvd., Culver City, Calif.
Phone: UP 0-5923 • Teletype: CVR CY 4138

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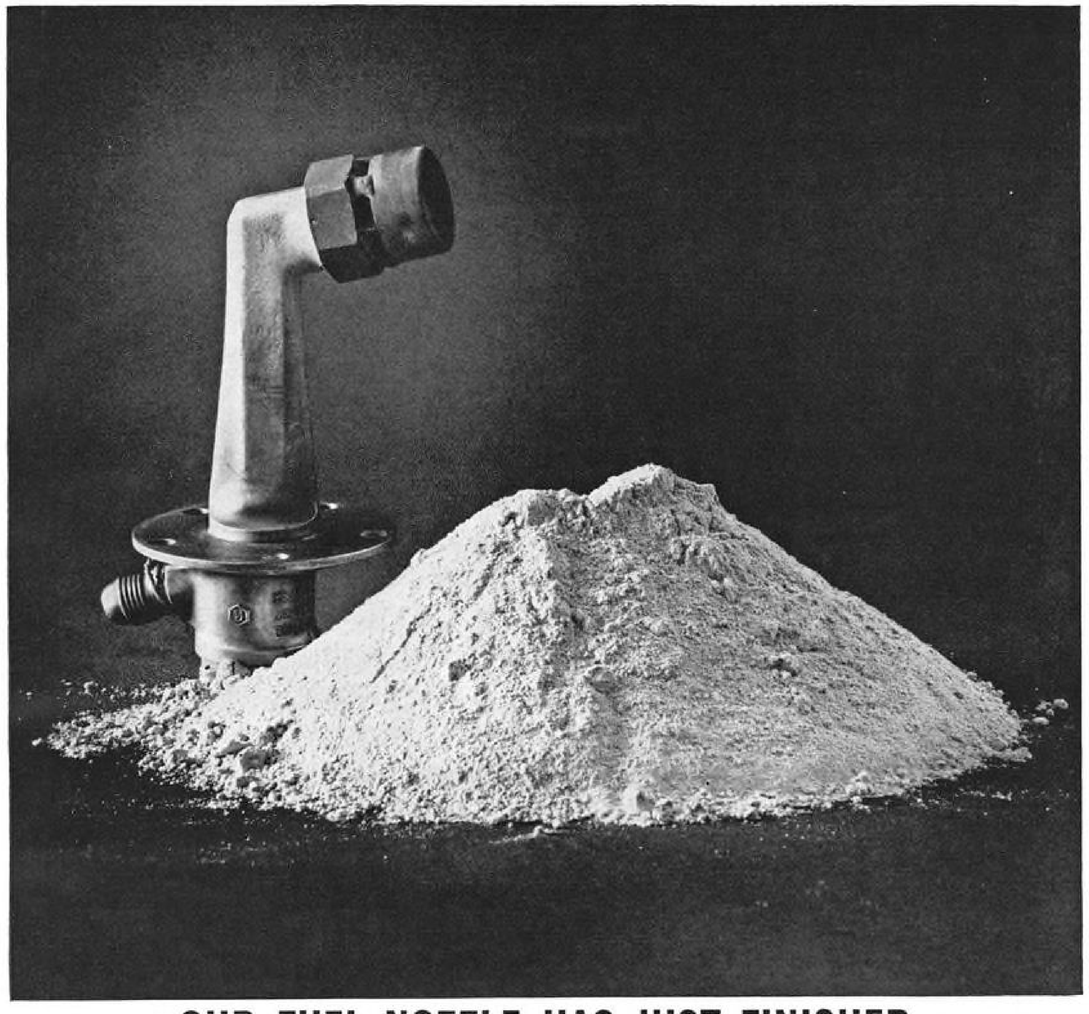


OUR FUEL NOZZLE HAS JUST FINISHED EATING 1,000 HOURS WORTH OF DIRT.

(With no unpleasant after-effects.)

That's what the pile is. The amount of dirt that accompanied the fuel used to run a nozzle for 1,000 hours. It's about what you could expect if you were to run a similar test on your engine with the fuel you normally use.

Since dirt is supposed to foul fuel nozzles, you might also expect the fuel nozzle would foul. Ours didn't. Why? We saw to it.

We purposely designed our fuel nozzles to perform under lousy conditions. Contamination is always a problem. High temperatures don't help much. Lesser nozzles really get choked up when the heat is on. Not ours. Bendix® fuel nozzles supply full atomization over a complete flow range. They don't gum up. They don't change calibration.

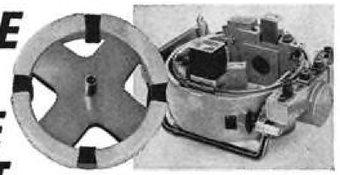
If you build engines for jets, missiles, helicopters or anything else that needs a fuel nozzle for full-time work, write us for details. The Bendix Corporation, Eclipse Machine Division, Elmira, New York.

Bendix-Elmira

THE Bendix CORPORATION

Circle Number 31 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.

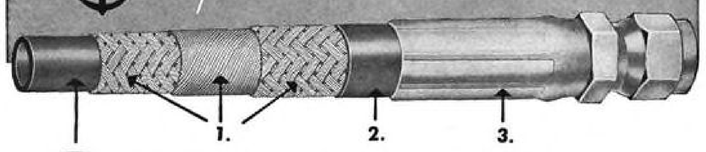
The Aeroflex DC Torque Motor is available in circular or segmented configurations in capacities from 0.1 oz. in. to 75 lb. ft., with rotational limits to ±60 degrees.

For more information on this unique drive, write Dept. JL-00.

AEROFLEX LABORATORIES
INCORPORATED
48-25 36TH STREET • LONG ISLAND CITY 1, N. Y.
STABILIZED PLATFORMS · GYROS · CABLE ISOLATING SYSTEMS · ANALOG COMPUTERS

Circle Number 59 on Reader-Service Card

NEW from ANCHOR® hdp Hose Assemblies for Aircraft, Missile H.P. Pneumatic Servicing



hdp high density polyethylene inner tube

50 ft. lengths can be fabricated! Polyethylene is easy to clean and is highly resistant to the effusion of gases.

1. Braid and spiral plies are of stainless steel for maximum corrosion resistance.
2. Neoprene cover to withstand rough handling and exposure.
3. Anchor exclusive stainless steel, ductile sleeve swaged couplings are leak-proof and permanent! Couplings have 37° female swivel nuts to mate with MS33656 fitting ends.

The Anchor **hdp** Hose Assemblies fully conform to MIL-H-26666A (USAF) specifications: Available in the -4, -8, -12 size for *4,000 PSI W.P.* and in the -6 size for *6000 PSI W.P.* Temperature range -65°F to +160°F for service with any inert gas. Request our new MIL-SPEC. CATALOG now!

ANCHOR Coupling Co. Inc.
376 North Fourth Street Libertyville, Illinois
Branch Plants: Dallas, Tex., Plymouth, Mich.

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LISLE *Magnetic* CHIP DETECTORS

Lisle Magnetic Chip Detectors provide early detection of internal breakdowns, assuring constant protection against in-flight failure.

Ferrous particles in a lubricant are a proven indication of excessive wear or impending breakdown. The Magnetic Chip Detector attracts these particles which bridge an electrically insulated gap in the Detector, completing a circuit which activates a warning light on the instrument panel.

Lisle Chip Detectors are used today in jet and reciprocating engines, accessory drives, propellers, constant speed drives and hydraulic systems in commercial and military aircraft.

Write for Catalog and Samples for Testing

LISLE CORPORATION
Clarinda, Iowa

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Circle Number 33 on Reader-Service Card →

WHY DID THEY WAIT 'TIL NOW TO THINK OF A COMPRESSED PACKAGING MATERIAL?

The test of a good idea is, "why didn't they think of that before?" A compressed packaging material is that kind of an idea. Actually, it isn't totally new. We'd been making packaging materials for a long while—including a special compressed grade for military and export use—before we perfected K-51, the new all-purpose Kimpak® compressed interior packaging.

We haven't been sitting on a good idea. We waited until we had enough experience to know the product was ready. It is.

New compressed Kimpak K-51 is unique, yet simple. Here's how it works. K-51 Kimpak is compressed to one-fifth its normal length. Then it's shipped that way to you, offering a big saving in handling and storage space. As your packers use it, they merely pull it out to its normal length—five times the compressed length.

But that's only part of the story. There's a lower price, exceptional conformity to your products, a special softness that makes your products ride smoother. Learn K-51's many other advantages by writing for a FREE, man-sized sample of new Kimpak compressed today.

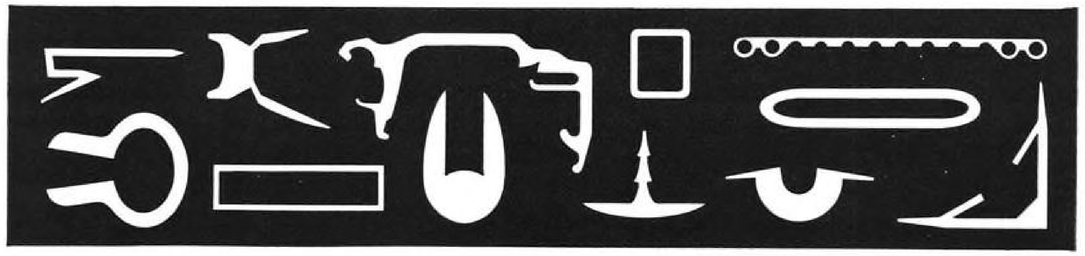
Kimberly-Clark

FREE SAMPLE OF KIMPAK®
INTERIOR PACKAGING

Yes, send me a generous sample of K-51, new Kimpak compressed. I understand there's no cost or obligation.

Name_____ Title_____
Company_____
Address_____
City_____ State_____
MAIL TO: Kimberly-Clark Corp., Dept. AV-122, Neenah, Wisconsin

Plastic Extrusions / Plastic Shapes



CUSTOM PROFILES, RODS, TUBES IN ALL THERMOPLASTIC MATERIALS . . . DESIGNED AND DEVELOPED TO YOUR PRINT SPECIFICATIONS . . . cut to precise lengths, in mill lengths, in coils or reels.

Ask us about STRIP-A-TUBE, clear or individually-colored vinyl tubes extruded in flat, tube-like form for electronic harnesses, liquid or gas distribution systems.

"Write for samples and list of diameters and wall thicknesses available in stock!"

ALSO COMPLETE DESIGN AND PRODUCTION FACILITIES FOR COMPRESSION AND TRANSFER MOLDING

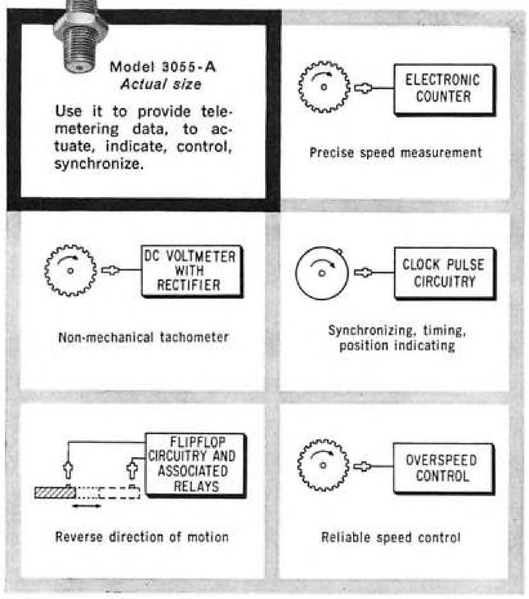
STOKES MOLDED PRODUCTS
DIVISION OF THE ELECTRIC STORAGE BATTERY COMPANY

805 TAYLOR STREET
TRENTON 4, NEW JERSEY

Circle Number 74 on Reader-Service Card

APPLICATION IDEAS from EPL

where and how to use Electro Magnetic Pickups



2262

...the self-generating signal source linking mechanical motion to instrumentation

Applications by the hundreds are possible with these sensitive transducers that generate voltage/frequency *without contact*.

No amplification needed, in most cases Electro Magnetic Pickups generate AC voltage in proportion to the speed of any ferrous metal object interrupting their external magnetic field.

Most Complete line. Over twelve standard models immediately available from local stocks. Specially engineered pickups take a little longer.

Write for Selection and Performance Guide CMP-50

ELECTRO PRODUCTS LABORATORIES
6125-AW Howard, Chicago 48 (Niles), Ill.
Phone: 647-6125

Canada: Atlas Instruments Ltd., Toronto

Proximity Switches • Magnetic Pickups • Pres-con Controls • Tachometers • Dynamic Micrometers • DC Power Supplies

Circle Number 75 on Reader-Service Card

CHROMALOX ELECTRIC
HEATING UNITS

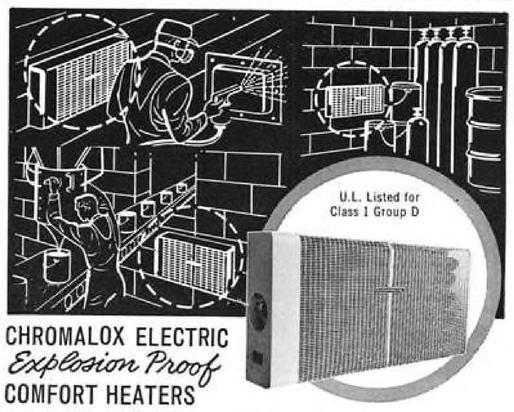
QUICK, LOW COST ANSWERS to your heating problems

Whether it's gases, liquids or solids you want to heat to exact temperatures . . . you'll find the easy and economical answers in Chromalox Electric Heaters. Thousands of units to choose from (mostly from stock) in ratings, voltages and sheath materials to meet working temperatures up to 1200° F.; manual or automatic thermostatic controls. Tell us your heating problem—our field engineers will come up with the answers.

WI-32

Write for Idea and Fact-filled Catalog 60.

CHROMALOX ELECTRIC HEAT
EDWIN L. WIEGAND COMPANY
7804 THOMAS BOULEVARD, PITTSBURGH 8, PA.
PROCESS COMFORT



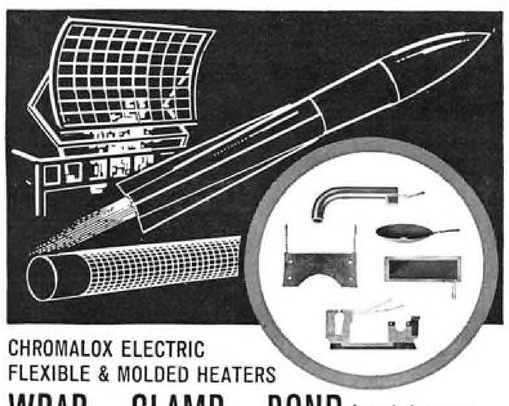
CHROMALOX ELECTRIC
Explosion Proof
COMFORT HEATERS

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



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
THE NAME IN ELECTRIC HEAT

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 . .
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DENVER, COLORADO 303 244-4291
DES MOINES, IOWA 515 255-3116
DETROIT, MICH. 313 KEnwood 8-2100 313 ELgin 7-0677
HOUSTON, TEXAS 713 Overland 6-3483
INDIANAPOLIS, IND. 317 Melrose 5-5313
KALAMAZOO, MICH. 616 FIreside 5-7181
KANSAS CITY, MO. 816 VIctor 2-3306
LOS ANGELES, CAL. 213 LUdlow 9-6321
MIDDLETOWN, CONN. 203 DIamond 6-9606
MILWAUKEE, WIS. 414 Broadway 1-3021
MINNEAPOLIS, MINN. 612 Federal 6-6631
NASHVILLE, TENN. 615 CYpress 2-7016
NEW YORK CITY, N. Y. 212 WOrth 4-2990
OMAHA, NEBRASKA 402 341-7600, 7610
PHILADELPHIA, PA. 215 Tennyson 9-3000
PHOENIX, ARIZ. 602 Crestwood 7-1662
PITTSBURGH, PA. 412 361-2900
PORTLAND, OREGON 503 Capitol 3-4197
RICHMOND, VIRGINIA 703 643-7897
ROCHESTER, N. Y. 716 HAmilton 6-2070
ST. LOUIS, MISSOURI 314 Chestnut 1-2433
SALT LAKE CITY, UTAH 801 485-3462
SAN FRANCISCO, CAL. 415 Underhill 1-3000
SEATTLE, WASH. 206 MAin 4-7297
SYRACUSE, N. Y. 315 GRanite 4-3933
WICHITA, KANSAS 316 Amherst 2-5647

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WI-37 (C)

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New from G. E.! 16-page 5-Star tube booklet tells...

How to *value-analyze* airline electronic tubes for highest reliability

If you buy or use electronic tubes, you'll want this handy, 16-page, fact-filled booklet.

- You'll learn why more airlines use G-E 5-Star high-reliability tubes than any other type.
- You'll be able to make objective evaluations of your equipment's performance compared to similar equipment using G-E 5-Star tubes.
- You'll have complete technical data on all fifty 5-Star types conveniently at your finger tips.
- You'll see some of G.E.'s new material developments and the 17 value-analyzed benefits that increase tube reliability.
- You'll see the fallacy in high-reliability *predictions* and money-back guarantees.
- You'll also learn about G.E.'s new TIPS (Technical Information and Product Service) group and how it can help you solve problems involving the use or selection of G-E tubes.

Progress Is Our Most Important Product

GENERAL ELECTRIC

For rapid availability on all G-E high-reliability tubes, see your authorized G-E Industrial Electronic Components Distributor.

ACCENT ON VALUE

For your free value-analysis booklet, send your name and title, clipped to your company letterhead, to: G-E TIPS, General Electric Company, Room 2819-A, 316 East 9th, Owensboro, Ky.

Name

Title

Circle Number 36 on Reader-Service Card

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**
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- **IN DIAMETERS FROM ¼" to 18'**
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- **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

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North Haven, Connecticut

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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: ⅜" 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

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Dayton 2, Ohio

UNIVERSAL JOINTS and ASSEMBLIES

Circle Number 37 on Reader-Service Card

The whole is greater than the sum of its parts in CRYOGENIC SYSTEMS built by COSMODYNE

Experience and Cosmodyne components are the plus factors that make the system greater than the sum of its parts. Field erected or pre-engineered packaged liquefiers, high-pressure gas systems, space simulators and test complexes are a few of the systems developed by Cosmodyne.

Let us put our experience to work for you in . . .

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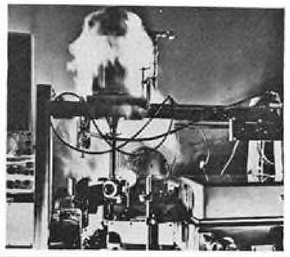

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COSMODYNE

THE COSMODYNE CORPORATION

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Midwestern Instruments ANNOUNCES:

DELUXE FEATURES ARE STANDARD IN NEW, MODERATELY PRICED

MODEL **800 OSCILLOGRAPH**

Simplicity of controls and a trouble-free multi-speed transmission are featured by the new Model 800 oscillograph. This high quality, direct writing, light beam galvanometer type recorder writes overlapping traces. ■ Standard features include 25 active galvanometer channels on 8" recording paper with a 12" optical magnification arm; low cost multiple pin galvanometer input connectors; push button controlled electric shift transmission with 8 paper speeds from 1"/sec. to 100"/sec.; 475 foot record capacity, and paper footage counter. ■ Optional features include provision for up to 36 channels; three interval flash timing; trace identification by optical interruption or sequential trace numbering; remote control unit, and many other extras.

For complete information and specifications, write:

MIDWESTERN INSTRUMENTS

P. O. BOX 7509 TULSA 35, OKLAHOMA

Circle Number 38 on Reader-Service Card

SYSTEMS PROGRESS

INSTRUCTIONS FOR SATELLITES

One of CSC's space support systems, produced for NASA's Goddard Space Flight Center, is the Minitrack Digital Command Console.

Installed at 13 NASA tracking stations around the world, this system is part of the complex of electronic equipment used to track and acquire data from earth-orbiting satellites. The console generates digital and tone commands which are relayed by transmitters to the satellites.

Thirty tone frequencies or 90 digital commands are available, selected manually by switches or programmed automatically from five-level punched paper tape.

This is one example of CSC activities in space sciences and support systems. Many other custom-engineered systems have been developed in the areas of analog and digital data handling, electro-optical instrumentation, environmental testing and industrial control. For details on how this experience can be useful in solving your systems problems, call our regional engineering office or write:

CONSOLIDATED SYSTEMS CORPORATION

1500 So. Shamrock Ave. • Monrovia, California

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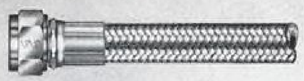
SPECIFY STRATOFLEX



SUPER-T TEFLON
124001-S-L
MIL-H-25579 Hose Assembly

SUPER "T-HP" TEFLON
129001-S-L
ARP 604 Hose Assembly

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

FOR EVERY AIRCRAFT AND MISSILE

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Hose Assembly
MIL-H-8794 Hose

FLEXIBLE FLUID LINE REQUIREMENT

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

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

(Above hose assemblies conform in every detail to specifications listed.)

*Registered DuPont Trademark

STRATOFLEX offers complete hose assemblies, hose and fittings in a wide range of sizes and types, allowing engineers exceptional freedom in equipment design. Stratoflex flexible hose and fittings are available for most fluid applications and for a wide range of pressures. Medium pressure Super-T Teflon* and high pressure Super "T-HP" Teflon* are designed for extreme temperature applications.

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

SF12-0

STRATOFLEX Inc.

P.O. Box 10398 ● Fort Worth, Texas
Branch Plants: Hawthorne, Calif., Fort Wayne, Ind.
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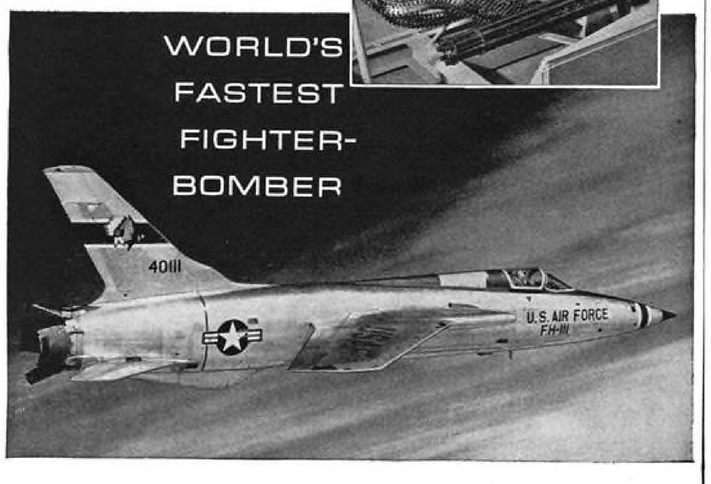
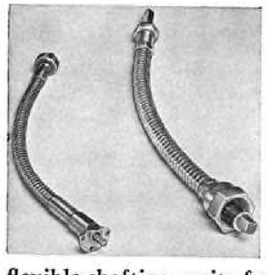
Circle Number 39 on Reader-Service Card

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.

STOW MANUFACTURING CO.
68 SHEAR ST. BINGHAMTON, N. Y.

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NEW! TYMETER® 24 HOUR CLOCK

"Time at a Glance"

$15 #100-24H

Here's the most remarkable clock you've ever used! The greatest advance in Time Telling since the dial face clock . . outdates all other ways of Time Telling. Easy-to-read numerals register every second, minute, 10-minute and hour. Walnut or ebony plastic case. 5" high, 7¾" wide, 4" deep. Wt. 3 lbs. 110V 60 cy. AC. One Year Guarantee. Plus tax.

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ORDER DIRECT FROM
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OPTICAL ENGINEERING SERVICES

Send specifications for immediate estimates

PRECISION LAPPING CO., INC.
34 Clinton Ave., Valley Stream, L.I., N.Y.
Telephone: (516) LO 1-2770

Circle Number 65 on Reader-Service Card

An important announcement from ALLMETAL®

To: **Buyers of Stainless Steel Fasteners**
Re: **Customer/Accommodation Services**

In an attempt to assist fastener buyers understand the factors that regulate pricing and delivery information; and clarify what satisfying "total requirements" actually means, ALLMETAL® offers the following Statement of Policy, and Guide to Buyers.

C/A Service 1. — **FULL STOCK ITEMS**
ALLMETAL® stocks a full range of regular and special fasteners **in full stock.** Prices on these items are lower than on corresponding non-stock or limited stock fasteners, and shipment can be made immediately **from stock.** Many new items are added to this list from time to time. We suggest that buyers contact the nearest ALLMETAL® Sales Office for full stocking, pricing, delivery information.

C/A Service 2. — **LIMITED STOCK ITEMS**
ALLMETAL® stocks a wide range of regular and special fasteners **in limited stock.** These fasteners normally require special production runs with minimal quantities. ALLMETAL® inventories limited stock items to accommodate its customers. Buyers benefit by immediate shipment from stock at prices lower than non-stock items. Again our list of limited stock items varies, new items being added continually.

C/A Service 3. — **NON-STOCK ITEMS**
ALLMETAL® can manufacture to order sizes and styles not carried "in stock". Due to our extensive manufacturing facilities these items are priced only slightly higher than stocked items, as a customer accommodation. We specialize in small quantity runs to your requirement. We suggest wherever possible that buyers recommend a stocked size or style for best price and delivery. A call to any ALLMETAL® Sales Office for assistance suggesting an alternate will bring prompt samples and quotations by return mail.

C/A Service 4. — **SPECIAL FASTENERS AND SCREW MACHINE WORK**
ALLMETAL® can supply a wide, full range of special fasteners and screw machine work in stainless steel **and all metals** to meet your specifications. Many Industry listed "specials" are manufactured regularly by ALLMETAL® which maintains a full stock of dies and special tools for this purpose. A quick reference to our latest catalog will supply buyers with a complete list of these "specials" manufactured under ALLMETAL® "C-part numbers". This list contains many different head styles and screw types. For prompt quotations on any "special" send your "total requirements" with a print or specification (or ALLMETAL® C-part number) including style, size and quantity needed.

C/A Service 5. — **GROUPED PURCHASES**
ALLMETAL® under certain circumstances can group various head styles and items to render a better combined price and delivery schedule. Because of our varying manufacturing schedule these grouped purchases can often cut down delivery time and price, especially on non-stock items. We suggest you check ALLMETAL® first for all your stainless fastener needs.

C/A Service 6. — **PRECISION MACHINE SCREWS**
ALLMETAL® mills from bar a select list of precision, "close tolerance", slotted machine screws in 18-8 Type 303 stainless steel. These are stocked in limited and full stock, in many head styles and sizes, and are available for immediate shipment **from stock.** ALLMETAL® specializes in "secondary operations" with the widest group of assorted equipment for the manufacture of stainless fasteners. New equipment and facilities are added to meet industry's needs.

MANUFACTURERS SINCE 1929
ALLMETAL®
SCREW PRODUCTS COMPANY, INC.

MAIN PLANT: 821 STEWART AVENUE, GARDEN CITY, N. Y.
516 Pioneer 1-1200

C/A Service 7. — **MINIATURES AND SUB MINIATURES**
ALLMETAL® stocks a large variety of stainless fasteners in 0 and 1 sizes, plus some items in 00. These represent the most complete list of **in stock** miniature stainless fasteners available anywhere. Items included are screws (all types), rivets, dowels, taper and cotter pins, washers and micro-size Flex-loc nuts. For a complete list refer to our latest stock list or contact our nearest office.

C/A Service 8. — **LARGE AND EXTRA LARGE SIZES**
ALLMETAL® stocks, ready for shipment, in full and limited quantities a complete variety of stainless fasteners in large and extra large sizes. These "jumbo sizes" are priced right because ALLMETAL® stocks the world's largest supply of stainless fasteners **in all sizes.** Extra large sizes include hex head bolts 1"-8 to 12" long, threaded rods (studs) 1"-8 to **six feet** long, plus taper and dowel pins, heavy jam and slotted nuts; available for immediate shipment — **from stock.** When your specification calls for "stainless", call ALLMETAL® first.

C/A Service 9. — **DEPENDABLE "ON TIME" DELIVERY**
ALLMETAL® meet all your **"total requirements"** by maintaining thorough inspection and quality control, eliminating "down time" and costly reordering, and assuring "on time delivery" and performance. At ALLMETAL® all size screws and nuts are gauged by our inspection department with the most complete sets of ring threadwork plugs (go and not go), available. All work is inspected "on the job" and again prior to going "on the shelf." In addition ALLMETAL® utilizes latest scientific test equipment to assure the quality required. ALLMETAL® enjoys highest "vendor ratings" for performance of order in the industry, because ALLMETAL® adheres to the Standards (A.S.A., AN, MS and NAS) in all stock items. When manufacturing to your specs the same rigid controls from metal to finished job are followed. A C/A service that rates us many thanks, daily from buyers.

C/A Service 10. — **SPECIAL NEEDS**
ALLMETAL® services your special needs. We maintain an up-to-the-minute "standards department" with complete Commercial and Military Specifications; with data available to buyers. The ALLMETAL® Catalog and Data Book (134 p.,) is on micro-film and available to users of VSMF Micro Files and Thomas' Micro Catalog. ALLMETAL® publishes booklets and brochures on stainless fasteners available to buyers upon request. Currently available is a 12 page condensed stock list, indexed and cross referenced for Commercial and Military (AN, MS and NAS) specs. Included are AN 3 & 6 Digit items, and MS Dash-number Charts. ALLMETAL® stocks fasteners in Monel, manufactures in **all metals,** and maintains continual research and development of new items, in stainless. ALLMETAL® fills special needs quickly.

Whatever your C/A service need, try ALLMETAL® first.

ALLMETAL® maintains offices and warehouses from Coast-to-Coast. For prompt service contact your nearest office listed below. The World's Largest Stock of Stainless Fasteners.

CULVER CITY, CALIF. Warehouse & Office: 5822 W. Washington Blvd. 213 WEbster 3-9595 TWX: LA 1472
PALO ALTO, CALIF. Bay Area Office: 488 Lytton Ave. 327-0310 TWX: 415-492-9498
NEW YORK CITY 212 Fleldstone 3-5800
NEWARK, N. J. 201 MArket 3-1117
BOSTON, MASS. 617 LAfayette 3-6119
CHICAGO 34, ILL. 6424 W. Belmont Avenue 312-AVenue 2-3232 TWX: 312-265-1351

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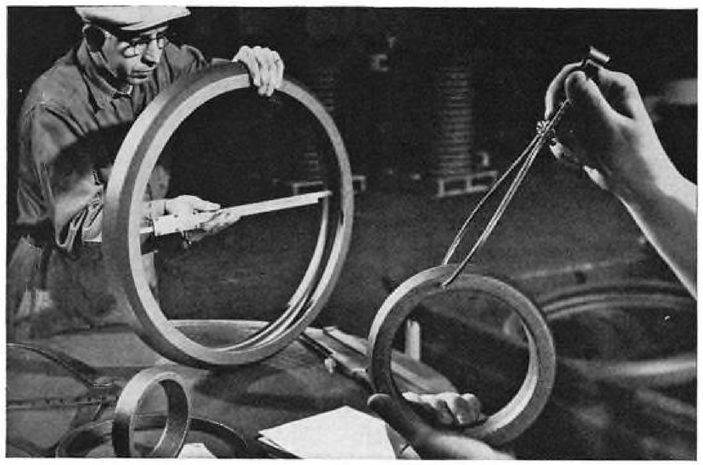

saving

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No matter how you look at an Edgewater ring, you see economies built right in—in materials, in machining.

The forming process matches the finished cross-section contour so closely that very little metal is wasted—especially important when costly alloys are used.

Each ring is hot-rolled so close to finish size that little machining is ever needed—a key cost factor in any job.

Less waste saves material. Far less machining time saves labor.

What do you need? A ring 5″ O.D.—or 145″? For bearing races, motors, aircraft engines, missiles?

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Or send for this free 12-page brochure telling why you get superior quality and save money, when you buy Edgewater rolled steel rings.

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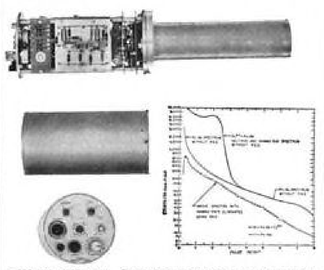
NE102 PLASTIC SCINTILLATORS
Radiation detectors. Slab Units up to 48″ square for accelerator, neutrino and cosmic ray studies, filaments, thin sheets, well counters, cylinders (with diameters to 36″) continuous capillary flow counters for corrosive solutions.

UNIVERSAL RADIATION MONITOR
A scintillation detector (transistorized), 2½ lbs. in weight. Versatile, suitable for all radiation detection in industrial Health Physics, or Civil Defense applications.



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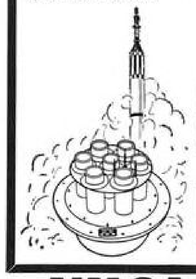
Gamma rejection ratio of 500:1. Higher detection efficiencies than ZnS detectors for fast neutrons in the presence of gamma rays. Three-way detection system also available.



SCINTILLATION PROBES
Radiation detection Probe Systems for rocket or balloon ascent; also complex systems utilizing pulse shape discrimination techniques.

Write today for a copy of the latest catalogue.

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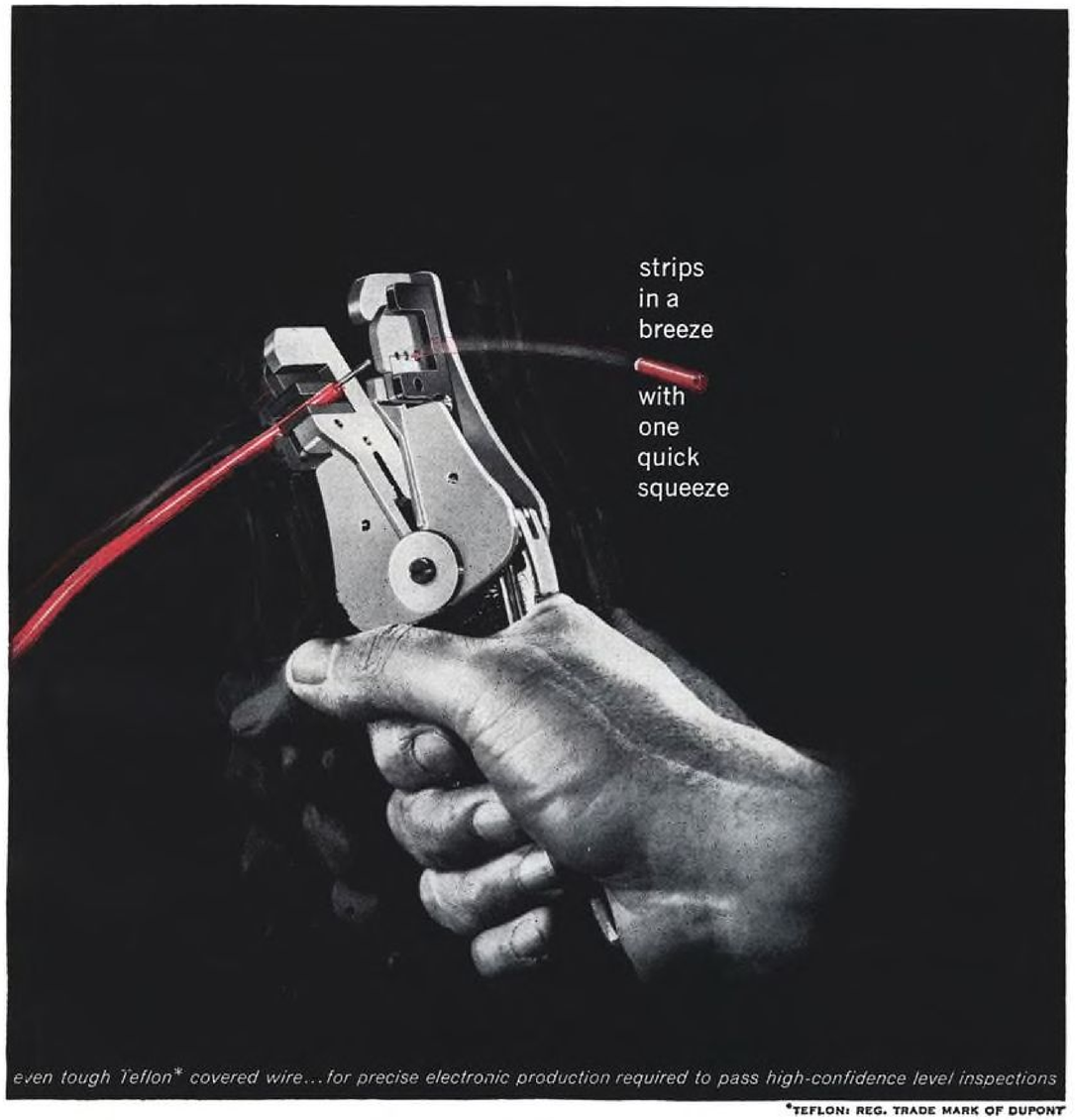

even tough Teflon covered wire... for precise electronic production required to pass high-confidence level inspections*

*TEFLON: REG. TRADE MARK OF DUPONT

IDEAL CUSTOM *Stripmaster*®

Strip solid or stranded wire easily — with no wire nicks, insulation scratches — no waste or rejects. Unique matched blades, drilled to exact wire size on watchmaker's equipment, plus colleting action, *help you meet high-confidence standards even on toughest insulation.* Three models — for Type E Teflon, Type EE Teflon and general purpose plastic and fibre-glass insulation. Sizes for 10 to 14, 16 to 26, or 26 to 30 wire. Optional transparent wire stop adjusts to strip exact insulation length. Send coupon for full information.

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DYNAMICS RESEARCH CORPORATION

presents an advanced concept in ... Optical Shaft Angle Encoders — **OPTISYN®**

OPTISYN is a high-accuracy incremental electro-optical digitizer for reliable indication of shaft position, shaft rate, and direction of shaft rotation. It employs a unique rotating moire fringe to produce high signal levels, valuable error compensation, and long operating life. OPTISYN is standard equipment on operational missiles, a proven component for inertial accelerometers, gimbal systems, pedestal mounts, and for digital data systems — both military and industrial.

WHY INCREMENTAL OPERATION?

Incremental transducers are inherently simpler and smaller in size

Incremental circuitry is likewise simpler and more reliable — fewer transmission leads

Incremental encoders facilitate accumulation of total shaft angle in binary or decimal codes

Incremental systems allow floating-zero operation fpr convenient placement of reference point

DISTINCTIVE FEATURES OF INCREMENTAL OPTISYN —

High resolution per turn in small size — can measure to seconds of arc, at high shaft rates

Maximum pulse-to-pulse error can be within 0.00025 of spacing

Remarkable cumulative accuracy — *a maximum total accumulated error* of ±0.25 quanta

High reliability — projected 6 years mean-time-to-failure

Rugged — meets MIL-E-5272C

High speeds with low wear — non-contacting design eliminates contact bounce, critical contact alignment, and abrasive wear

Rapid readout rates — counting rates as high as 300,000 to 500,000 quanta per sec.

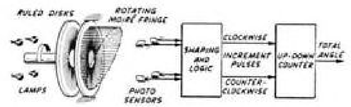
Low torque—low-inertia shaft carried on matched precision ball bearings

Wide-aperture optics — provides valuable error-compensation, high signal level, and allows reduced-voltage lamp excitation for long life

Std. synchro mounts — simplifies installation

OPTISYN OPERATION

OPTISYN uses two transparent disks having precise ruled patterns of alternately opaque and clear sectors. The anchored disk has one (1) more opaque sector than the rotating disk, resulting in the moiré fringe illustrated. Four quadrature light sources (d-c or a-c excitation) illuminate four corresponding sensors. Maximum light is transmitted at one point on the pattern, while 180° away, cell illumination is minimum. A full rotation of the input shaft causes the moiré pattern to rotate n times, n being the number of opaque lines on the rotating disk. Outputs of the photo-sensors, operating into simple solid-state circuits, indicate digital shaft position, rate, and direction of rotation.



MILITARY APPLICATIONS include pickoffs for gimbal systems, accelerometers, radar and optical pedestal mounts, servo controls for airborne and shipborne use, telemetry, data processing systems, and motor commutators.

INDUSTRIAL APPLICATIONS include pickoffs for lead-screw drives, tool carriage positioners, indexing tables, tape speed controls, digital data transmission, and rolling and drawing stands.

STANDARD MODELS

Size 11: **Miniature high-precision encoder series designed for space and airborne uses where size and weight are critical.**

Sizes 23 and 35: **High-resolution performance provided in a standard package. Useful for more general military and industrial applications.**

Size 27: **Recommended for low-cost industrial applications; provided with bearings sealed against dust and dirt; heavy-duty shaft and sealed shaft are optional.**

	Size 11	Size 23	Size 27	Size 35
Resolution* (counts/rev)	25 to 2048	400 to 4096	400 to 3600	400 to 16,384
Shaft inertia (gm-cm²)	2	40	40	205
Diameter (in.)	1.062	2.312	2.75	3.500
Length (in.)	1.325	15/16	2.25	1.406
Weight (oz.)	3.5	7	17	20
Max. operating case temp. (°C)	75	75	66	75

Obtainable from OPTISYN operating through standard shaping and logic circuits.

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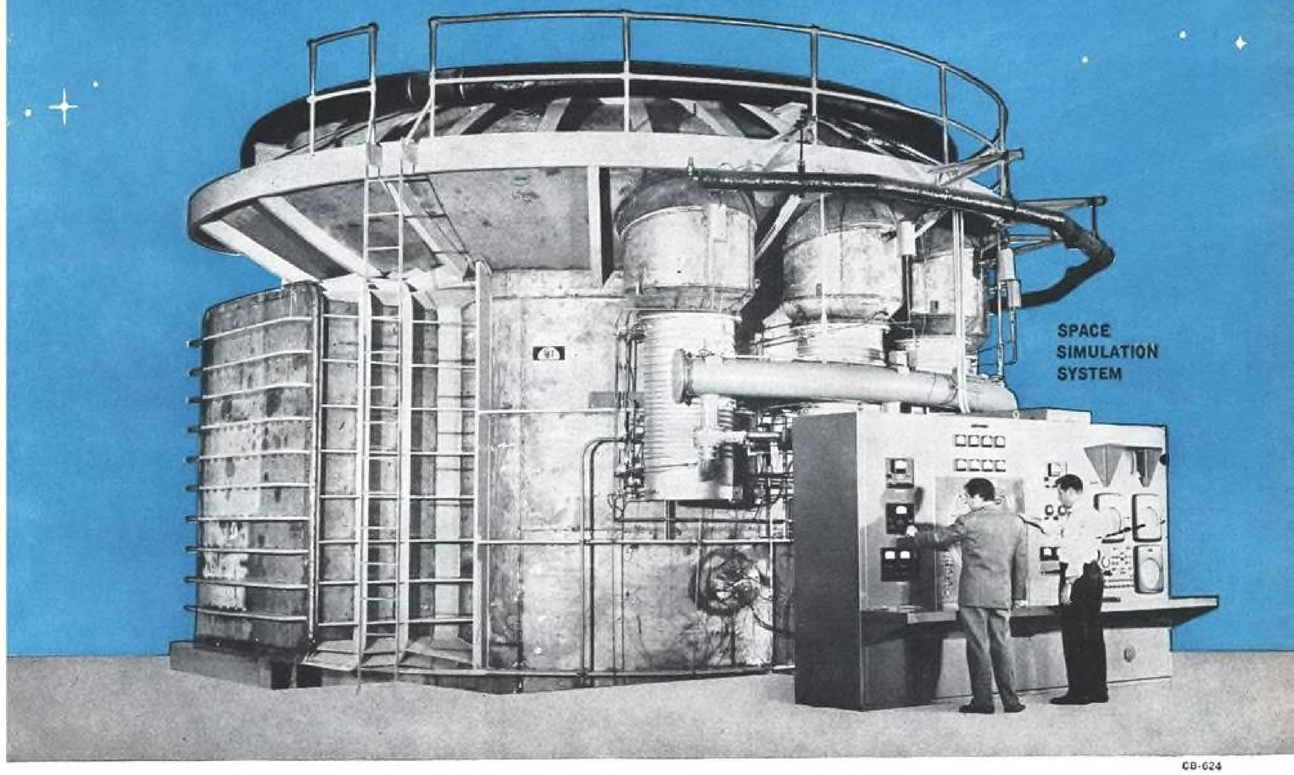

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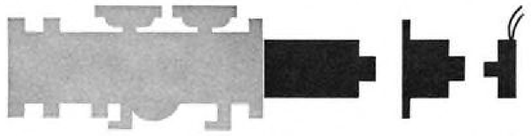

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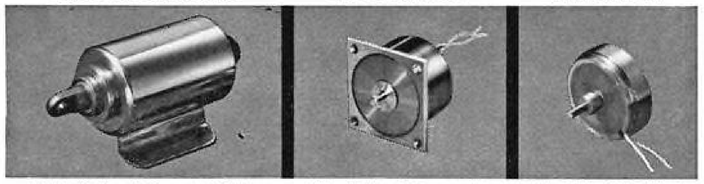

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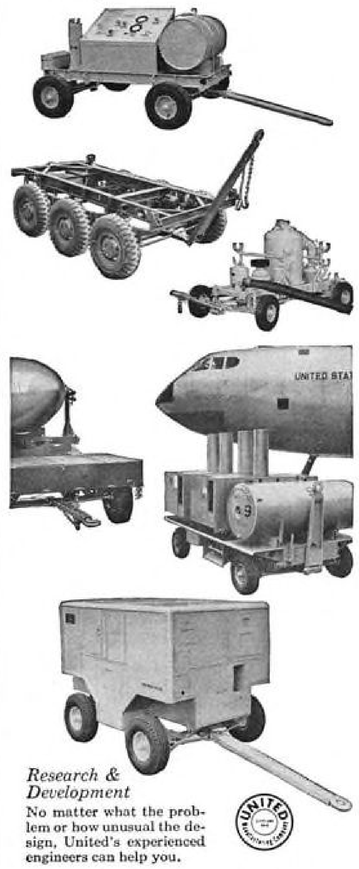

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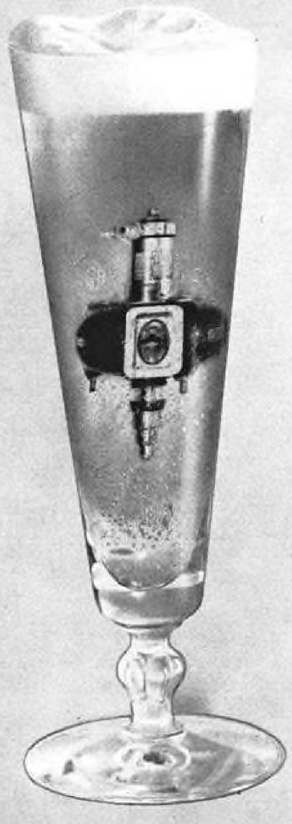

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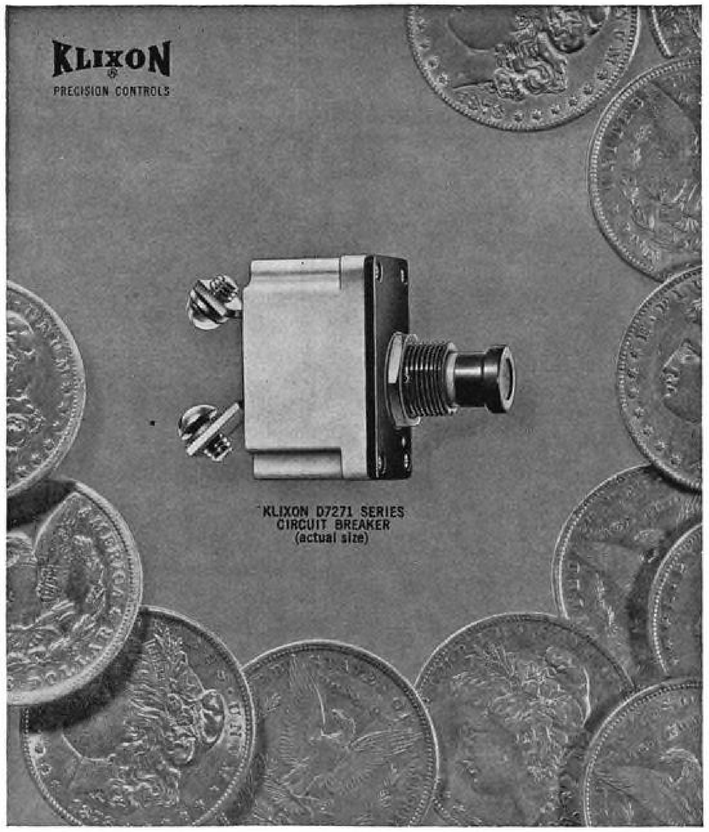

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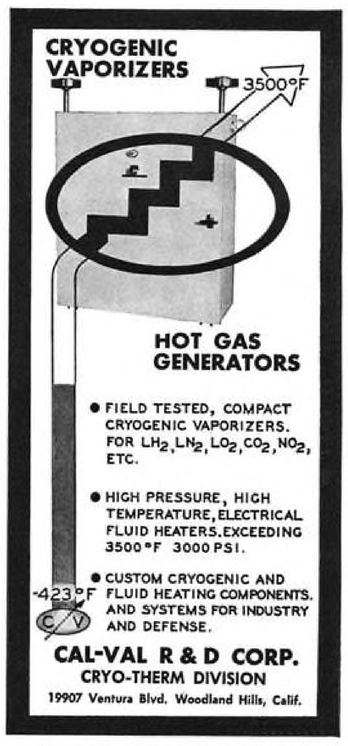

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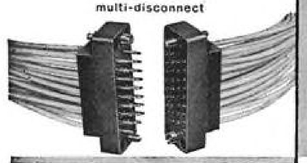
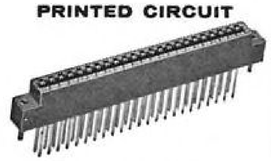
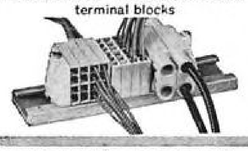
HYFEN® multi-disconnect 	Plug and receptacle connectors with crimp-type, snap-locked contacts, and solder types.	Miniature rectangular, rack and panel, general purpose, modular plug-in relay base, coaxial—miniature and standard.	Tool-installed crimped contacts are individually or gang connected and disconnected. Extremely versatile and reliable. Quality materials used for inserts and contacts which are normally gold plated. Modular concepts.
PRINTED CIRCUIT 	Card receptacles and pin type printed circuit connectors.	Solderless and solder terminations—solder-eye, taper pin, taper tab, solderless wrapped, solderless HYFEN types.	Tooled for production. Quality materials in connector bodies, springs, and contacts. Include 10, 15, 18, 22, 30 and 43 place sizes.
MINILOK® MODULOK® • CRABLOK® terminal blocks 	Modular, miniature, quick-disconnect or permanently-connected terminal blocks.	MINILOK for standard cable and miniature coax—top and side feed. MODULOK for standard cable and coax—2 and 4 tier. CRABLOK in 5 and 15 bay styles.	Extremely versatile modular design. Reliable electrical contact in both quick-disconnect or permanent connection position. Tool-installed crimp-type contact tips. Modules accommodate standard, standard coax, and miniature coax conductors.
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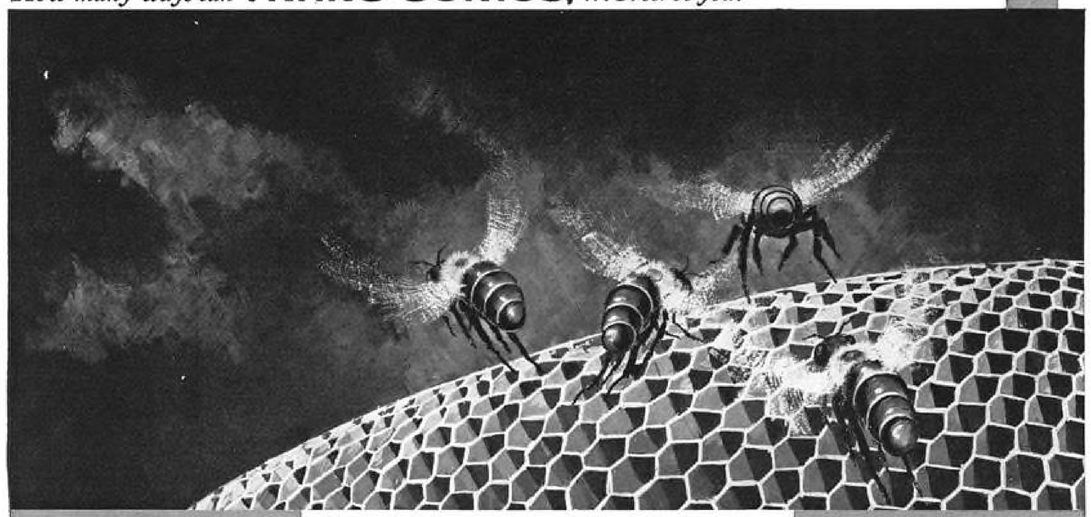

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Aviation Week & Space Technology

Volume 77
Number 27

Mid-December, 1962

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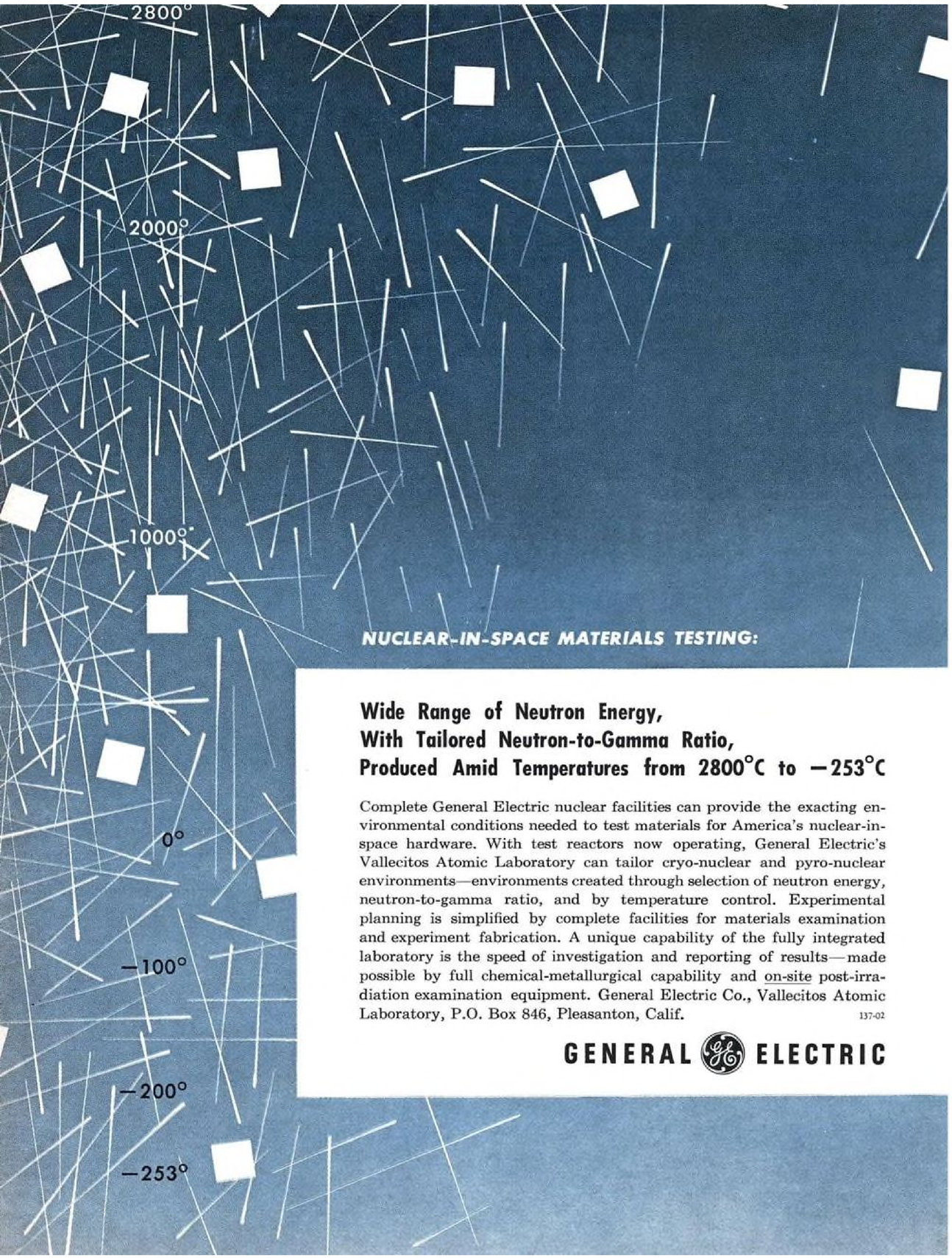
COVER: Grumman Aircraft's GRV-1 re-entry vehicle is shown undergoing Mach 4 tests at low angle of attack in the company's supersonic wind tunnel. Design features a flat-nosed, edged configuration with twin vertical aerodynamic surfaces. At Mach 4 and high angles of attack, edge-contour design was found to be useful in influencing yaw and roll forces without using fin controls. Grumman design team has indicated that extension of the edge design concept might prove valuable in the development of vehicles capable of withstanding a wide range of re-entry conditions during future planetary exploration missions (AW Dec. 3, p. 72).

PICTURE CREDITS

Cover—Charles McLaughlin, Grumman Aircraft Engineering Corp.; 56—Aviation Week; 57—Viron Div., Geophysics Corp.; 58—General Electric; 59—NASA/USAF; 60—McDonnell Aircraft Corp.; 61—(top) NASA/USAF, (bottom) Lockheed-Georgia Co.; 63—NASA; 64—(top) PFC Paul Wilkes, Army, (bottom) Douglas Aircraft Co.; 65—United Technology; 67—USAF/USIS; 71—Hughes Aircraft; 72—Antenna Systems, Inc.; 73—Lockheed Electronics; 78—American Airlines; 79—British Aircraft; 83—Piper Aircraft.



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A significantly greater number of companies and organizations are represented in this year's Buyers Guide Issue as well as a greatly expanded list of products, reflecting the industry's growth as new aerospace companies are formed, and as firms long established in other industries venture into this field of fast-moving technological developments.

The 98-page Products and Services Section names some 3,000 suppliers of more than 2,000 products and services, including research, development, test and engineering organizations as well as manufacturers and suppliers of basic materials. Information in this section is right up to date as the result of a massive industry survey conducted by AVIATION WEEK & SPACE TECHNOLOGY.

Engineer's Role

As we pointed out in the first Buyers Guide Issue, published in mid-December, 1955, the engineer is a key individual upon whom the initial responsibility for sagacious buying and selling falls. Good purchasing and good selling starts at the preliminary design stage.

The growing acceptance of the Buyers Guide Issue since 1955 is a matter of record. Readership checks conducted to determine the use which is made of the Buyers Guide Issue found that this publication is referred to in increasing frequency by engineering-management people in connection with their aerospace assignments. The mid-December, 1962, Buyers Guide Issue documents almost all the products and services which, in the aggregate, constitute the $17-billion aerospace market.

One obvious way in which the Buyers Guide Issue can be of proven usefulness is in ferreting out new sources of supply. As AVIATION WEEK & SPACE TECHNOLOGY pointed out in an article concerning production of the Sidewinder, when Navy selects a second source for a weapon such as this air-to-air missile, it insists that the new contractor develop a different group of subcontractors and vendors wherever practical. This assures that the cost-saving advantages of competition will be established at several levels in the production structure and not merely at the prime contractor level.

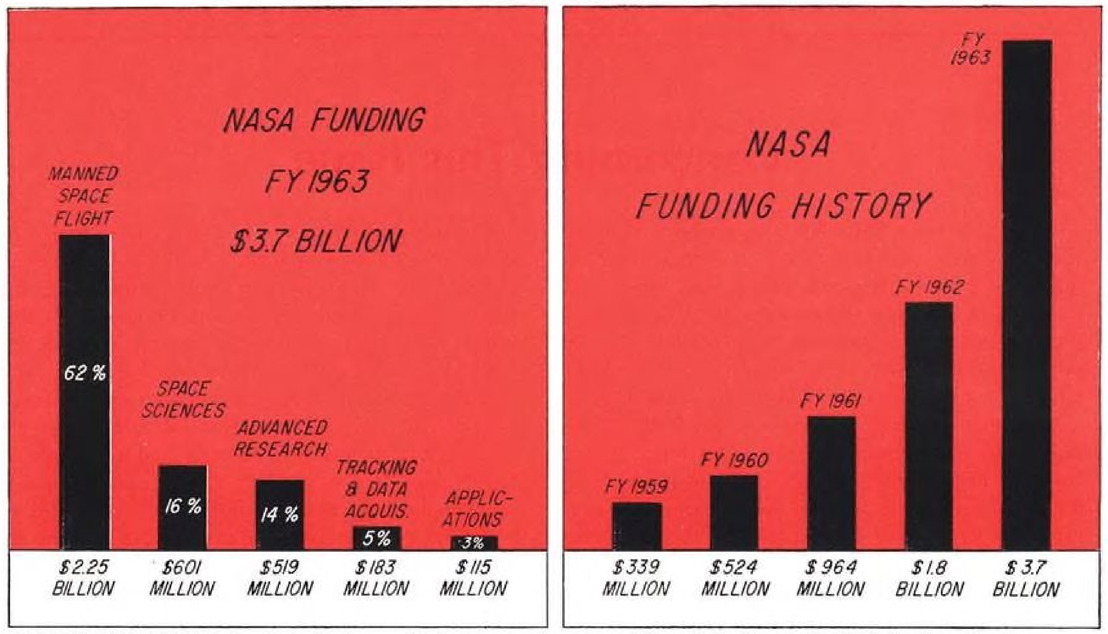
Another advantage of this seeking out of new sources is that it broadens the industrial base and makes production less vulnerable to natural and man-made interruptions. It is in precisely this area of finding new suppliers that the Buyers Guide Issue can play an important role—by creating an awareness of hitherto untapped sources and resources.

Vital Concepts

The Buyers Guide Issue takes on particular importance at this time, when value analysis and value engineering should be fully accepted as vital concepts of profitable aerospace technology. Increasing interest on the part of the Defense Dept., General Accounting Office and Renegotiation Board in the cost of aerospace procurement demands greater ingenuity and diligence in obtaining the most technological progress with the most efficiency and economy. Secretary of Defense Robert S. McNamara, in an advisory to the military services, stated that "we should ruthlessly eliminate all activities the cost of which is not commensurate with their contribution toward national defense." And the National Aeronautics and Space Administration, faced with a deficit of $300 million while at the same time preparing a near-$6-billion budget request for Fiscal 1964, can be expected to turn a sharp eye to trimming excess cost out of its procurement.

Here, then, is your Buyers Guide Issue, our final service issue in 1962—a year which has proven to be a record one for AVIATION WEEK & SPACE TECHNOLOGY in readership, in advertising volume and in world-wide acceptance. We are certain that our more than 84,000 net paid subscribers, as well as those countless thousands of additional readers throughout the aerospace world, will find it an exceedingly useful and practical industry tool.

—Robert W. Martin, Jr.,
Publisher



CHARTS REVEAL NASA's dominant funding emphasis on manned programs left, and steadily growing fiscal funding allocations.

NASA Foresees $5.5-$7 Billion Budgets

By Edward H. Kolcum

National Aeronautics and Space Administration foresees a gradual leveling trend in the amount of money it will receive to conduct the U. S. space program, but the budget anticipated in the immediate future continues to place the space agency in the category of big business. The level of effort during the next decade is expected to range between $5.5 and $7 billion annually and the space market will continue to be highly competitive.

Major portion of these funds will be spent, according to NASA Administration Director Albert F. Siepert, in the engineering development of space hardware—launch vehicles, spacecraft, flight instruments and the ground-based facilities to build, test, launch and track flight hardware. Siepert illustrated this point with a breakdown of the $3.7 billion appropriation for the current year, Fiscal 1963:

• **Construction** of ground-based facilities will total $752 million, 20% of the entire appropriation, with $471 million committed to large launch vehicle testing and launching complexes. Remainder of the construction money is being spent this way: spacecraft and instrumentation research facilities, $120 million; tracking and communications facilities, $45 million, and general laboratory facilities for research and advanced technology, $115 million.

• **Research, development and operations** funding, which totals nearly $3 billion and provides $1.1 billion for development, procurement and flights of launch vehicles; $1.2 billion for the spacecraft and on-board experiments; $528 million to support the NASA agency, and $135 million to track and acquire data from space vehicles.

In major funding areas, NASA will spend 62%, or $2.25 billion, on manned space flight this year. Space science appropriation totals $601 million, and satellite applications, $115 million. Research and advanced technology total is $519 million, and tracking and data acquisition, $183 million.

More than 90% of the total NASA dollar is spent on contracts or grants with non-federal institutions, Siepert said. This is a distinct upward trend in the agency. Estimates of the Fiscal 1962 budget portion remaining inside the agency were as high as 25% (1962 Buyers Guide, p. 35).

Fundamentally, NASA conducts its hardware program through a series of projects, which currently total about 40. They range in effort from the billion-dollar Saturn C-5 and Apollo spacecraft projects to modest single-flight experiments on sounding rockets. Since the Apollo manned lunar landing program was made a national goal last year by President Kennedy, those projects within the broad meaning of direct or indirect support for Apollo are those which will be given top national and top NASA funding and scheduling priority.

All NASA centers are involved to some degree in the manned lunar landing program, and most NASA business with contractors flows directly from the agency's field installations, which exercise primary control of the specific projects. However, each center maintains its own bidders and source lists for supplies, research and services they buy.

A company in the aerospace field should make its availability known to all NASA centers for consideration in the contract competition process. This process is essentially the same as that used by Defense Dept., which set the pattern for NASA's procurement regulations.

Although NASA continually emphasizes its intention to keep the aerospace market highly competitive, the agency has initiated a two-step competitive process on the highly-expensive projects it manages.

This process involves a pre-proposal bidders' conference, open to all who believe they qualify to compete, and then a formal bidders' conference which normally is an invitation-only session.

Preceding this hardware competition, NASA normally awards two or three conceptual study contracts on a project, from which the agency can obtain basic information on which to base detailed specifications. This was done in the Apollo spacecraft competition, and is continuing with definition studies of the Nova vehicle and the lunar supply system spacecraft and payload. When supplies, materials, equipment, construction work or services can be clearly described, the project will be formally advertised and requests for bids will go out to the companies named on the source lists maintained by the center managing the project.

Negotiated procurement is a technique NASA uses when the project cannot be defined by detailed specifications. Again, the source list is the basis for selecting companies with which the agency will negotiate.

NASA uses these two contract types:

• **Fixed-price,** most frequently used both in formally advertised bids and negotiated procurements. In this category are lump-sum contracts employed for support of research. Because of the research nature of NASA's work, most contracts will protect the company in special situations with price redetermination clauses.

• **Cost,** which is used where research and development unknowns predominate in the scope of the contract. Normally, this contract type involves a direct reimbursement or a fixed fee. Although by law fees are negotiated in dollars, they have averaged 6-7% of the total contract award.

Major procurement problems NASA faces involve poor estimates made by the agency in developing programs, and equally poor estimates which industry makes in responding to NASA bid requests. Estimates in the past have been considerably low, which has caused some program delays in the current fiscal year.

Following is a summary, prepared by NASA, of its installations and the markets which predominate at each:

Headquarters Procurement

The Headquarters Procurement Branch of the Procurement and Supply Division is responsible for planning, negotiating, awarding and administering contracts based on procurement requirements initiated by and under the technical cognizance of the Headquarters staff and program offices. Such requirements include, but are not limited to: liquid hydrogen, reliability studies, the initial phases of research and development projects, recruitment advertising services, mobile lecture-demonstrations units, exhibits, motion picture services, management analysis surveys, and various consultant and professional services. In addition, this branch is responsible for negotiating and awarding all NASA contracts with foreign government and foreign commercial organizations.

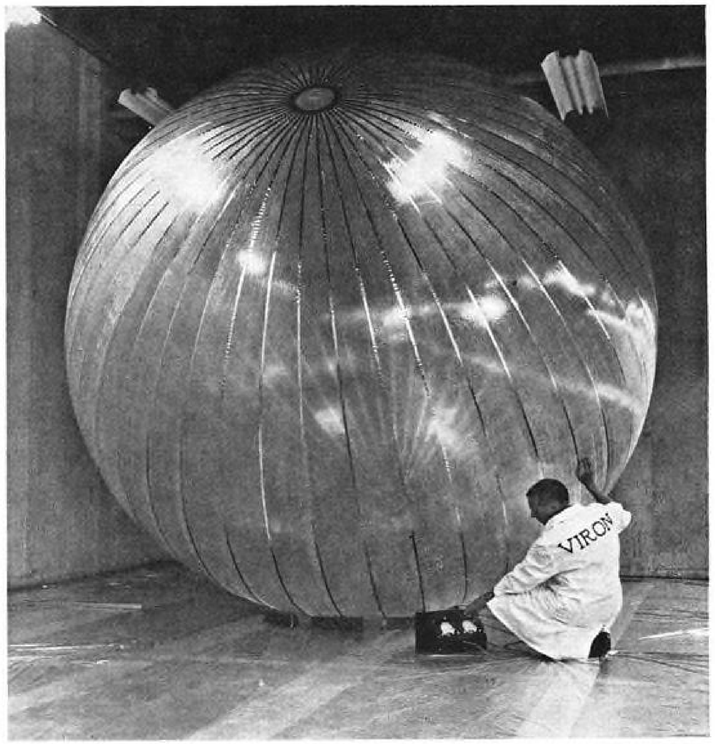
Excluded from the branch's procurement responsibilities are the following: office supplies and services, furniture and equipment, magazine subscriptions, printing, reproduction, graphic arts services, and other Headquarters support type items which are the responsibility of the Administrative Services Division; and research grants and university contracts which are the responsibility of the director of Grants and Research Contracts.

Manned Spacecraft Center

The Manned Spacecraft Center located in Houston, Tex., was created in 1958 as the Space Task Group and charged with carrying out Project Mercury and other NASA manned space flight programs. In January, 1961, it became a separate NASA field element and in October, 1961, Space Task Group initiated a move to Texas and became officially known as Manned Spacecraft Center. It is expected the move to the new site presently under construction in the Houston area will be completed by early 1963.

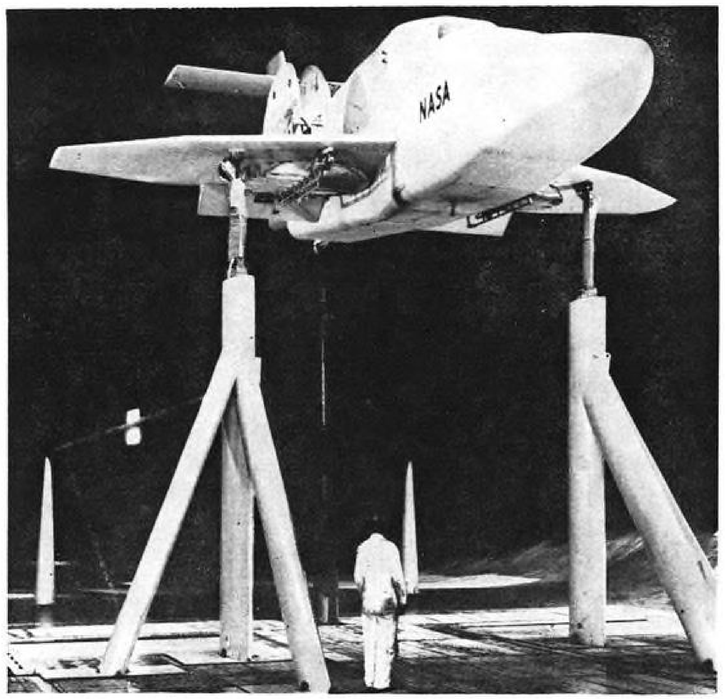
Manned Spacecraft Center functions include investigations into man's performance capabilities and ability to survive in a true space environment. This program involves a research and development buildup from unmanned sub-orbital and orbital flights and recovery, to manned flights. It operates the largest technical space laboratory and environmental chamber in the world and conducts all civilian aspects of manned space flight capabilities, including space guidance and communication systems, orbital rendezvous, re-entry and recovery, spacecraft development, space sciences and astronaut training, and will test in their entirety, actual space vehicles with boosters in simulated flights to other space systems.

Manned Spacecraft Center is also responsible for Gemini, follow-up to Project Mercury, which will carry two men on an earth orbital flight, and Project



Sphere Used in Communication Satellite Studies

Test sphere, 12¼ ft. in dia., is being used by National Aeronautics and Space Administration to assist in designing new passive communication satellites. Sphere is one of a series built by Geophysics Corp. of America's Viron Division, Anoka, Minn., for testing in NASA and USAF space environment vacuum chambers. It is constructed of rigidized, expanded aluminum wire mesh laminated between two sheets of polypropylene covering.



XV-5A Model Tested in Wind Tunnel

Full-scale wind-tunnel model of Army's XV-5A lift-fan research aircraft is shown before tests at NASA's Ames Research Center. XV-5A, formerly designated VZ-11 (AW Aug. 20, p. 32), incorporates 6-ft.-dia. lift fans mounted in the wings for V/STOL (vertical and short takeoff and landing) capability. Ryan Aeronautical Co. is building two XV-5A aircraft to be ready for flight tests by the middle of next year. Wing fans will multiply thrust of the two GE J85 turbojets by 300% for vertical flight.

Apollo, which will follow Project Gemini, with circumlunar and lunar landing missions.

Marshall Center

The Marshall Space Flight Center consists mainly of facilities and personnel transferred under agreement from the Army Ballistic Missile Agency and other Army organizations at Redstone Arsenal, Ala. The center occupies 1,200 acres adjoining the city of Huntsville. Its facilities are valued at approximately $100 million. The center has charge of developing and operating NASA's launch vehicles, and conducting related research.

Technical functions of the center are divided among nine laboratories. Activities include investigation of aeroballistics and related sciences, simulation and data reduction, production of experimental model and prototype boosters and research in manufacturing methods and technology, the design and pilot development of guidance and control systems and checkout and launching of boosters and space vehicles.

Typical projects of the Marshall Space Flight Center include: development of the Saturn vehicle, the F-1 single-chamber, 1.5-million-pound thrust engine, the J-2 200,000-lb. liquid hydrogen-liquid oxygen engine, the RL-10, the M-1 and the H-1 engines. Marshall also handles the Rift (reactor in-flight test) project for the Space Nuclear Propulsion Program.

The Michoud Assembly Plant at New Orleans and the Mississippi Test Facility are part of the Marshall Space Flight Center complex and operations conducted there are under the administrative direction and responsibility of the center, although most of the work carried on is under contract to various industrial organizations.

Jet Propulsion Laboratory

The task of exploring the moon and the planets is the major responsibility of NASA's Jet Propulsion Laboratory. This facility was transferred to NASA from the Army Ordnance Missile Command in December, 1958, and is operated under contract by the California Institute of Technology.

Research at JPL is administered through eight technical divisions and covers the broad spectrum of activities associated with space programs, including propulsion, aerodynamics, chemistry, guidance, communications, physics, mathematics, and many other related fields.

Although JPL is operated under contract, it follows NASA policy which encourages subcontracting tasks to industry. It is expected that in the near future 75% of the JPL contract funds will be awarded to outside organizations.

Space Nuclear Propulsion

The Space Nuclear Propulsion Office was established as a joint activity of the Atomic Energy Commission and the National Aeronautics and Space Administration so that the work of common interest carried out by groups in each agency would be coordinated and merged in a single unit to develop the application of the nuclear rocket to space missions.

In accordance with the statutory responsibilities of both agencies, the AEC will have primary responsibility in this program for the development of nuclear reactors for use in connection with flight missions specified by NASA. NASA will have primary responsibility for research and development of non-nuclear components and the integration of the reactor and non-nuclear components into complete engines systems and vehicles involved in the various space projects which include nuclear power or propulsion.

This office is responsible for all aspects of Project Rover, including development of the Nerva engine, advanced technology, test facilities, vehicle development and reactor development. Inquiries with respect to these and other projects involving nuclear energy should be addressed to either the Headquarters Office at Germantown, Md., or the Extension Office at the Lewis Research Center.

Langley Research Center

The Langley Research Center is primarily concerned with the conduct of research related to the problems associated with space flight and entry from space into planetary atmospheres, and problems of advanced aircraft.

In the areas of space flight and atmospheric entry, Langley Research Center activities include work on heat transfer, materials, structures, and guidance and control of satellites and spacecraft, ballistic missiles, anti-missile missiles, and boost-glide and winged space vehicles.

Aircraft research problems investigated at Langley are applicable to military and commercial vehicles of all types —missiles, bombers, interceptors, supersonic transports, helicopters, vertical takeoff-landing (VTOL) and short take-off-landing (STOL) airplanes, and ground effect machines (GEMs) which permit large vehicles to ride on a cushion of air.

Typical projects at the Langley Research Center include: experimental techniques duplicating the high-speed, high-temperature environment of returning spacecraft, aerodynamic and structural research related to high-speed airplanes, missiles and spacecraft, studies of basic fluid mechanics including magnetoplasmadynamics and the characteristics of gases at high temperature, development of special structures capable of withstanding high temperature or landing impact, design and development of specialized research instrumentation, supporting research on specific development projects for both NASA and other government organizations including Mercury, Minuteman, Polaris and B-70, and development of a number of launch vehicles for research purposes including the four stage, solid-fueled Scout.

Ames Research Center

The Ames Research Center, with an extensive background in high-speed aerodynamics, is currently making important contributions in basic and applied research on both aeronautical and space flight problems.

Approximately two-thirds of the center's programs are directly applicable to space. Space travel-oriented programs are concerned with atmosphere re-entry for manned satellites, boost-glide vehicles, proposed manned interplanetary and lunar craft, ballistic missiles and life support. These include a wide variety of environmental studies and the development of highly specialized simulation apparatus, as well as research, both basic and applied, in stabilization and guidance. The Life Sciences Group studies many areas untouched by other researchers in the U.S., including exobiology (extra-terrestrial life and life synthesis), environmental biology (microbiology, pathology, physiology, radiobiology) and biotechnology (application of biological data to engineering problems and systems).

The remaining portion of the Ames research effort is concerned with the fundamentals of hypersonic and supersonic aircraft and the problems of vertical and short take-off and landing aircraft.

Typical projects at the Ames Research Center include: orbital attitude stabilization of an advanced meteorological satellite, stabilization and control for an orbiting astronomical observatory; studies of the ability of a human pilot to control a space vehicle during re-entry, design approaches for re-entry vehicles, wind tunnel and flight research on vertical and short take-off and landing aircraft, instrumentation and simulation techniques and devices, and studies of military and civilian aircraft of the future.

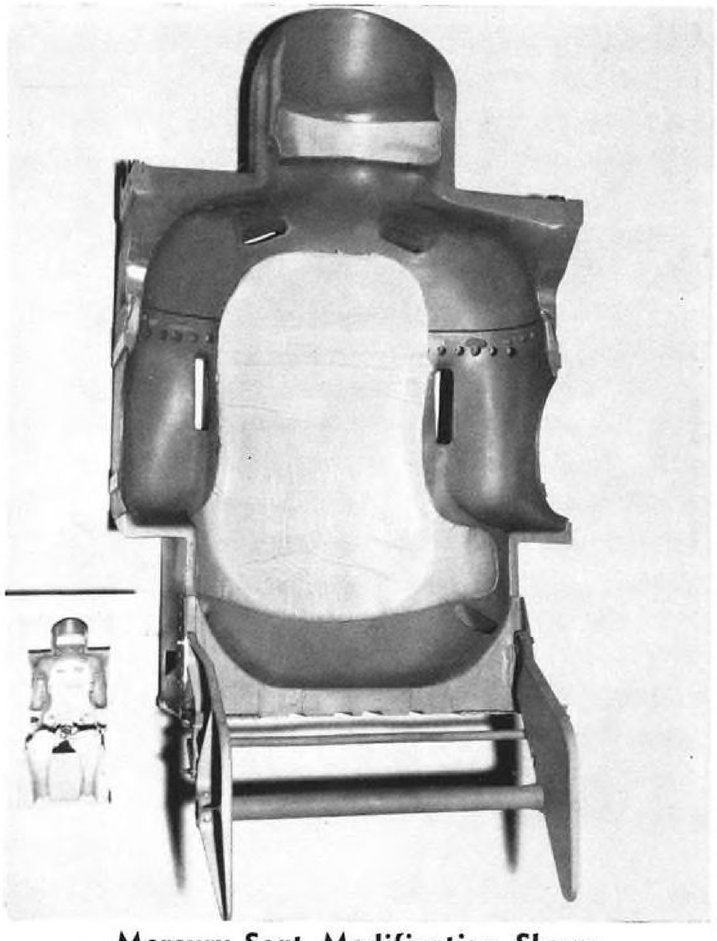
Goddard Center

The Goddard Space Flight Center has a twofold mission. It is charged with the responsibility for complete development programs in (1) space science and satellite applications and (2) tracking and data acquisition and reduction. Involved in this multi-faceted scientific effort are various programs in theoretical research requiring experimental interpretations of results and the ability to foresee problems, anticipate needs and plan long-range applications of new developments. This effort is essential to maintain technical proficiency in a fast-changing scientific scene and to provide back-up support for monitoring larger spacecraft programs accomplished through industrial contractors. A complete environmental test and evaluation program is operated by the center for the small satellites and to perform flight acceptance testing on the larger observatory-type spacecraft.

The space science program develops both basic and applied scientific research with spacecraft in aeronomy and meteorology, astronomy, ionospheric physics, lunar sciences, planetary and interplanetary sciences, energetic particles and fields, and the biosciences.

The applications program chiefly involves research and development with meteorology and communications satellites.

In tracking and data acquisition and reduction the center is the tracking and communications hub of the world-wide minitrack and Mercury networks. For the second generation of scientific satellites now approaching, the center is designing and building data acquisition



Mercury Seat Modification Shown

Photo shows modification of the astronaut seat in the McDonnell Mercury space capsule for Navy Cdr. Walter Schirra's MA-8 six-orbit flight Oct. 3 (AW Oct. 8, p. 26). Small photo at left shows earlier seat which incorporated leg grooves.

stations with giant 85-ft. parabolic antennas. For manned space flights Goddard has designed and operates a global chain of stations which provide vital tracking, telemetry, and ground voice communications on a "real time" basis. The focal point of this system is Goddard's space control center which determines and predicts satellite orbits, reduces scientific and biomedical data and commands a voice network linked to 10 stations in the Mercury network.

In Goddard's theoretical program, studies are being conducted in astrophysics, celestial mechanics, the nature of plasmas, the moon's surface and structure, and the atmospheres of the earth and planets. The Goddard Institute of Space Studies was established May 1, 1961, in New York City. The purpose of the institute is to conduct basic theoretical research in the space sciences in collaboration with universities in that area.

The theoretical effort at the Greenbelt site differs from the institute's in that it is more closely related to NASA projects and experimental activities with special emphasis being placed on studying energetic particles and magnetic fields in space.

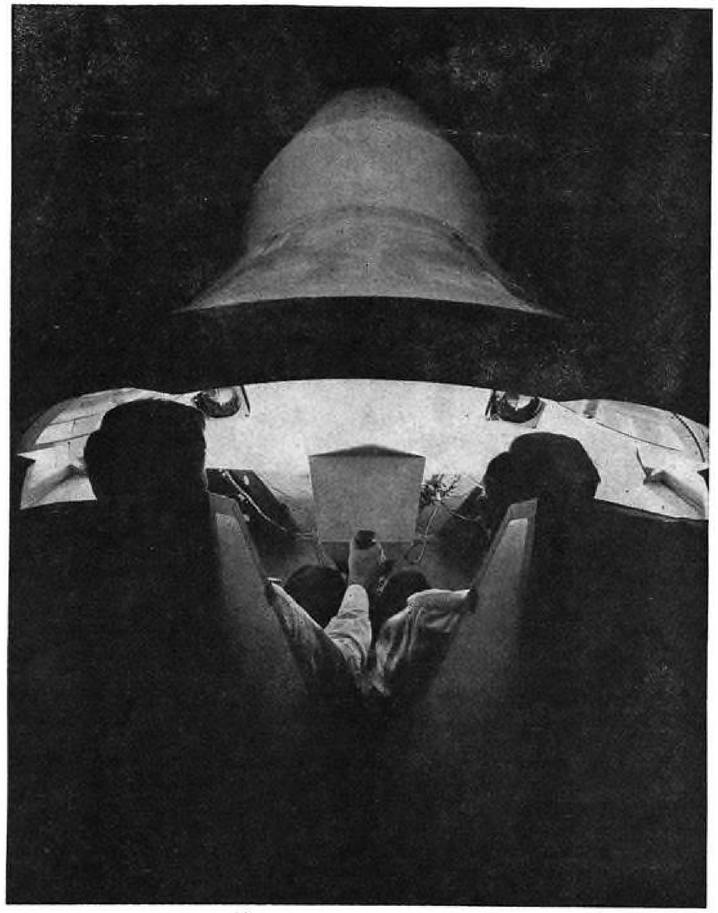
Lewis Center

The Lewis Research Center is primarily responsible for basic and applied research in aeronautical and space propulsion and power generation.

The effort is divided into five major areas: chemical rocket engines, nuclear rocket engines, electrical propulsion systems, power generation systems and space environmental systems.

Typical projects at Lewis include: high energy propellants for rocket systems, effects of zero-g on propellant storage and pumping systems, propulsion systems for "soft" lunar landings, direct conversion of heat to electricity, electrical rocket systems for space propulsion, materials and heat transfer research related to nuclear rocket systems, analytical and experimental studies of fluid mechanics involving pumps, turbines and heat exchangers, and investigation of materials, lubrication and wear and instrument systems.

The Lewis Research Center operates the Plum Brook Station at Sandusky, Ohio. This facility consists of a 60-mw. water-cooled nuclear reactor, hot laboratory and supporting facilities which provide the means to carry out nuclear irradiation programs in addition to research and development on cryogenic pumps, turbines, turbo-pumps, gas generators, propellant tanks, flow systems, system dynamics, nozzles, control systems and heat transfer studies.



Gemini Simulator Aids Systems Design

Simulator for the Gemini two-man spacecraft is being used by NASA and McDonnell Aircraft Corp., Gemini prime contractor, to assist in evaluating designs for spacecraft systems. The simulator is wired to analog computers and a 7090 computer at McDonnell.

Western Operations

Liaison responsibility for NASA contract activities located west of Denver is centered at the Western Operations Office, Santa Monica, Calif. This office provides liaison on the West Coast for industry and research organizations on one hand, and for NASA Headquarters and field installations on the other.

Western Operations Office administers NASA contracts, performs technical monitoring and liaison on NASA contracts or projects and advises headquarters on technical developments and capabilities in the area. The office performs associated security, legal and patent services and auditing.

Wallops Station

Wallops Station's present-day function is to conduct experiments with rocket-propelled vehicles carrying payloads used for aeronautical and space research. These payloads may be in the form of re-entry or space flight models, models of manned-space capsules, ionized layer data-gathering and other sounding devices or any other space research device capable of being carried by the vehicles which Wallops Station can launch. Occasionally research is conducted at Wallops Station with free-fall instrumented payloads or models dropped from aircraft, in addition to ground-launched research vehicles.

Up to seven rocket stages have been used to launch research payloads from Wallops Station. Missiles have flown higher than 3,500 mi. above the Atlantic Ocean and at speeds in excess of 20,000 mph. for the purpose of space flight research. Thus far, more than 4,500 models have been launched at Wallops, with over 200 research vehicles being launched each year. The largest of these research vehicles launched at Wallops Station is the Scout. Sounding rockets are continuously being launched at this station.

Facilities are available at Wallops Station to gather research data from such vehicles. Wallops Station is presently engaged in tracking and receiving various types of data from the Tiros weather satellite now in orbit and will continue to be the prime tracking and command station for the remainder of the Tiros program.

In addition to radar and telemetry data, most tests are supported at Wallops Station with photographic coverage and optical tracking facilities. If necessary, special assistance may be obtained from outside agencies to support the standard equipment available at this station. For most tests, the characteristics of the atmosphere are determined either just before or immediately after a specific launching by means of radiosonde sounding balloons, radar balloons, and rocket sondes. Wallops Station is a primary center for the launching of research models for the study of hypersonic and space flight problems. Preliminary investigations and studies for Project Mercury were conducted at this station.

Flight Research

Full-scale flight research, including such fields as aerodynamics, hot structures, operating problems and the mechanics of flight in the atmosphere is the task of the NASA Flight Research Center.

In addition to analytical programs, the Flight Research Center specializes in extensive flight studies using specially equipped operational and experimental aircraft. A major program at the current time is the X-15, designed to yield new data at extreme altitudes and speeds.

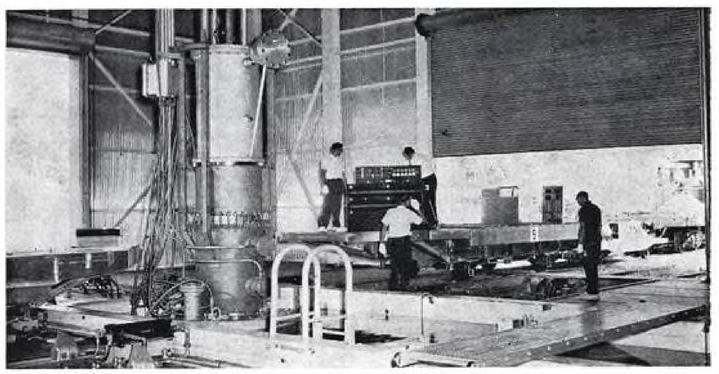
A major future program involves technical direction for research instrumentation and participation in the flight program of the joint USAF-NASA Dyna-Soar 1 (X-20).

While the major effort at the Flight Research Center is directly associated with the X-15 program, additional research includes: prediction of hypersonic aerodynamic characteristics through analog simulation techniques and correlation with flight, investigation of the handling qualities of advanced military and commercial aircraft, and radar and telemetry support for flight projects.

Launch Operations

Launch Operations Center serves as the NASA point of coordination for the preparation and submission of all requirements for launch support and negotiations with missile range officials to fulfill such requirements.

The recently established procurement office is charged with the responsibility to make and administer contracts for all supplies, materials and services, including construction, necessary for support of the Launch Operations Center and other NASA organizations.



Rift Material Tested at Lockheed-Georgia

Scientists at Lockheed-Georgia's Georgia Nuclear Laboratories check the first shipment of material for the Rift (reactor in-flight test) program. Shipment included coaxial cables, insulation for Rift propellant tank and several types of adhesives.

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DOD Begins Incentive Systems, Combines

By Larry Booda

Washington—Two actions taken in the past year by the Defense Dept. will greatly affect procurement policies of the entire department and the individual services. First was the establishment of the Defense Supply Agency (DSA). The second was the initiation of changes in the Armed Services Procurement Regulations (ASPR), effective Dec. 1, which strengthen the government's hand in administering incentive type contracts.

Creation of DSA tied together the general procurement of the military services. The broad categories covered are automotive supplies, traffic management, logistics management, electronics, construction, industrial supplies, petroleum, medical supplies, clothing and textiles, subsistence and general.

DSA procurement covers standard items which are normally sold to the public and do not need to be developed. Most of the contracts covered by DSA are of the fixed price type, with formal bids and award to the lowest bidder.

The ASPR changes affect the other end of the procurement spectrum. This involves research, development and procurement of weapon systems and related items which are unique. Many of these procurements cannot be contracted for by the open bid system. Many are covered by security regulations. In some instances, there may be only one contractor qualified to do a job. This results in the necessity for negotiating contracts.

The ASPR changes have been the subject of considerable discussion for more than a year. Basically, Defense Dept. has wanted to encourage economy in weapon system contracts by providing for incentive fees as opposed to cost-plus-fixed-fee and similar contracts where costs are not tightly controlled. It was suggested that the eventual aim was to allow fees to range from 15% profit to as much as minus 5% penalty fee for poor performance.

The result of these initial ASPR changes is that provisions are made for reduction of fees or lowering of prices under a great variety of conditions, but there is little mention of provisions for increasing prices or fees for good performance.

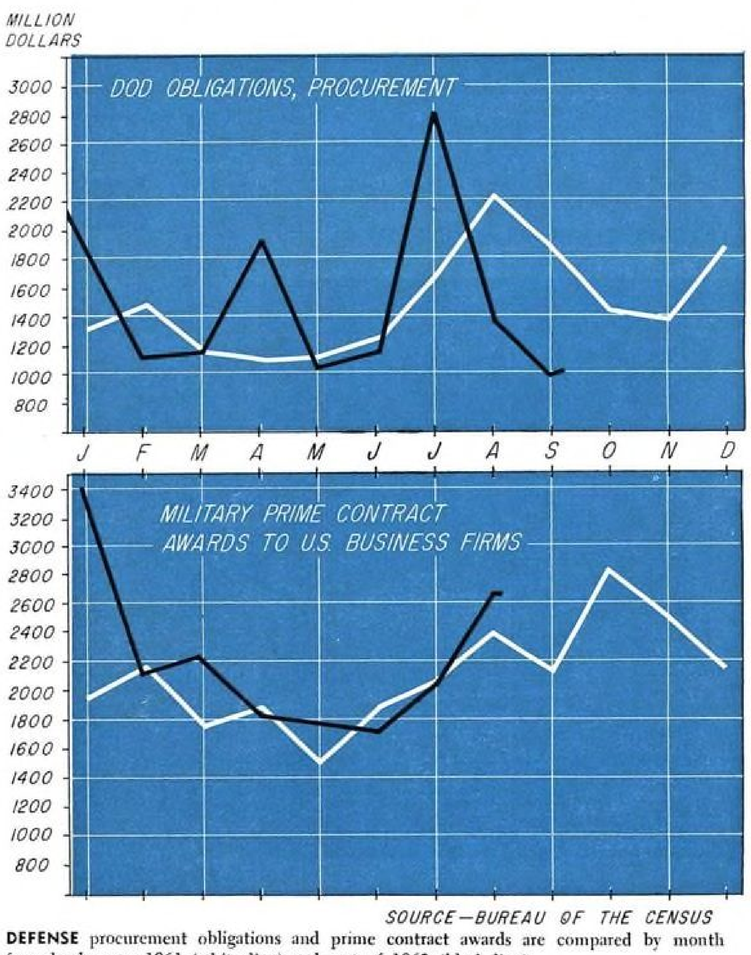
The ASPR changes will achieve to some extent Defense Secretary Robert S. McNamara's aim to achieve economy in the procurement of expensive weapon systems. As they now stand they can be described as one-sided. If a contractor should, by superior management, achieve substantial economies, the ASPRs provide for adjustments.

But this is only the first severe review he must survive. The Renegotiation Act permits the Renegotiation Board to enter the picture at some later date to determine whether excessive profits were made. If such a determination is made, a refund to the government will be ordered.

Defense Dept. officials explain that the new ASPRs are aimed at establishing such a degree of control within the Defense Dept. that the Renegotiation Board will find no fault in the profits made by contractors.

The revisions are mandatory for procurement actions taken after Nov. 30, 1962. Exceptions are in cases where there has been formal advertising and the bids have been opened, but award of a contract is not possible before Dec. 1. However, contract officers in such instances are directed to try to include the new clauses by mutual agreement.

Circumstances under which a contract can be negotiated, rather than opened to bidding, are described in the new ASPR Section 3-214. In general, contracts can be negotiated when a service secretary decides that procurement of technical or special property requires a substantial initial investment or an extended period of preparation for manufacture, and when



DEFENSE procurement obligations and prime contract awards are compared by month for calendar year 1961 (white line) and part of 1962 (black line).

Some Buying

he believes that an award through bidding would increase the cost to the government by duplicating the investment.

Examples of the types of material coming under this procedure are aircraft, tanks, radar, guided missiles, rockets, major components of these items, and any supplies of a technical or specialized nature. Such procurement usually involves high starting costs which may have already been paid for by the government, preliminary engineering and development work already completed or under way, special tooling already acquired, considerable time and effort expended in prototype development, or important design changes which will continue to be developed by the supplier.

When some or all of these conditions prevail, they form the basis for placing a production contract with the supplier who developed the equipment. This assures the government the benefit of techniques, tooling and equipment already acquired by the supplier, either at his own or government expense.

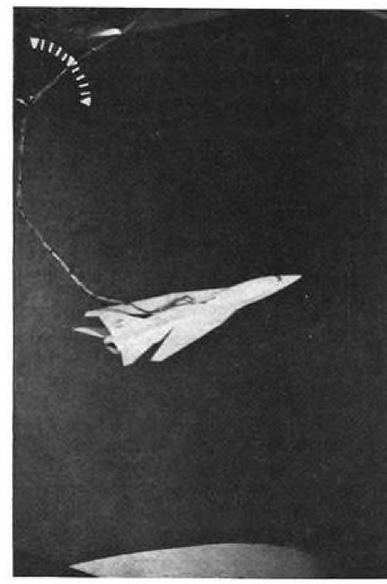
A cautionary note is added in the statement that this procedure should not be used to avoid duplication of private investment unless this duplication would be likely to result in additional cost to the government.

In deciding that a contract should be negotiated, the service secretary must make sure that the supplies come under the categories described above and that changing suppliers would result in additional cost to the government or preparation time.

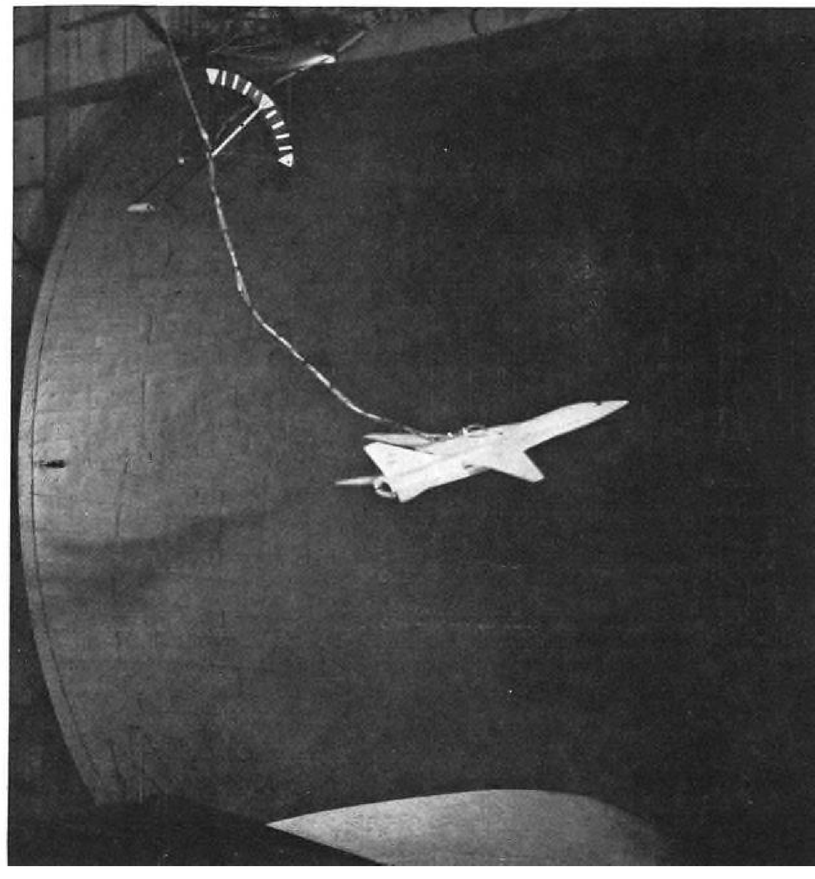
Pricing and cost analysis techniques are described in the new Section 3-807. It offers ways in which contractors' proposals can be evaluated and how the contracts can be negotiated.

Some form of price or cost analysis must be made with every negotiated contract. If the contracting officer sees that there will be adequate price competition, the analysis of costs does not have to be as thorough. If price competition does not exist, then he may require cost data to be submitted. Price is described as what the customer pays for goods or services. Cost is defined as what the supplier must spend to deliver the goods or services.

Price analysis is the process of examining and evaluating prospective price data without reference to the contractor's cost data. This can be done by comparison of price quotations submitted; comparison of previous quotations and contract prices with current quotations for the same or similar items, taking into account dissimilarities in specifications, quantities delivered and



CONSIDERABLE RESEARCH on the principle of variable swept wings, which will be used by the Dept. of Defense TFX bi-service fighter program, was carried out by the National Aeronautics and Space Administration. Among the configurations tested in the Full Scale Wind Tunnel at the Langley Research Center was this one of a supersonic aircraft employing a hinge outboard of the aircraft fuselage for varying the wing sweep. This system reduces mechanical complications and eliminates large stability changes that might otherwise occur.



ROYAL THAI ARMY soldiers are using U. S. equipment in assault training exercises. Two Bell HU-1B helicopters are operating with an FMC Corp. M-113 air transportable armored personnel carrier.

delivery time; the use of rough yardsticks such as dollars per pound, per horsepower or other units; comparison with published price lists issued on a competitive basis and published market prices; comparison of proposed prices with estimates of cost which have been independently developed by the purchasing activity.

Price analysis can be used to determine the reasonableness of awards without cost analysis whenever there is adequate price competition.

Cost Analysis

Cost analysis, as distinguished from price analysis, is the process of obtaining a breakdown of cost from prospective contractors or subcontractors. This process is broken down into verification of cost data, the evaluation of specific elements of cost and the projection of these data to determine the effect on prices of such factors as necessity, reasonableness of amounts estimated, allowances for contingencies, the basis for allocation of overhead costs and the appropriateness of overhead cost allocations to the contract.

Actual costs previously incurred by the contractor must be compared with his last prior cost estimate for the same or a similar item.

Evaluations must include current cost estimates from other sources and prior estimates or historical costs of other manufacturers making the same or similar items.

For the historical cost experience, the making of forecasts of future trends is considered important. Trends must be spotted when costs are either going up or down, especially for labor and materials.

A contractor must submit cost or pricing data and certify that it was accurate, complete and current prior to the award of any of these contracts:

- **Cost-reimbursement type,** incentive or price redeterminable contract regardless of dollar amount.
- **Any firm fixed price** or fixed price with escalation negotiated contract expected to exceed $100,000.
- **Any contract modification** expected to exceed $100,000 to any formally advertised or negotiated contract, whether or not cost or pricing data was required in connection with the initial pricing of the contract.
- **Any negotiated contract** not expected to exceed $100,000 in amount or any contract modification not expected to exceed $100,000 to any formally advertised or negotiated contract whether or not cost or pricing data was required in connection with the initial pricing of the contract, provided the contracting officer who has jurisdiction considers that the circumstances warrant such action.

The subject of what happens when defective cost or pricing data is submitted, or the refusal to submit any, is treated in the same section. Essentially it says that the government can adjust price when such a condition exists.

Purchasing Practices

Cost analysis in reference to subcontractors is covered in depth in Section 3-807.10. It explains that, since a large proportion of prime contract dollars go to buy services, raw materials and parts, it is necessary for the prime contractor to have efficient purchasing practices.

While the prime contractor is basically responsible, the contracting officer must be able to know whether the subcontractors are performing their work efficiently.

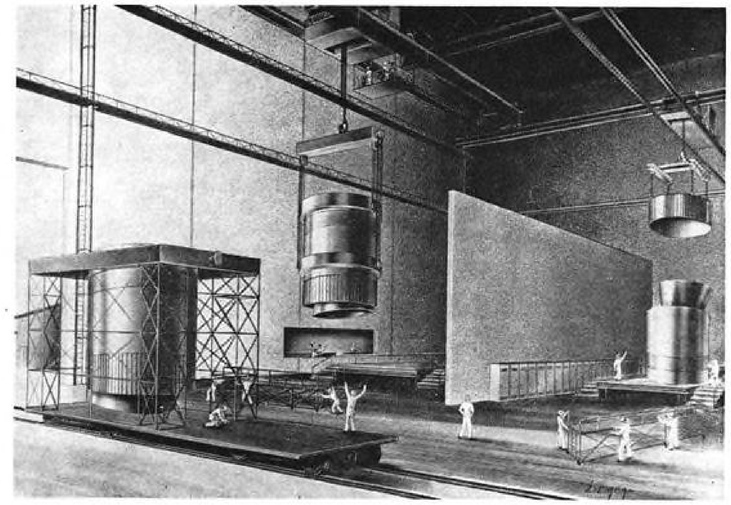
Proposals of prime contractors include their "make-or-buy" programs and proposed subcontracts. The contracting officer reviews this package to determine the purchasing practices of the prime contractor; the principal components to be subcontracted including the degree of competition in obtaining them, the cost and price analyses by the prime contractor on the proposed subcontracts, and the extent of subcontract supervision; the types of subcontracts, the estimated total extent of subcontracting, including procurement of procurement of parts and materials.

FULLY FUELED solid-propellant Minuteman intercontinental ballistic missile is loaded aboard a USAF Military Air Transport Service Douglas C-133 Cargomaster during a test of the loading system. Minuteman weighs more than 80,000 lb.

The ASPR says that it is the duty of a prime contractor to undertake price analyses of all significant subcontract transactions, and when competition does not exist or is minimal, to conduct cost analyses. Thus the burden passes to the prime contractor from the contracting officer. In instances where the consent of the contracting officer is required for award of a subcontract, price or cost analysis is mandatory.

Major subcontracts are subject to review for possible redetermination of price in order to avoid excessive profits. Generally speaking, prime contract prices should not be negotiated before the subcontract prices have been settled. In some instances where subcontract cost data is fairly firm, the contracting officer can proceed with negotiations.

Section 7-104.42 deals with a variety of audit procedures. Minor differences exist in the clauses inserted in contracts concerning audit procedures. In almost every instance, however, the government insists that records be kept for three years after termination of a contract and that it have the right to examine the books, records, documents and other supporting data which would permit adequate evaluation of the cost or pricing data submitted. This right extends to the contracting officer and the U. S. Comptroller General or their representatives.



ARTIST'S CONCEPTION of final assembly operations of the proposed Air Force Titan 3 booster also shows other elements of the on-site mating operation included in the over-all USAF 624A standardized space launching system. Aft closures and nozzles of the United Technology Corp. 120-in. solid propellant motors are to be mated (above) on flat cars in one building of a new Air Force site complex at Cape Canaveral, Fla. They then will be moved to an adjacent Solid Motor Assembly Building for joining with the four other segments that comprise each pair of strap-on solid boosters. Mating of the two solid propellant boosters to the Martin Titan 2 storable propellant core (below) is then carried out in the same building, also on a flat car. Special equipment required includes handling rings connected to lifting fixtures and high capacity overhead cranes, special "inverting" fixtures for turning the segments over for access, and specialized lifting transporters and towing vehicles.

Adjustment Clauses

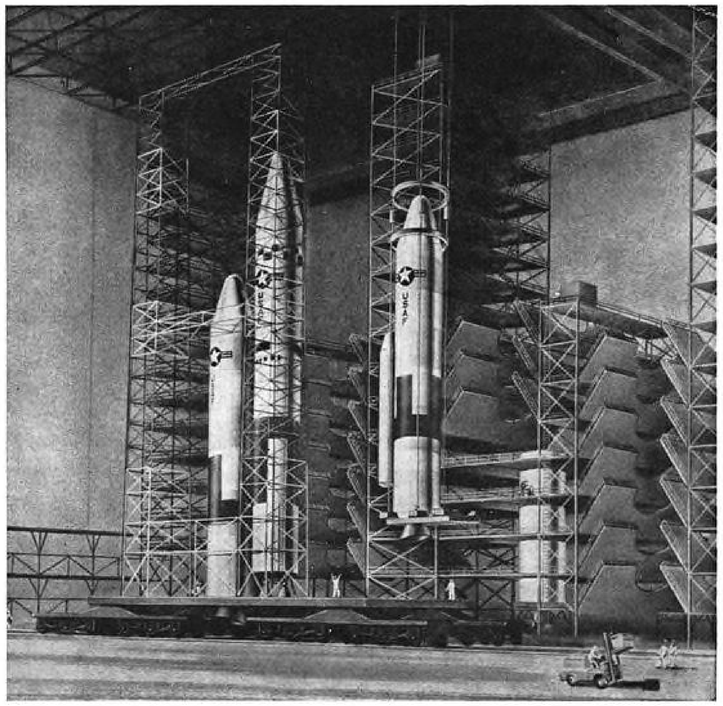
The same section also contains clauses to be inserted in contracts which dictate the terms for price reduction and adjustments in both prime contracts and in subcontracts made necessary for a variety of reasons.

Section 3-300 states the conditions which apply to the determinations and findings of the service secretary. In general, the special conditions applying to negotiated contracts over $100,000 must go to the secretarial level for final decisions. The rules governing procurement by negotiation are promulgated in Section 3-303.

Other ASPR changes emphasize that all contracts for supplies and services, with certain stated exceptions, shall be made by formal advertising. Free competition is the key item in the general policy statement of Section 2-201.1.

The Defense Supply Agency (DSA) began operations Jan. 1, 1962, as a single manager agency of the Defense Dept., joining three other major single manager units, the Defense Intelligence Agency (DIA), the Defense Communications Agency (DCA) and the Defense Atomic Support Agency (DASA).

In addition to the actual procurement functions of the centers reporting to



him, the DSA director has the responsibility for coordinating supply cataloguing, standardization of items procured, utilization and disposal of surplus supplies. He also conducts system analyses aimed at improving integrated supply and service systems for the Defense Dept.

During the current year, DSA will manage an inventory averaging $2.6 billion, make sales to the services of $3.1 billion and buy $2.9 billion of new supplies. It will manage 1.1 million items by the end of June, 1963, and provide service for four million of them. Annual transactions will total about 18 million. By the close of the fiscal year, it will employ about 25,000 persons.

The time-phased schedules that were set last January will result in DSA taking over management of all assigned commodities and services except electronics material by next July 1. Electronics management will follow during Fiscal 1964.

New Headquarters

DSA is planning to move its cataloguing activities to Battle Creek, Mich. It has completed studies of industrial production equipment and common chemical supplies and has conducted a pilot study on aeronautical repair parts.

The headquarters staff occupies a converted warehouse at the Army's Cameron Station supply center at Alexandria, Va.

Here is what DSA plans to do in the near future:

- **Install uniform and simplified** procedures in procurement by using automatic data processing techniques in performing bid evaluations and applying them to data flow. There will be increased emphasis on quality control, seeking more competition to reduce the cost of supplies.
- **Implement the DSA** distribution system while at the same time reducing the number of locations at which wholesale stocks are being maintained.
- **Increase the volume** of asset-sharing among the services in place of new procurement.
- **Speed the process** of standardization in order that the Federal Catalog growth can be controlled.
- **Screen all proposed** new items to control their entry into the system.

Army Lt. Gen. Andrew T. McNamara is the director of DSA and Rear Adm. Joseph M. Lyle, (SC) USN, is deputy director. The remainder of the headquarters staff is made up of civilians and officers from all of the military services.

Since DSA is still in its formative stage, the headquarters group that has had the most influence and will continue to have in the near future is the Assistant Directorate for Plans, Programs and Systems. This group generates the type of information Gen. McNamara needs to run the organization.

The principal aim of this group is to reduce the time that it takes for information to reach from the bottom to the top of the widespread supply organization. Historically, supply systems have tended to bog down under inadequate and slow information systems. The automated system is the answer.

The commodity studies now being made by the plans group are aimed at determining whether the nine current centers are the logical ones to have and whether the items they handle are in the right place.

The reason for having only a pilot study in aeronautical spares is that it is difficult to identify common items for the more highly complex weapon systems involving aircraft, because each one has been custom-developed. It must be determined whether a part of one system can do the same job in another system. It will take a long time to draw up a common list.

Electronic parts are in much the same category as aeronautical spares. The problem is not as complex, however, and a common catalog will be completed soon.

The establishment of a standard distribution system is another function that the plans group recommended. Implementation is only beginning because of the vast system of the individual services that it will replace. It has run into a variety of opposition from the services themselves, and politics has entered the picture as local activities are threatened with closing as centralization proceeds. The argument that economy will result is used to overcome such opposition.

Small Business Help

Small business is gaining an increased amount of attention from the Defense Dept. Defense expenditures account for more than half the total for the whole government. Through the Small Business Administration, the government is guiding an increased amount of defense business to small contractors, either through direct buying and contracting or through subcontracting (see p. 74).

Since the average small business does not have the capital or talent to engage in highly sophisticated research and development programs, it is recommended that the subcontracting avenues be investigated if this type of work is desired. Many small businesses with a single technical talent can participate through working with a prime contractor.

Some research and development work can be done directly for the Defense Dept. through the many laboratories operated by the military services. In each instance, the organization which lets such contracts has a specialist in small business who is the focal point for information.

Regardless of the approach taken, contractors are expected to be fully qualified from the standpoint of being organized in standard business form, competent to perform the type of contract let by having properly trained personnel, good accounting methods and an investment in the physical plant. There can be exceptions to this, however. Many small businesses offer only specialized research and management talent. They are growing more popular with defense procurement agencies to solve highly technical problems that appear as one-time occurrences in the performance of contracts in cases where the contractor does not have the specialized talent.

If a small contractor is working directly for a defense agency, he may need working capital to acquire the inventory of materials to start work and to keep going before the work is completed. In such a case it is in the interest of the government to provide the financial assistance. This help can come in a variety of ways. It can come through guaranteeing a loan, advance payments, accelerated progress payments or a combination of these.

Close Inspection

In working for the Defense Dept. agencies, the small contractor must be prepared to accept close inspection of his work. If the volume of business warrants it, inspectors are stationed full time in the contractor's plant. Otherwise, it is on a part-time basis as sufficient work is completed to be inspected. Inspection can also be done at the point of delivery or final destination.

Government specifications are the inspector's guide. He has the final authority to accept or reject completed work. Thus it behooves the small contractor to assure that his quality control in production is sufficiently strict to allow the work to pass inspection. A high volume of rejected material can result in lowered profits if the contracting officer refuses to allow rejected-work costs.

Most government contract specifications are built around a set of published standards on quality, size, performance, inspection, packaging and testing. Every prospective contractor should have in hand the Indices of Military Specifications, which can be obtained from the Superintendent of Documents. Many invitations for bids do not spell out the specifications, but refer to certain standard specifications.

General information on defense contracting can be obtained from the Central Military Procurement Information Office, Assistant Secretary of Defense for Installations and Logistics, Room 3E821, The Pentagon, Washington 25, D. C.

Two Commands Handle Buying for USAF

Washington—Applied research, development and production for the U.S. Air Force is the responsibility of the Air Force Systems Command (AFSC), which was formed in mid-1961 to coordinate the service's weapon system procurement.

After systems become operational, responsibility for their supply and maintenance shifts to the Logistics Command. Basic research is the responsibility of the Office of Aerospace Research.

Headquarters, AFSC, performs a policy and coordinating function. Actual contact with industry is maintained by the divisions and centers. Each of these activities has management responsibility for the projects under its cognizance.

Procurement practices of the Systems Command reflect the policies set by the Armed Forces Procurement Regulations and the Air Force Deputy Chief of Staff for Systems and Logistics. Control of procedures stems from these two sources.

These are the four general areas of procurement governing acquisition of Air Force weapon systems:

- **Basic research.** The Office of Aerospace Research contracts for all work to be done in this area. Private commercial laboratories, laboratories operated by educational institutions and foundations and government laboratories participate in basic research programs. U.S. Air Force Office of Aerospace Research is located at Temporary Building D, 4th & Independence Ave., S.W., Washington 25, D.C.
- **Systems procurement.** All Air Force weapon and electronics procurement is the responsibility of AFSC through its divisions. Manned systems, for the most part, come under the purview of the Aeronautical Systems Division at Wright-Patterson AFB, Dayton, Ohio. This includes aerodynamic aircraft, the X-20 (Dyna-Soar) boost-glider and the aerospace plane concept.

  The Electronics System Division at L. G. Hanscom Field, Bedford, Mass., is responsible for airborne and ground radar, computers, fire control systems and command and control systems. All ballistic missiles come under the Ballistic Missile Division at Norton AFB, Calif. The Space Systems Division is responsible for all Air Force space projects and cooperation with the National Aeronautics and Space Administration. Future USAF manned space systems, other than those mentioned above, are the responsibility of SSD.
- **Support procurement.** Supplies, services and continuing support for weapon systems come under the Logistics Command (AFLC). After a weapon system becomes operational, AFSC relinquishes its responsibility to the operational command, which in turn is supported by AFLC. Replenishment spare parts, inspection, maintenance, repair and modification must be accomplished by AFLC, whose headquarters is at Wright-Patterson AFB, Dayton, Ohio.
- **Base procurement.** Supplies and services, including construction, are contracted for by the individual installations of the various Air Force operational commands in the U.S. and overseas. In the U.S., these commands are the Strategic Air Command, Tactical Air Command, Training Command, Air Defense Command, Military Air Transport Service, the Headquarters Command and the Alaskan Air Command. Each installation has its own small business specialist.

AFSC and AFLC account for the

MATS BOEING C-135 jet transport unloads military supplies at Dum Dum Airport, Calcutta, during the emergency airlift to India (AW Nov. 19, p. 39). Support equipment was flown in by MATS Lockheed C-130s and Douglas C-124s from Far East and Europe.

bulk of the procurement funds spent by the Air Force. Of these two, AFSC spends more than $7 billion a year.

In acquiring weapon systems, AFSC must contract for applied research, which is "bread-board" work on parts of systems and, in some instances, whole systems. When the Air Force is given the green light to develop a system, these components are put together and made to work together. Development includes testing and evaluation. In some, systems production is allowed to proceed while development is going on. In others, production must wait to see if the system and its parts will work successfully.

Each AFSC division has a Contractor Relations and Sources Office available to every contractor, big and small. This also applies to the regional and district offices, which in themselves have no purchasing responsibilities but which are charged with locating contractors who could be sources for current or future projects.

It is the small business specialist located in each of these offices who is the best contact for the small businessman who desires to bid on Air Force work, whether it comes under AFSC or some other command. Each of these offices has or can obtain complete information on procurements amounting to $10,000 or over.

The requirements of AFSC vary widely. Obviously, major weapon systems have to be awarded to large manufacturers who have the capability of management for several tiers of subcontractors.

Even in this type of contract, the small businessman plays a part, although his relationships are with the prime contractor.

In many instances the small business can get prime contracts, especially in applied research. Many small firms offer specialties, such as expert help in the research or development of one component.

Any small business, individual, laboratory or educational institution seeking a point of contact for their questions or proposals may write to Air Force Systems Command, Attention: SCMKP-3, Andrews AFB, Washington 25, D. C. This office will not answer in detail, but will direct the inquirer to the proper point of contact.

Each of the divisions mentioned above, plus the centers under them, maintains a central office that lists a great variety of businesses and organizations which can be of use in the procurement of a system. Once an organization or business has been identified, it is placed on one or more of these lists.

If detailed information is wanted, a personal visit to one of the divisions or centers is suggested. The Small Business and Contractor Relations offices are listed below and on pp. 74-77. These offices were established specifically to provide the initial contact with potential contractors and those with whom the Air Force is already doing business. After initial contact with this type of office, other appointments with technical personnel will be arranged as the individual case requires.

Contract management represents a large part of the AFSC effort. Working under the rules of the Defense Dept.—the Armed Services Procurement Regulations (see p. 62)—each division employs a force of specialists who are charged with supervising performance of a contract so that the government can get the most for its money. Much of this supervision is done by permanent offices located at the plants of the large manufacturers. Each of these offices reports to one of three Contract Management Regions.

The regional offices have cognizance over the large plant supervision and, in addition, supervision of work done in smaller businesses where a full time force is not needed. These regional offices are also charged with the responsibility of making facility capability surveys. Whenever the Air Force considers award of a contract, each bidder's capabilities must be known. In many instances the surveys have already been done. With new bidders, the survey must be done before the award is made so that every bidder has an equal chance.

The regional offices are focal points for procurement clinics and conferences on business opportunities especially aimed at aiding small businesses.

Following is a list of Systems Command procurement specialists who are assigned at the command's Divisions and Centers:

AIR FORCE SYSTEMS COMMAND

Headquarters, Andrews Air Force Base, Maryland
Director of Procurement
Mail Symbol: SCMK
Contractor Relations and Procurement Sources Mr. LeRoy E. Olson
Mail Symbol: SCMKP Tel: 981-6331 (Washington, D. C.)

Electronic Systems Division
L. G. Hanscom Field, Massachusetts Tel: Crestview 4-6100 (Bedford)
DCS/Procurement and Production
Mail Symbol: ESK
Contractor Relations and Sources Mr. John Condon & Mr. Norman Mullen
Mail Symbol: ESKB Ext 2244
Interests are: Complete acquisition program for electronic systems.

Aeronautical Systems Division
Wright-Patterson Air Force Base, Ohio Tel: Clearwater 3-7111 (Dayton)
DCS/Procurement and Production
Mail Symbol: ASK
Contractor Relations and Sources Miss Betty Weisbrod
Mail Symbol: ASKS 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 system dynamics. Aircraft and missile systems components. Aerodynamics, including instruments, structure, design, dynamics control, and propulsion.
Deputy Commander for Aerospace Systems
Air Force Unit Post Office, Los Angeles 45, California Tel: Orchard 0-1444
Assistant for Material
Mail Symbol: DCMK
Interests are: Acquisition of missile and aerospace systems.

Aerospace Medical Division
Post Office Box 63, Lackland Air Force Base, Texas Tel: Walnut 3-3411 (San Antonio)
Chief of Procurement Office
Scientific areas of interest to the new organization will include life sciences, human factors, aerospace medicine, bio-sciences, bio-medicine, behavioral sciences, space medicine, bio-technology, human engineering, human resources, aviation medicine and space biology.

Air Force Flight Test Center
Edwards Air Force Base, California Tel: Clifford 8-2111 (Town of Edwards)
Director of Procurement
Mail Symbol: FTK
Contractor Relations and Sources Mr. James L. Thompson
Mail Symbol: FTKSA Ext 29431
Interests are: Testing of new aircraft systems, research aircraft, aircraft components, flight test instrumentation, rocket propulsion and parachutes.

Air Force Special Weapons Center
Kirtland Air Force Base, New Mexico Tel: Chapel 7-1711 (Albuquerque)
Director of Procurement
Mail Symbol: SWK
Contractor Relations and Sources Mr. M. H. Nickerson
Mail Symbol: SWKSB Ext 2153
Interests are: Research, development, test, and evaluation of Air Force components of equipment related to atomic weapons.

Air Force Missile Test Center
Patrick Air Force Base, Florida Tel: Ulysses 7-6151 (Cocoa Beach)
Director of Procurement
Mail Symbol: MTK
Contractor Relations and Sources Mr. Richard McCoy
Mail Symbol: MTKSA
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 Air Force Base, New York Tel: FF 6-3200 (Rome)
Director of Procurement
Mail Symbol: RAK
Contractor Relations and Sources Mr. John Vella
Mail Symbol: RAKS Ext 5220
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 Air Force Base, Florida Tel: Eglin 2231
Director of Procurement
Mail Symbol: PGK
Contractor Relations and Sources Mr. J. V. Leftwich
Mail Symbol: PGKS 672842-672843
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
Post Office Box 393, Holloman Air Force Base, New Mexico Tel: Granite 3-6511 (Alamogordo)
Director of Procurement
Mail Symbol: MDK
Contractor Relations and Sources Mr. D. P. Hathcock
Mail Symbol: MDKS Ext 6861
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 Tel: GI 5-2611 (Tullahoma)
Director of Procurement
Mail Symbol: AEK
Contractor Relations and Sources Mr. J. Moriarty
Mail Symbol: AEKS Ext 509
Interests are: Aerodynamics, research and development of power-plants related to operation and tests 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.

Navy Buying Follows Functional Lines

Washington—U. S. Navy has concentrated its weapon system procurement in one location to a greater degree than the other services. Navy's principal procurement office is the Bureau of Weapons here.

Bureau of Weapons does have field activities located mostly on the east and west coasts, but the control stems from the Bureau's complex of World War 1 buildings on Constitution Avenue.

In the Navy's bilinear organization, the Chief of the Bureau of Weapons, Rear Adm. K. S. Masterson, reports directly to the Secretary of the Navy, as do all of the other bureau chiefs. Technically, none of them is forced to deal with the Chief of Naval Operations except through the secretary. In practice, there is close coordination between the bureau chiefs and the deputy chiefs of naval operations in the establishment of requirements for weapon systems.

Aircraft, missiles and astronautics and their supporting electronics systems are the principal concern of the Bureau of Weapons. To some extent, the Bureau of Ships and the Bureau of Yards and Docks participate in weapon system procurement.

Weapon system support after operational status is achieved is under the Bureau of Supplies and Accounts, whose Air Force counterpart would be the Logistics Command.

Parts support in the field for the Navy is provided by the Bureau of Supplies and Accounts through a network of supply centers and departments located at principal air stations and fleet support activities.

It is recommended that businessmen who desire to participate in the procurement of Navy weapons contact one of the following, all located in the Bureau of Weapons, Room 0308, Main Navy Building, 19th & Constitution Ave. N.W., Navy Department, Washington 25, D.C. Head of the Small Business Office is J. F. Lenahan, whose telephone number is OXford 6-4792. Procurement Plans and Review is under S. Patigan, assisted by T. F. Connors. Their numbers are OXford 6-4452 and OXford 6-6022. Subcontracting Officer is George W. Wilson, OXford 6-6558.

This office is under the control of the assistant chief of the bureau for contracts. This part of the Bureau has the main interest in the specialized area of applying provisions of the Armed Services Procurement Regulations (see p. 62), although many other have active roles in the administration of contracts.

As in the case of every assistant chief's office, the contracts office coordinates work in the field. The field organization is divided into three general areas under Bureau of Naval Weapons Fleet Readiness Representatives Atlantic, Central and Pacific.

Each of the area offices controls procurement offices located in contractor plants and cities where there are a number of contractors in a specific district. The plant and district offices are under Bureau of Naval Weapons Representatives.

It is the duty of each representative to manage a contract from all aspects—fiscal, performance and technical. For the various functions he is responsible to the various assistant chiefs of the bureau. Thus for price and cost analyses, contract adjustments, negotiations and contract awards, his contact is the assistant chief for contracts.

Future programs are the special province of the assistant chief for research, development, test and evaluation (RDTE). The research and engineering division of this office is concerned with research, materials, engineering and nuclear applications for propulsion, explosives, vehicles and electronics from the standpoint of proving concepts and providing information leading to component development.

The aircraft division is the largest one reporting to the RDTE assistant chief. It is composed of design desks covering fighter, attack, rotary wing, and patrol and support aircraft. Power plant, airborne equipment, avionics and airframe design branches complete the division.

Reporting to the same assistant chief is the missile division, which covers all missiles except the Polaris submarine-launched intermediate range ballistic missile, which is under a special project office. Two offices cover the air-launched and ship-launched missile programs. Missile propulsion and missile ordnance (warheads) are separate branches.

Anti-submarine warfare and ship installations are the two other divisions under RDTE.

When RDTE projects become programs for eventual production, they come under purview of the assistant chief for program management. Directors who report to this assistant chief cover ship programs, strike warfare programs, undersea warfare programs, anti-air programs, support systems programs and logistic programs.

Each of the program officers or managers under these directors has greater influence on the bureau representatives in the field than any other working level person under other assistant chiefs in the control of production programs. This is the closest analogy to the Air Force System Program director.

There is a strong possibility that Navy procurement machinery may undergo a major reorganization in 1963. Studies have been under way since early this year. There are indications that the old bilinear system will be abolished and an organization resembling those of the Air Force and Army will emerge, where all applied research, development, production and logistic support would be placed under one or two commands. In some ways the Navy's present organization fragments these efforts, in a manner similar to the Army's old technical services.

Following is a list of Navy offices and personnel dealing with procurement:

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.

Bureau of Naval Weapons Representatives' Offices

Atlantic Area

Bureau of Naval Weapons Fleet Readiness Representative, Atlantic, USN Air Station, Norfolk 11, Va.
RAdm L. S. Chambers
Ph: 622-1351, Ext. 228

Westinghouse Electric Corp., P. O. Box 746, Baltimore, Md.
Capt. R. E. Rader
Ph: SOuthfield 1-1000, Ext. 3048

Grumman Aircraft Engineering Corp., Bethpage, L. I., N. Y.
Capt. R. L. Gates
Ph: LR 5-0574

Cornell Aeronautical Lab., P. O. Box 235, Buffalo 21, N. Y.
Cdr. J. W. Ladosz
Ph: NF 2,7500, Ext. 315

Pratt & Whitney Aircraft, Division United Aircraft Corp., East Hartford 8, Conn.
Capt. R. C. Thorburn
Ph: Hartford-Jackson 8-4811, Ext. 8641

Pratt & Whitney Aircraft, Florida Research & Development Center, West Palm Beach.
Cdr. H. J. Barnes
Ph: Victor 4-7311, Ext. 494, 495

Vertol Div., Boeing Co., Morton, Pa.
Cdr. B. E. McMullen
Ph: KIngswood 3-4000, Ext. 687

Applied Physics Lab., John Hopkins Univ., 8621 Georgia Ave., Silver Spring, Md.
Capt. J. W. Maddex
Ph: 589-7700

Allegany Ballistics Lab., Cumberland, Md. (Ridgeley, W. Va.)
LCdr. J. W. Kehoe
Ph: REdwood 8-900, Ext. 333

Hayes International Corp., Dothan, Ala.
LCdr. J. R. Stevenson

Ordnance Aerophysics Lab., Daingerfield, Tex.
Mr. Thomas K. Ewan
Ph: Lone Star 2211, Ext. 476

The Bendix Corp., Eclipse-Pioneer Div., Teterboro, N. J.
Cdr. E. M. Bray
Ph: ATlas 8-2000, Ext. 2153-2104

Reaction Motors Div., Thiokol, Denville, N. J.
Cdr. E. P. Stafford
Ph: OAkwood 7-7000

Bureau of Naval Weapons Representative, 40 Second Ave., Waltham 54, Mass.
Capt. L. S. Robinson
Ph: TWinbrook 9-8000, Ext. 496, 497

Bureau of Naval Weapons Branch Rep., Bristol, Tenn.
Cdr. W. Y. Morton
Ph: SOuth 4-1122, Ext. 241

Hamilton Standard Division, United Aircraft Corp., Windsor Locks, Conn.
Cdr. M. R. Gromada
Ph: NAtional 3-1621, Ext. 301

Kaman Aircraft Corp., Bloomfield, Conn.
LCdr. R. B. Dawson
Ph: Hartford-Chapel 2-4481, Ext. 275

Bureau of Naval Weapons Representative, c/o Sikorsky Aircraft Division, United Aircraft Corp., Stratford, Conn.
Capt. M. W. Alley
Ph: DRexel 8-6361, Ext. 1444

Central Area

BuWeps Fleet Readiness Representative, Central Wright-Paterson Air Force Base, Dayton, Ohio.
RAdm J. E. Dodson
Ph: CLearwater 3-7111, Ext. 32314

Bureau of Naval Weapons Representative, Goodyear Aircraft Corp., 1210 Massilon Rd., Akron 5, Ohio
Cdr. C. G. Williams
Ph: STadium 4-7127

North American Aviation, Inc., 4300 E. Fifth Ave., Columbus, Ohio
Capt. E. B. Holley
Ph: BEImont 1-1851, Ext. 283

Naval Weapons Industrial Reserve Plant, P. O. Box 5907, Dallas, Tex.
Capt. A. C. Holt, Jr.
Ph: ANdrews 2-3211, Ext. 3008, 677

Bell Helicopter Co., P. O. Box 482, Fort Worth.
Cdr. E. R. Wagner
Ph: ATlas 4-1491

Northern Ordnance, Inc., Minneapolis 21, Minn.
Cdr. J. O. Lyon
Ph: SUnset 8-8601

Bureau of Naval Weapons Representative, 400 South Belger Street, Mishawaka, Ind.
Capt. P. M. Donahue
Ph: BLackburn 5-2111, Ext. 469

McDonnell Aircraft Corp., P. O. Box 516, St. Louis 66, Mo.
Capt. R. E. Sorensen
Ph: PErshing 1-2121, Ext. 2731, 2732

Pacific Area

Bureau of Naval Weapons Fleet Readiness Representative, Pacific, U. S. Naval Air Station, North Island, San Diego 35, Calif.
RAdm. R. M. Reynolds
Ph: HEmpstead 5-6611, Ext. 792

Aerojet-General Corp., 1100 W. Hollyvale Ave., Azusa, Calif.
Cdr. J. N. Alley
Ph: CUmberland 3-6111, Ext. 5280

Factory A-1, Lockheed Aircraft Corp., Burbank.
Capt. S. H. Dodge
Ph: TRiangle 7-2711, Ext. 2585

Bendix Pacific Div., Bendix Corp., 11600 Sherman Way, North Hollywood, Calif.
LCdr. J. P. Onorato
Ph: TRiangle 7-2881

Lockheed Aircraft Service, Inc., Honolulu International Airport, Honolulu, Hawaii
LCdr. E. F. Aeschliman
Ph: Navy 4711, Ext. 42170

Douglas Aircraft Co., A/C Div., 3855 Lakewood Blvd., Long Beach, Calif.
Capt. R. M. Tunnell
Ph: Harrison 9-2441, X-3493

North American Aviation, Inc., Los Angeles 45.
Cdr. W. R. Wilson
Ph: EAstgate 2-3234 or ORegon 8-8956

Bureau of Naval Weapons Resident Rep., Goodyear Aircraft Corp., Litchfield Park, Ariz.
Cdr. H. J. Baird
Ph: WEstport 5-9331, Ext. 251, 219

Hiller Aircraft Corp., 1350 Willow Rd., Palo Alto.
Cdr. G .A. Robinson
Ph: DAvenport 5-3241, Ext. 410

Bureau of Naval Weapons Representative, 1675 W. 5th Street, Pomona, Calif.
Capt. E. J. Pawka
Ph: NAtional 9-5111

Convair (Div. of General Dynamics Corp.), San Diego 12, Calif.
Capt. G. W. Okerson
Ph: CYpress 6-6611, Ext. 2022

Lockheed Aircraft Corp., Missile Systems Div., P. O. Box 504, Sunnyvale, Calif.
Capt. W. A. Hasler, Jr.
Ph: REgent 9-4321

Hercules Powder Company, Bacchus Works, Magna, Utah
Cdr. J. E. Dodgen; Ph: BYron 7-5911

Aerojet-General Corp., P. O. Box 1947, Sacramento, Calif.
Cdr. J. W. Reese, Jr.; Ph: Yukon 5-5111

U. S. Navy Purchasing Office, Box 45, Navy #100, Fleet Post Office, New York, N. Y.
Cdr. R. G. Lindsey, USN
Ph: Place call to London, England
Ask Operator for DEnham 3013

Army Revises

Washington—Most radical reorganization of procurement machinery of all the armed services was effected by the Army this year. The Army Materiel Command (AMC) combines the applied research, development, production and logistics functions which formerly were fragmented among technical services, some of which had been in existence since 1776.

AMC is still in its shakedown period. Lt. Gen. Frank S. Besson, Jr., and his staff are still tying together the widespread activities which formerly belonged to the technical services. The task of eliminating duplication in the procurement organization will last several years. Local economic and political factors will be the major obstacles to overcome.

The scope of AMC responsibilities goes one step further than that of the Air Force with its Systems Command and Logistics Command, which came into being early in the Kennedy Administration. AMC combines the functions of both of these.

AMC was formed last May 8 and became operational Aug. 1. At that time, it took over the direction of materiel activities of six of the seven technical services—the Ordnance Corps, Quartermaster Corps, Signal Corps, Engineer Corps, Transportation Corps and Chemical Corps. The specific areas of responsibilities cover research and development, inventory management, maintenance and disposal.

AMC will spend about $7.5 billion per year and control an inventory worth $23.5 billion. It directly employs 20,000 military and 166,000 civilian personnel in activities stretching from coast to coast and overseas.

Headquarters for AMC is located in building T-7 on the grounds of Washington National Airport here. It operates through seven major subordinate commands which serve as a mid-management level. These commands in turn control a great number of centers, depots, laboratories, arsenals, maintenance and overhaul shops, proving grounds, test ranges, procurement offices and transportation terminals.

Army has decided to make maximum use of the "vertical management" technique in many of its projects. The vertical management concept is similar to the "red line" management technique used by the Air Force in its 13 designated systems. Vertical management makes use of a complete team of specialties for any given project. Horizontal management, on the other hand, makes specialties pools available to a number of projects. AMC has designated 31 projects which will come under this form of management.

Procurement, Forms Materiel Command

These are the projects of special interest in the aerospace industry:

• **Special warfare.** Procurement of all of the weapons used in limited actions such as in Southeast Asia are coordinated under this project manager.

• **Light observation helicopter.** The LOH competition, which involves the development of prototype aircraft by Bell Helicopter Co., Hiller Aircraft Co. and Hughes Tool Co., is aimed at replacing the Army's fixed-wing L-19 aircraft and H-15 and H-23 helicopters. The winner is expected to produce more than 3,000 aircraft by 1970.

• **Sheridan-Shillelagh.** This refers to an armored reconnaissance airborne assault vehicle equipped with armament suitable for both the antitank and infantry support roles. It is being developed by Aeronutronic Division of Ford Motor Co.

• **Aircraft weaponization.** This is aimed at providing a varied selection of weapons to support ground and air tactical missions. Some present weapons will be modified and improved and new ones will be developed. The principal types of weapons are machine guns, small caliber explosive shells, rockets and anti-tank guided missiles.

• **Mohawk observation aircraft.** The OV-1 (formerly AO-1) is being built by the Grumman Aircraft Engineering Corp. It is capable of day and night photography in one configuration and electronic surveillance and target location with side-looking radar in another.

• **Caribou aircraft.** This short-takeoff-and landing twin-engine assault transport is now in production in quantity by de Havilland of Canada.

• **Iroquois helicopter.** The HU-1 is a single-rotor turbine-powered helicopter being built in quantity by Bell.

• **Chinook helicopter.** The CH-47A (formerly HC-1B) is a twin-engine, tandem-rotor medium transport being produced by the Vertol Division of the Boeing Co.

• **Satcom (formerly Advent).** The Army Satellite Communications Agency has responsibility for development of surface terminals for the operational satellite communications system being developed by the Defense Dept.

• **Nike Zeus.** This anti-missile missile system is being developed and tested. No production go-ahead has been given, however.

• **Lance (formerly Missile B).** This tactical missile for battlefield use is in a program definition phase prior to selection of a prime contractor.

• **Pershing.** This replacement for the Redstone is a two-stage, solid-propellant tactical missile capable of being fired from its own mobile erector-launcher. It is being produced in quantity by the Martin Co.'s Orlando Division. Range capability is up to 300 mi.

• **Sergeant.** Range capability of this replacement for the Corporal is up to 75 mi. It is also powered by solid propellants. It is produced by Sperry Rand Corp.

• **Mauler.** As an air defense guided missile, Mauler will be able to shoot on-the-move from its mobile launcher at supersonic aircraft and short-range missiles and rockets deployed against front line troops. It is still in the applied research stage.

• **Hawk.** This air defense missile is in production and in use in the U. S. Army and is being manufactured in Europe for five NATO members. Raytheon is prime contractor.

• **Nike Hercules.** This air defense missile, powered by two solid propellant stages, is in operational use. It is designed to knock down high flying aircraft. It has the highest altitude capability in the U.S. inventory. Western Electric is the prime contractor.

• **CCIS-70, Command Control** Information System. Aim of this system is to miniaturize computers so that battlefield commanders will have information handling systems readily available. It is still in the applied research stage.

As one of the major subordinate commands of AMC, the Army Mobility Command has cognizance over most of the aircraft procurement functions.

Complete list of elements of the new Army Command and areas covered follows:

ARMY MATERIEL COMMAND:

Mobility Command, Centerline, Mich.
Procurement responsibility includes the following materiel: aeronautical, aerial delivery, surface transportation, power generation, construction, surface, barrier and bridging equipment, general purpose vehicles, general support equipment and supplies. The principal sub-commands are: Army Tank-Automotive Center, Detroit, Mich.; Detroit Arsenal, Centerline, Mich.; Engineer Research and Development Laboratory, Ft. Belvoir, Va.; Transportation Materiel Command, St. Louis, Mo.; Engineer Procurement Office Chicago, Ill.; Quartermaster Procurement Agency, Columbus, Ohio; Transportation Research Command, Ft. Eustis, Va.

Missile Command, Huntsville, Ala.
Procurement responsibility includes free rockets, guided missiles and associated equipment. Subcommands are Redstone Arsenal, Ala., and Watertown Arsenal, Mass.

Weapons Command, Rock Island, Ill.
Procurement responsibility includes weapons and combat vehicles. Sub-commands are Rock Island Arsenal, Ill.; Springfield Armory, Mass., and Watervliet Arsenal, N. Y.

Munitions Command, Dover, N. J.
Procurement responsibility for nuclear and nonnuclear ammunition, rocket and missile warhead sections, chemical, biological and radiological materiel, propellants, explosives and pyrotechnics, and propellant actuated devices. Sub-commands are: Ammunition Procurement and Supply Agency, Joliet, Ill.; Chemical-Biological-Radiological Agency, Edgewood, Md.; Chemical Research and Development Laboratory, Edgewood, Md.; Nuclear Defense Laboratory, Edgewood, Md.; Edgewood Arsenal, Edgewood, Md.; Pine Bluff Arsenal, Ark.; Rocky Mountain Arsenal, Colo.; Fort Detrick, Md., operating six chemical plants; Frankford Arsenal, Pa.; Picatinny Arsenal, Dover, N. J.; Chemical Procurement Offices in New York, N. Y. and Oakland, Calif.

Electronics Command, Ft. Monmouth, N. J.
Procurement responsibility for communications, electronic warfare, combat surveillance, automatic data processing, radar and meteorological materiel. Sub-commands are: Electronics Research and Development Agency, Ft. Monmouth, N. J.; Electronics Materiel Support Agency, Ft. Monmouth, N. J.; Electronics Research and Development Activity, Ft. Huachuca, Ariz.; Electronics Materiel Agency, Philadelphia, Pa.; Air Defense Engineering Agency, Ft. Meade, Md.; Avionics Field Office, St. Louis, Mo.; Electronics Inspector General's Office No. 1, Upper Darby, Pa.; Electronics Inspector General's Office No. 2, Chicago, Ill.; U. S. Army Satellite Communications Agency, Ft. Monmouth, N. J.

Director of Research and Development; Headquarters, U. S. Army; Washington 25, D. C.
Laboratories operating under the director are: Ballistics Research Laboratory, Aberdeen, Md.; Research and Engineering Command, Natick, Mass.; Human Engineering Laboratory, Aberdeen, Md.; Materiel Research Laboratory, Watertown, Mass.; Cold Regions Research and Engineering Laboratory, Hanover, N. H.; Diamond Ordnance Fuze Laboratory, Washington, D. C.; Coating and Chemical Laboratory, Aberdeen, Md.

Director of Procurement and Production; U. S. Army Headquarters; Washington 25, D. C.
Small Business and Labor Surplus Office: H. M. Evans, Chief. Room 1602, Building T-7, Washington 25, D. C. U. S. Army Procurement Districts are located in Birmingham, Ala.; Boston, Mass.; Cleveland, Ohio; Los Angeles and San Francisco, Calif.; Philadelphia, Pa.; St. Louis, Mo.; Cincinnati, Ohio; Detroit, Mich., and New York, N. Y.

MOCKUP OF HUGHES OH-6A light observation helicopter shows 4-place seating capability.

Avionics Price, Quality Demands Growing

By Philip J. Klass

Several important trends will increase the emphasis on quality and price—particularly the former—in the market served by several thousand avionic equipment, subsystem and component suppliers.

Foremost, perhaps, is the Defense Dept.'s new emphasis on placing major procurements on an incentive-type contract in which the prime contractor's profit margin depends upon his costs, meeting his schedules and upon the performance of the end product.

Of these several factors which enter into the final appraisal, the most important consideration in most incentive contracts will be the end product performance and reliability. This has important implications both for major system producers and the hundreds of smaller component and subsystem suppliers who operate in the avionics field.

Small components such as resistors and capacitors, once produced by low-cost, mass-production techniques—which satisfied the needs of the electronics industry of several decades ago when its major customer was the home entertainment market—must now be fabricated, handled and tested as if each had a value thousands of times greater than its actual cost.

In fact, each does have a value which far exceeds its actual cost, particularly if it is destined for use in a vital weapon such as a Minuteman ICBM, a Midas early warning satellite, or a military communications system. The failure of a single resistor selling for less than $5 may incapacitate a satellite which cost $10 million or more to build and launch.

Where formerly resistors and capacitors used to spill off mechanized production lines by the thousands, were dumped into cartons and shipped to a customer, a radical change is taking place in companies that supply components for major defense and space programs.

Growing numbers of companies are producing high reliability components in special air-conditioned ultra-clean rooms, a type of facility seldom found outside the gyro manufacturing field a few short years ago.

Manufacturing processes must be carefully controlled to assure that prototype units which successfully passed rigorous qualification tests are truly representative of the units that subsequently are delivered to the customer.

Component suppliers who once had complete freedom to introduce product improvements or new processes at their own discretion increasingly will find that such changes can not be made without the written permission of their customers. And to obtain such permission will require an extensive new series of product re-testing to assure that the new process does not adversely affect performance or reliability.

For example, on the man-rated Titan 2 booster to be used for Gemini, the Martin Co. as prime contractor will require an officer of each of its suppliers to submit a statement certifying that no changes have been made between the time that prototype units were approved and the subsequent production hardware is delivered.

In selecting components for use in the Telstar communication satellite, Bell Telephone Laboratories not only tested prototypes to determine which types could be expected to offer the greatest reliability, but it also carried out extensive aging-screening tests on production units to select the best of these for actual use in the satellite.

Components that showed less than normal aging during screening tests were rejected as well as those that experienced greater than normal aging, even though the former might have given Telstar slightly better performance initially. But this less-than-normal aging might result from two intrinsic faults which temporarily compensate for one another but which in time would lead to failure.

Product uniformity is considered to be an important clue to product reliability. For component manufacturers, this will mean increased use of automation wherever possible to eliminate human factors. For those operations where human skills and/or judgment is required, manufacturers must improve the motivation of workers on the line so that each knows that a single slipshod or careless act may be responsible for leaving two astronauts stranded on the moon, or seriously weaken the nation in its contest with powerful enemies.

Motivation which prompts top management to put in long hours to get an important job out on time must be injected among workers, who need the same sense of responsibility.

Products of avionics companies can be expected to undergo an even greater change during the next several years.

In many instances these will be new products coming out of new technology. In other cases they may be new versions of old products, abandoned five years ago as the emphasis shifted to ICBMs and to space. There is growing evidence that the Administration intends to place increased emphasis on expanding limited war capabilities.

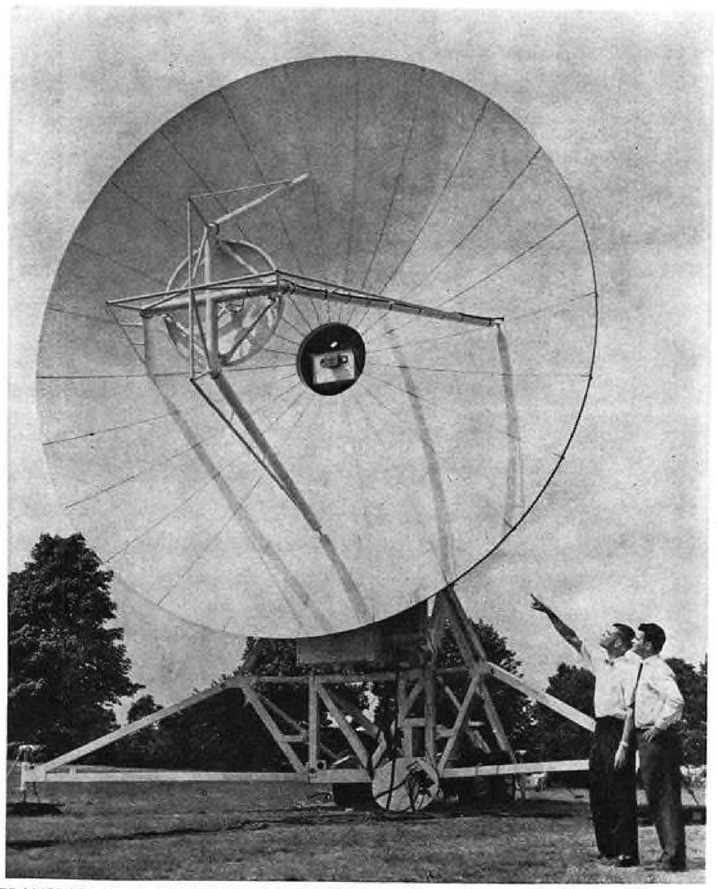
There will be increased emphasis on conventional (non-nuclear) weapons and weapon delivery systems—also on aerial reconnaissance systems, both optical and infrared for limited warfare.

Many of the technological advances of the last five years, developed to meet the needs of ICBM warfare and space, should find important uses in limited warfare weapon systems.

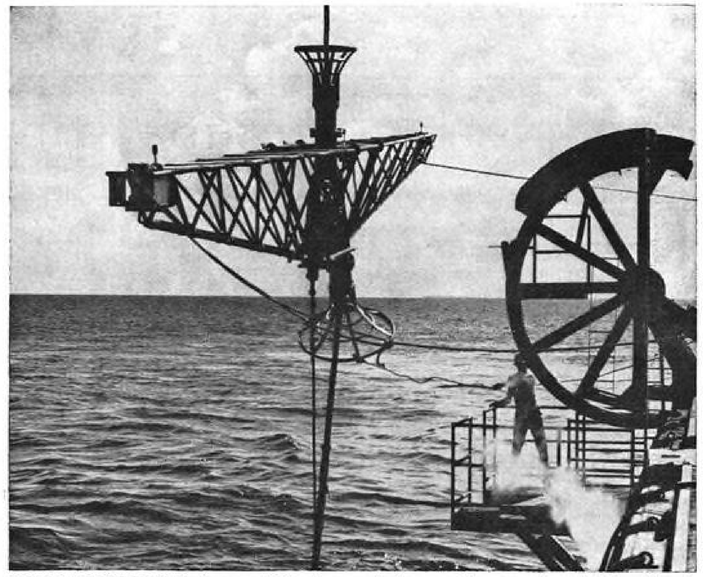
For example, the application of recent developments in microcircuitry should permit a major reduction in the size, weight and power consumption of avionics equipment, making it possible to build a great deal more capability into a small, lightweight military aircraft.

One of the most dramatic technological advances in the avionics field has been the optical maser (laser). In little more than two years, the laser has captured the imagination of scientists in hundreds of companies, building another important technological bridge between electronics and optics.

Devices and techniques which previously had a market limited to a handful of optical companies or research laboratories suddenly are in demand by dozens of avionics companies seeking to exploit the laser for weapon systems, radar or communication applications.



TRANSPORTABLE, RELATIVELY LOW-COST tracking antenna with 30-ft. solid surface Cassegrainian-type parabolic dish was designed by Antenna Systems, Inc., Hingham, Mass., under an ITT Federal Laboratories contract.



HYDROPHONE TEST is begun at Navy's new Autec acoustic range, installed in Atlantic Ocean by Lockheed Electronics Co., a division of Lockheed Aircraft Corp.

AVIONICS PROCUREMENT

Air Force Systems Command:

Headquarters: Andrews AFB, Md. Leroy E. Olson (SCMKP-3); Tel: 981-6331.
Electronic Systems Div., Hanscom Field, Mass. Normal Mullen (ESKB); Tel: CR-4-6100, Ext. 2244.
Rome Air Development Center, Griffis AFB, N. Y. Col. Howard Burhanna, Dir. of Procurement; John Vella (RAKS); Tel: FF-6-3200, Ext. 5220.
Aeronautical Systems Div., Wright-Patterson AFB, Ohio. Miss Betty Weisbrod (ASKS); Tel: CL-3-7111, Ext. 3-9250.
Air Proving Ground Center, Eglin AFB, Fla. J. V. Leftwich (PGKS); Tel: 67-28-42.
Air Force Missile Test Center, Patrick AFB, Fla. Richard McCoy (MTKSA); Tel: UL-7-6151 (Cocoa Beach).
Following AFSC centers also buy avionic instrumentation, computers, etc.
Air Force Flight Test Center, Edwards AFB, Calif. Mrs. Ruth Davis (FTKSA); Tel: CL-8-2111, Ext. 2-9431.
Air Force Missile Development Center, Holloman AFB, N. M. D. P. Hathcock (MDKS); Tel: GR-3-6511, Ext. 4-6861.
Air Force Special Weapons Center, Kirtland AFB, N. M. M. H. Nickerson (SWKSR); Tel: CH-7-1711 (Albuquerque), Ext. 2917.
Aronid Engineering Development Center, Arnold AF Station, Tenn. John Moriarty (AEKS); Tel: GL-5-2611 (Tullahoma), Ext. 509.
Aerospace Medical Division, Brooks AFB, Tex. Miss W. Bell (AMKS); Tel: LE-2-8811 (San Antonio), Ext. 2-3202.
Following are AFSC Science-Technology liaison offices:
Eastern Contract Management Region: (REL): Olmsted AFB, Penna. Lt. Col. Gilbert Foster; Tel: WH-4-5521, Ext. 7-4101.
Washington 25, D. C.: c/o Dept. of Navy, Room 2305, Munitions Bldg.: Lt. Col. A. P. Mercier; Tel: OX-6-3594.
Langley AFB, Va. Langley Research Center (NASA): Major C. D. Bailey; Tel: PA-2-7911, Ext. 2-1144.
Washington 25, D. C. Naval Research Laboratory: Lt. Col. K. A. MacAaron; Tel: JO-3-6600, Ext. 2266.
Aberdeen Proving Ground, Md., Bldg. 305: Capt. J. P. McDonough, Jr.; Tel: 272-4000, Ext. 4-1287.
Indian Head, Md. Naval Propellant Plant: Major William Cameron III; Tel: RI-3-2111, Ext. 448.
New York City, 111 East 16th St.: M. Pavane; Tel: FP-7-4200, Ext. 775.
Johnsville, Pa. Naval Air Research & Develop. Command: Lt. Col. C. A. Hazelwood; Tel: OS-5-7000, Ext. 431.
Cambridge, Mass. Mass. Instit. of Technology: 68 Albany St., Major C. R. Wheaton; Tel: UN-4-6900, Ext. 3509.
Central Contract Management Region (RCEL): Wright-Patterson AFB, Dayton, Ohio. Lt. Col. F. W. Campbell; Tel: CL-3-7111, Ext. 5-2195.
Chicago 66, Ill. O'Hare International Airport, P.O. Box 8758: Capt. H. M. Giesen; Tel: CY-6-4411, Ext. 397.
Cleveland 35, Ohio. Lewis Research Center (NASA), 21000 Brook Park Road: Lt. Col. D. J. Iddins; Tel: OR-1-1211.
Ottawa, Canada, 1327A Wellington St.: Capt. J. A. Street; Tel: PARK-8-1741, Ext. 320.
Randolph AFB, Texas, Air Training Command (ATTRL): Major J. F. Gardner; Tel: OL-8-3511, Ext. 2-5174.
Western Contract Management Region (RWE): Mira Loma AF Station, Mira Loma, Calif. Col. L. M. Taylor; Tel: OV-5-5211.
Los Angeles, Calif., 6331 Hollywood Blvd.: Lt. Col. A. A. Konkel; Tel: HO-7-5171.
China Lake, Calif., Naval Ordnance Test Station: Maj. L. E. Clark; Tel: 5-0111, Ext. 7-1403.
Palo Alto, Calif., 1069 East Meadow Circle: Maj. H. H. Teifeld.
Moffett Field, Calif., Ames Research Center (NASA): Lt. Col. G. S. Brownell; Tel: YO-7-3056.
Point Mugu, Calif., Naval Missile Center: Lt. Col. O. L. Koontz; Tel: HU-6-8331, Ext. 8012.
Seattle 24, Wash., c/o Boeing Co.: Lt. Col. R. L. Kendig; Tel: JU-5-5744.
Rome Air Materiel Area, Griffiss AFB, N. Y.: Col. Robert V. Kirkland, Dir. of Procurement; Tel: FF-6-3200.

Department of the Navy

Bureau of Naval Weapons, Washington 25, D. C.
Capt. K. L. Jeffery, director of Purchase Div.; Tel: OX 6-2905.
Mr. A. Jacobson, procurement information officer; Tel: OX 6-6605.
Naval Aviation Supply Office, 700 Robbins Ave., Philadelphia 11, Pa.; Tel: RA 8-1212.
Cmdr. W. A. Wilson, chief of buying branch, Ext. 406.
Mrs. R. Robinson, supervisor for contractor relations, Ext. 470.

Department of the Army

Army Electronics Command, Ft. Monmouth, N. J.; Tel: 532-1100.
Information officer: Peter Hoffman.
Army Missile Command, Huntsville, Ala.; Tel: 876-5485.
Information officer: David Harris.

Department of Defense

Defense Electronic Supply Center, 1507 Wilmington Pike, Dayton 20, Ohio; Tel: 252-6551: Col. K. N. Smith, USMC, Dir. of Procurement. Ext. 2-1115.
Capacitors, resistors, switches & potentiometers: Lt. Col. Smoot, USA: Ext. 2-8250.
Tubes, transistors and transformers: Maj. C. V. Evans, USAF: Ext. 2-5149.
Electrical supplies, cable: Lt. Col. C. D. Collins, USA: Ext. 2-2121.
Small business contractor relations: B. L. Castle: Ext. 2-6218.

Federal Aviation Agency

Procurement Division, Washington 25, D. C.
Radar & Traffic Control Branch: Raymond Mulari; Tel: WO-7-4541.
Weather & Communications Branch: H. N. Austin; Tel: WO-7-2793.
Aircraft & Navigation Aids Branch: John A. Donohue: Tel: WO-7-2750.

Small Business Share Grows in Contracts

By Katherine Johnsen

Washington—Small business is buttressed by government in its fight to hold position in this era of rapidly advancing technology and the big management required to direct it.

Defense Dept. has a vertical organization, extending from a broad-base field operation to a top-policy command in the Office of the Secretary of Defense, specifically dedicated to channeling defense dollars into small firms.

Small Business Administration, which exists for the sole purpose of counseling, assisting and protecting small business, is one of the fastest-growing agencies in Washington. Its staff has increased from about 2,300 employes to some 3,400 during the past two years—a growth of 48%. One of SBA's functions is to maintain close contact with Defense Dept. and other procurement agencies.

Overseeing the Defense Dept. and SBA are the Senate Select Committee on Small Business and the House Select Committee to Conduct a Study and Investigation of the Problems of Small Business. Both groups are unanimously authorized each session to continue their activities on behalf of small firms. Annual public hearings before the Senate committee focus on government aerospace procurement policies, programs and projects aimed at strengthening the position of small companies. Both committees are staffed to handle the individual problems of small firms on a case-by-case basis during the year.

What makes a business "small"—and thus eligible for special government treatment—depends on administrative judgment using criteria such as number of employes, annual sales volume, and type of activity. The dividing line between "medium" and "small" is fuzzy. The rule-of-thumb definition in government circles—which still has innumerable exceptions—is that a "small" business is one with fewer than 500 employes.

Two weeks after taking office, President Kennedy spurred his Administration to strengthen small business by showing personal interest. In a memo to Defense Secretary Robert S. McNamara, Kennedy wrote, on Feb. 6, 1961:

"I note that Congress has once again criticized the Department of Defense for not giving more contracts to small business. I think it would be useful for you to have someone look into exactly how this is handled and whether it is possible for the Defense Department to put more emphasis on small business . . ."

The outcome was Defense Dept.'s "Operation Booster," which set—and more than attained—a goal of a 10% increase in awards to small business during Fiscal 1962, compared with Fiscal 1960.

The percentage in number of awards increased from 16.1% in Fiscal 1960 and 15.9% in Fiscal 1961 to 17.7% in Fiscal 1962. This reversed a five-year downward trend.

The percentage increase in dollar volume was even greater. The $4.6 billion that went to small business in Fiscal 1962 compared with $3.4 billion in Fiscal 1960—a 35% increase.

Operation Booster was accomplished by assigning an improvement quota to every principal procurement organization within the department, against which their performance was measured monthly.

Defense Dept.'s goal is to increase its awards to small business by $200 to $300 million annually during Fiscal 1963 and Fiscal 1964.

Air Force, because of its requirement for big aerospace contracting, is substantially below the Defense Dept. averages in direct awards. USAF channelled $1 billion, or 9.6% of the total number of its contracts, to small firms during Fiscal 1962.

Defense Dept. is now concentrating on subcontracting as the most fertile field in which to increase small business participation in procurement.

Richard W. Webb, who heads Defense Dept.'s Directorate of Small Business, is visiting the headquarters of each of the 150 biggest defense contractors to review their small business programs, accompanied by representatives of the military service with small business cognizance over the company. Thirty have already been reviewed. Webb will visit the 120 remaining over the next 12 months.

Air Force has been assigned responsibility for the small business subcontracting programs of 140 of the largest contractors. Army and Navy each have been given responsibility for about 75 big firms.

The goal is to increase subcontracting by $300 million annually for the next three years. Defense Dept. estimates that small business subcontracts increased by about $200 million over the past year—from $3.5 billion in Fiscal 1961 to $3.7 billion in Fiscal 1962.

These are the approaches being used by Defense Dept. to make possible more small business participation in big procurements, as well as achieve more competition:

- **Break-out.** This involves dividing one big procurement into smaller separate procurements. For example, generally, after production requirements have been established by a weapons system contractor, parts of the system can be offered for separate procurements in which small business might compete.
- **Make-or-buy.** This involves continuous study and surveillance of prime contractors' programs to assure that a proper amount of work is made available for small business subcontracting rather than produced in-plant.
- **Alternate buy.** This involves shifting from the former practice of buying replenishment items—notably aeronautical spare parts—from a sole source, the original producer.

Success in increasing contract breakout and decreasing sole source procurement usually hinges on obtaining drawings and specifications from the prime contractor. Over the past year, Defense Dept. has been under criticism from several congressional committees for being lax in doing this.

Under a formal agreement between Defense Dept. and SBA that has been in effect for several months, SBA is given access to all subcontracting records for double check. Under the agreement major contractors are required to maintain records reflecting how many large and how many small firms were solicited for subcontracts; how many large and how many small firms bid; what firm received the award, and, if applicable, why small business did not receive the award.

In addition to Defense Dept.'s own program, SBA programs offer financing, technical, and management assistance to give small firms the capability to compete effectively for defense and other business.

SBA loans, granted to small firms that could not obtain private financing, mounted from $195 million during calendar 1960 to $370 million during 1961.

In addition, SBA is authorized to license and give financial assistance to small business investment companies which, in turn, make long-term loans and equity capital available to small firms. A total of 656 have been licensed.

SBA's budget to help small firms develop research, engineering, and production capability and improve management has increased from $4.4 million two years ago to $6 million this fiscal year.

The government's organization for giving guidance and assistance to small business is extensive. Defense Dept.'s Directorate of Small Business has equal status with the Directorate for Procurement Policy and the Directorate for Procurement Management under Deputy Assistant Secretary of Defense Graeme Bannerman. Bannerman serves under the Assistant Secretary of Defense for Installations and Logistics Thomas D. Morris.

Army, Navy, Air Force, and Defense Supply Agency each have small business offices at Pentagon headquarters.

In the field, the defense establishment has small business specialists stationed at 500 depots, commands, and other installations that engage in procurement throughout the U. S.

SBA is headed by John E. Horne, formerly on the staff of the Senate Small Business Committee. It has 14 regional offices in major cities.

Commerce Business Daily, published by Commerce Dept. for an annual subscription charge of $20, tells the small businessman where to look for business. It lists:

- **Products and services** which individual military procurement offices currently plan to buy;
- **Proposed procurements** by other government agencies;
- **Subcontract opportunities** offered by defense prime contractors;
- **Prime contract awards,** which furnish leads to possible subcontract opportunities.

All military procurement offices maintain bidders' mailing lists of firms capable of filling given types of procurements. Firms on the list are supplied invitations to bid or requests for proposals when there is a new procurement.

Following is a list of small business specialists in Air Force procurement offices. This list is followed by a list of Navy procurement office small business specialists.

AIR FORCE SMALL BUSINESS SPECIALISTS

Headquarters U.S. Air Force:

Mr. Kennard Weddell—AFSDC-B
Air Force Small Business Adviser & Assistant for Small Business
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Mr. Edward J. McMurray—AFSPM-SB
Assistant for Small Business
Directorate of Procurement Management
Deputy Chief of Staff, Systems & Logistics
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Mr. Seymour Milnovsky, Small Business Specialist, SRKF
Office of Aerospace Research
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Washington 25, D. C.
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Headquarters Air Force Systems Command

Mr. John C. Elden—SCMK-4
Executive for Small Business
Directorate of Procurement
Andrews Air Force Base
Washington 25, D. C.
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Electronic Systems Division
Mr. John Condon, Small Business Specialist, ESKB
Mr. Norman Mullen, Assistant Small Business Specialist, ESKB
Directorate of Procurement
L. G. Hanscom Field
Bedford, Mass.
TEL: CR 4-6100 X 2244 & 2794

Aeronautical Systems Division
Mr. George Rattenbury, Small Business Specialist, ASKS
Mr. Larry Grier, Assistant Small Business Specialist, ASKS
Mr. Paul Knost, Assistant Small Business Specialist, ASKS
Directorate of Procurement & Production
Wright- Patterson Air Force Base
Dayton, Ohio
TEL: CL 3-7111 X 23222 & 33270

Space Systems Division
Mr. Roy A. Watkins, Small Business Specialist, SSD
Directorate of Procurement
Air Force Unit Post Office
Los Angeles, Calif.
Tel: OR 0-1444 X1005

Ballistic Systems Division
Mr. L. McGarry, Small Business Specialist, BSD
Directorate of Procurement
Norton AFB, Calif.
Tel: TU 9-4411

San Antonio Research & Development Procurement Office (Division of ASD)
Miss W. Bell, Smal Business Specialist, ASRKL5
Procurement Office
Lackland Air Force Base
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Air Force Flight Test Center
Mr. J. L. Thompson, Small Business Specialist, FTKB
Directorate of Procurement
Edwards Air Force Base
Edwards, Calif.
TEL: CL 8-2111 X 29461

Air Force Special Weapons Center
Mr. M. H. Nickerson, Small Business Specialist, SWK5B
Directorate of Procurement
Kirtland Air Force Base
Albuquerque, N. Mex.
TEL: CH 7-1711 X 2153

Air Force Missile Test Center
Mr. Richard McCoy, Small Business Specialist, MTKSA
Directorate of Procurement
Patrick Air Force Base
Cocoa Beach, Fla.
TEL: UL 7-6151

Rome Air Development Center
Mr. John Vella, Small Business Specialist, RAKS
Directorate of Procurement
Griffiss Air Force Base
Rome, N. Y.
TEL: FF 6-3200 X 5220 & 74166

Air Proving Ground Center
Mr. J. V. Leftwich, Small Business Specialist, PGKZ
Directorate of Procurement
Eglin Air Force Base
Valparaiso, Fla.
TEL: EG 2231 X 29243

Air Force Missile Development Center
Mr. D. P. Hathcock, Small Business Specialist, MDKB
Directorate of Procurement
Holloman Air Force Base
Alamogordo, N. Mex.
TEL: GRanite 3-6511 X 46861

Arnold Engineering Development Center
Mr. Joseph F. Moriarty, Small Business Specialist, AEKS
Directorate of Procurement
Arnold Air Force Station
Tullahoma, Tenn.
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Washington, D. C. Regional Office
Mr. Wesley Grieve, Small Business Specialist, AFSCRO
Room 2305, Munitions Building
Washington 25, D. C.
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Contract Management Regions

Eastern Contract Management Region
Mr. Robert A. MacMillian, Small Business Specialist, REB
Olmsted Air Force Base
Middletown, Pa.
TEL: WH 4-5521 X 75188

Boston Air Force Contract Management
Mr. Edward J. Fitzgerald, Small Business Specialist, REHBB
Mr. John McManus, Assistant Small Business Specialist, REHBB
Boston Army Terminal
Boston, Massachusetts
TEL: LI 2-6000 X 887 & 886

Newark Air Force Contract Management District
Mr. Vincent J. Farrell, Small Business Specialist, REHNB
Mr. Joseph L. Lewis, Assistant Small Business Specialist, REHNB
218 Market Street
Newark, N. J.
TEL: MI 3-3434 X 125 & 147

New York Air Force Contract Management
Mr. Wilbur V. Gould, Jr., Small Business Specialist, REHYB
Mr. Harry Stegeland, R&D, Small Business Specialist, REHYB
111 East 16th Street
New York, N. Y.
TEL: SP 7-4200 X 690

Philadelphia Air Force Contract Management District
Mr. John A. Walter, Small Business Specialist, REHPB
1411 Walnut Street
Philadelphia, Pa.
TEL: LO 7-3886 X 257

Rochester Air Force Contract Management Office
Mr. Harry B. Huntington, Small Business Specialist, REHRB
20 Symington Place
Rochester, N. Y.
TEL: FA 8-7670 X 60

Atlanta Air Force Contract Management District
Mr. T. W. Turbiville, Jr., Small Business Specialist, REHAB
41 Exchange Place, S. W.
Atlanta, Ga.
TEL: JA 2-4121 X 580

Orlando Air Force Contract Management District
Mr. DeFarest A. Long, Small Business Specialist, REHOB
Orlando Air Force Base
Orlando, Fla.
TEL: GA 3-0561 X 2077 & 2036

Central Contract Management Region
Mr. Joseph H. Lammert, Small Business Specialist, RCB
Wright-Patterson Air Force Base
Dayton, Ohio
TEL: CL 3-7111 X 53231

Cleveland Air Force Contract Management District
Mr. R. W. Livingston, Small Business Specialist, RCHAS
113 St. Clair Avenue
Cleveland, Ohio
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Dayton Air Force Contract Management District
Mr. Paul E. Birkhold, Small Business Specialist, RCHBS
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Wright-Patterson Air Force Base
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Cincinnati Air Force Contract Management Office
Mr. Chester R. Methena, Small Business Specialist
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Cincinnati, Ohio
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Detroit Air Force Contract Management District
Mr. Hugh E. McGowan, Small Business Specialist, RCHDS
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Detroit, Mich.
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Grand Rapids Air Force Contract Management Office
Mr. John A. Barney, Small Business Specialist, RCHDGP
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Grand Rapids, Mich.
TEL: GL 9-8251 X 3

Indianapolis Air Force Contract Management District
Mr. Robert Ramey, Small Business Specialist
c/o Allison Plant #26
Indianapolis 7, Ind.
TEL: CH 4-1511 X 4249

South Bend Air Force Contract Management Office
Mr. Ernest J. Koehler, Small Business Specialist, RCHIGA
521 North Eclipse Place
South Bend, Ind.
TEL: CE 3-2101 X 5

Chicago Air Force Contract Management District
Mr. Victor J. Ripp, Small Business Specialist, RCHCD
Mr. Dean Stevenson, R&D Small Business Specialist, RCHCD
O'Hare Int'l. Airport P.O. Box 8758
Chicago, Ill.
TEL: CY 6-4411 X 390

Milwaukee Air Force Contract Management District
Mr. Russell H. Leitch, Small Business Specialist, RCHMD
770 North Plankinton Avenue
Milwaukee, Wisc.
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(Continued on page 76)

Minneapolis Air Force Contract Management Office
Mr. R. T. Schumacher, Small Business Specialist, RCHMSD
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Minneapolis, Minn.
TEL: 339-90112 X 372

Dallas Air Force Contract Management District
Mr. George R. Phillips, Small Business Specialist, RCHEB
500 South Ervay
Dallas, Tex.
TEL: RI 8-5611 X 2388

St. Louis Air Force Contract Management District
Mr. Kenneth E. Kichline, Small Business Specialist, RCHSD
9th Floor, 1114 Market Street
St. Louis, Mo.
TEL: MA 1-8100 X 2330

Wichita Air Force Contract Management Office
Mr. E. Keith Groskinsky, Small Business Specialist, RCHSSWP
816 West Second Street
Wichita, Kan.
TEL: AM 7-0211 X 336

Kansas Air Force Contract Management Office
Mr. F. Howard Whiteley, Small Business Specialist, RCHSSKP
601 Hardesty Street
Kansas City, Mo.
TEL: CH 1-7900 & 277 X 279

Western Contract Management Region
Mr. Edgar L. Harris, Small Business Specialist, RWB
Mira Loma Air Force Station
Mira Loma, Calif.
TEL: OV 5-5211 (Riverside, California) X 420

Los Angeles Air Force Contract Management District
Mr. George J. Byrnes, Small Business Specialist, RWHLD
Mr. Paul M. Goodwin, Assistant Small Business Specialist, RWHLD
Miss Florence Fellows, Assistant Small Business Specialist, RWHLD
Mr. William V. Stalew, R&D, Small Business Specialist, RWHLD
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San Diego Air Force Contract Management District
Mr. Robert Downing, Small Business Specialist, RWHDB
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San Francisco Air Force Contract Management District
Mr. Richard Quinn, Small Business Specialist, RWHS
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West Grand Avenue & Maritime
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Phoenix Air Force Contract Management District
Mr. J. W. Gaskins, Small Business Specialist, RWHHB
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Ogden Air Force Contract Management District
Mr. Wilford R. Thornock, Small Business Specialist, RWHOB
Hill Air Force Base
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Air Force Plant Representative Office
The Martin Company, Denver Division
Denver, Colorado

Denver Air Force Contract Management Office
Mr. Ralph Wilson, Small Business Specialist, RWRVZ
3800 North York Street
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Air Force Plant Representative Office
Boeing Air Plane Company
Seattle, Washington

Seattle Air Force Contract Management Office
Mr. Arthur Perry, Small Business Specialist, RWRSO-1
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TEL: MA 4-0360

Headquarters Air Force Logistics Command

Mr. Maurice L. Johnson, MCP-5
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Middletown Air Materiel Area
Mr. William Lines, Small Business Specialist, MAPE
Olmstead Air Force Base
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TEL: WH 4-5521 X 72233

Mobile Air Materiel Area
Mr. Louis L. McKean, Small Business Specialist, MOPE
Mr. Howard W. McNamee, Assistant Small Business Specialist, MOPE
Mr. William H. Freeman, Assistant Small Business Specialist, MOPE
Brookley Air Force Base
Mobile, Ala.
TEL: HE 8-6011 X 3227 & 6141

Oklahoma City Air Materiel Area
Mr. John B. Colwell, Small Business Specialist, OCPE
Tinker Air Force Base
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Ogden Air Materiel Area
Mr. F. K. Jarrard, Small Business Specialist, OOPE
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San Antonio Air Materiel Area
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Mr. William J. Dunkerley, Small Business Specialist, SBPE
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Warner Robins Air Materiel Area
Mr. Thomas B. Fowler, Small Business Specialist, WRPE
Mr. Richard H. Eaves, Assistant Small Business Specialist, WRPE
Robins Air Force Base
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2709th Air Force Vehicle Control Group
Mr. John P. Broderick, Small Business Specialist, MPPR
Memphis Air Force Vehicle Office
Memphis Army General Depot
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Headquarters Military Air Transport Service

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Headquarters Tactical Air Command

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Headquarters Air Defense Command

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Headquarters Air Training Command

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Headquarters Strategic Air Command

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Headquarters Alaskan Air Command

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Headquarters Command

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Yards & Docks Annex
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Military Sea Transportation Service
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Capt. H. F. Olsen, USMC
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California

Barstow:
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WO T. L. Whisler
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Camp Pendleton:
Marine Corps Base
Mr. E. H. Sherman
Tel: SA 2-4711 Ext: 2922

Los Angeles:
U. S. Navy Purchasing Office
929 South Broadway
Mr. L. H. Porter
Tel: RI 9-4711 Ext: 1430

Oakland:
U. S. Naval Supply Center
Mr. G. R. Kinnear
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Pasadena:
U. S. Naval Ordnance Test Station
Pasadena Annex
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Mr. C. V. Weaver
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Port Hueneme:
Yards & Docks Supply Office
Miss Olive E. Sherman
Tel: HU 6-1651 Ext: 8515

San Bruno:
District Public Works Office
12th Naval District
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San Diego:
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CWO J. L. Knott
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District Public Works Office
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Albany:
Marine Corps Supply Center
Mr. R. J. Thrower
Tel: HE 5-4351 Ext: 512

Macon:
U. S. Naval Ordnance Plant
Mr. G. W. Holcomb
Tel: SH 3-5401 Ext: 403

Hawaii

Pearl Harbor:
U. S. Navy Purchasing Office
Bldg. 475, Naval Supply Center
(Mail Address: Navy 128, FPO, San Francisco, Calif.
Mr. T. H. Sunn
Tel: Pearl Harbor 4711, Ext: 54156

Illinois

Forest Park:
U. S. Naval Ordnance Plant
7500 W. Roosevelt Road
Mr. J. C. Van Dyke
Tel: ES 8-3800 Ext: 283

Great Lakes:
District Public Works Office
9th Naval District
Mr. Frank McGuire
Tel: DE 6-3500 Ext: 147

Great Lakes:
Electronic Supply Office
Mr. A. J. Dowe
Tel: DE 6-3500 Ext: 8298
U. S. Naval Supply Depot
Mr. D. R. Foster
Tel: DE 6-3500 Ext: 8225

Indiana

Crane:
U. S. Naval Ammunition Depot
Mr. P. A. Anderson
Tel: CR 2-511 Ext: 5421

Indianapolis:
U. S. Naval Avionics Facility
Mr. M. T. Wampler
Tel: FL 7-8311 Ext 583

Kentucky

Louisville:
U. S. Naval Ordnance Plant
Mr. R. S. Loebig
Tel: EM 3-3511

Louisiana

New Orleans:
District Public Works Office
8th Naval District
CDR T. L. Stamp, CDC, USN
Tel: FO 6-2311 Ext: 349
Military Sea Transportation Service
Gulf Subarea, 4400 Dauphine St.
Mr. C. H. Wiesendanger
Tel: WH 7-5571 Ext: 240
U. S. Naval Station
Mr. G. H. Shephard
Tel: FO 6-2311

Maryland

Annapolis:
U. S. Naval Academy
Mr. B. Ford
Tel: area code 301, 268-7711 Ext: 739

Indian Head:
U. S. Naval Propellant Plant
Mr. J. A. Kenlon
Tel: RI 3-2111 Ext: 334

Patuxent:
U. S. Naval Air Station
Miss Grace Moore
Tel: VO 3-3111 Ext: 201

Silver Spring:
U. S. Naval Ordnance Laboratory
White Oak
Mr. Ward Bull
Tel: HE 4-7100 Ext: 511

Suitland:
U. S. Navy Hydrographic Office
Mr. James R. Newberry
Tel: JO 8-9060 Ext: 205

Massachusetts

Boston:
Boston Navy Shipyard
Mr. A. J. Dolan
Tel: CH 2-1400 Ext: 2206
District Public Works Office
1st Naval District
495 Summer Street
Mr. S. C. Roberts
Tel: LI 2-5100 Ext: 236

New Hampshire

Portsmouth:
Portsmouth Naval Shipyard
Building 153
Mr. W. M. Varrell
Tel: Kittery, Maine, ID 9-1000 Ext: 424

New York

Brooklyn:
Military Sea Transportation Service
Atlantic Area, 48th Street, & 1st Ave.
Mr. J. G. Burke, Jr.
Tel: GE 9-5400 Ext: 5182
Naval Ships Store Office
3rd Avenue & 29th Street
Mr. J. O. Combes
Tel: ST 8-5000 Ext: 352
U. S. Navy Purchasing Office
3rd Avenue & 29th Street
Mr. Joseph Riemer
Tel: ST 8-5000 Ext: 804

New York City:
Area Public Works Office
90 Church Street
Mr. Theodore Savath
Tel: RE 2-9106

Port Washington:
U. S. Naval Training Device Center
Mr. H. A. Treat, Jr.
Tel: Port Washington 7-9100 Ext: 433
Mr. L. H. Schenot
Tel: Port Washington 7-9100 Ext: 313

North Carolina

Camp Lejeune:
U. S. Marine Corps Base
Mr. E. D. Cleaton
Tel: JA 346-2111 Ext: 73546

Cherry Point:
U. S. Marine Corp Air Station
Mr. J. G. Gordon
Tel: GI 7-2111 Ext: 22141

Oklahoma

McAlester:
U. S. Naval Ammunition Depot
Mr. Dale H. Adams
Tel: GA 3-6300 Ext: 275

Pennsylvania

Johnsville:
U. S. Naval Air Development Center
Mr. J. W. Miller
Tel: OS 5-7000 Ext: 571

Mechanicsburg:
Ordnance Supply Office
Mr. P. J. Horan
Tel: PO 6-8511 Ext: 669
Ships Parts Control Center
Naval Supply Depot
Mr. L. A. Yeager
Tel: PO 6-8511 Ext: 527

Philadelphia:
Aviation Supply Office
700 Robbins Avenue
Mr. W. F. O'Connell
Tel: PI 2-1000 Ext 468
District Public Works Office
4th Naval District
Mr. R. L. Downey
Tel: HO 5-1000 Ext: 3967
Marine Corps Supply Activity
1100 Broad Street
Mr. John Bruneau
Tel: KI 6-2000 Ext: 8638
Naval Air Material Center
Miss Mildred G. Miller
Tel: HO 5-1020 Ext: 2695
Philadelphia Naval Shipyard
Naval Base
Mr. C. B. Friel
Tel: HO 5-1000 Ext: 2418

York:
U. S. Naval Ordnance Plant
Mr. E. J. Yergo
Tel: YO #-7821 Ext: 245

Rhode Island

Newport:
U. S. Naval Supply Depot
Lillian L. Whitty
Tel: VI 1-3266

South Carolina

Charleston:
Charleston Naval Shipyard
Mr. W. H. Heissenbuttel
Tel: SH 7-4171 Ext: 2107
District Public Works Office
6th Naval District
Naval Base. P. O. Box 365
Mr. T. E. Page
Tel: SH 7-4171 Ext: 2487

Paris Island:
Marine Corps Recruit Depot
Mrs. Erma Zehler
Tel: JA 4-2111 Ext: 4273

Tennessee

Memphis:
U. S. Naval Air Station
Mr. Wendell H. Watson
Tel: JA 6-8851

Texas

Corpus Christi:
U. S. Naval Air Station
Mr. H. F. Hale
Tel: TE 5-8211

Orange:
Commander Texas Group
Atlantic Reserve Fleet
CWO H. R. Stohler, USN
Tel: TU 3-4311 Ext: 215

Virginia

Dahlgren:
U. S. Naval Weapons Laboratory
Lt.jg R. N. Beeman, SC, USN
Tel: NO 3-3511 Ext 991

Norfolk:
U. S. Navy Supply Center
Miss Esther M. Roberts
Tel: MA 2-8211 Ext: 3051
District Public Works Office
5th Naval District
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Mr. C. A. Goodwyn
Tel: MA 2-8211 Ext: 2926

Portsmouth:
Norfolk Naval Shipyard
Mr. L. C. Shaughnessy
Tel: EX 7-6541 Ext: 2046

Quantico:
Marine Corps Schools
Capt. V. P. McStone
Tel: QU-1000 Ext: 22164

Washington

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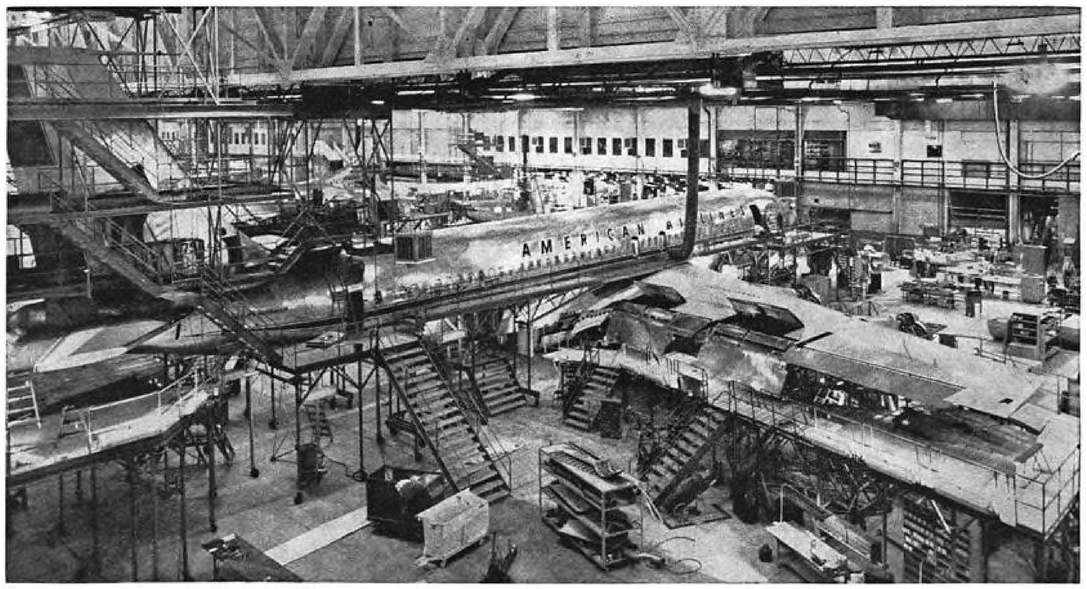
Puget Sound Naval Shipyard
Mr. R. I. Shenenberger
Tel: ES 3-5011 Ext: 07-355

Keyport:
U. S. Naval Torpedo Station
Mr. W. M. Bennett
Tel: ES 3-5011 Ext: 08-372

Seattle:
Naval Supply Depot
LCDR L. J. Crook, SC, USN
Tel: AT 3-5200 Ext: 421
District Public Works Office
13th & 17th Naval Districts
U. S. Naval Station
Mr. G. L. Moulton
Tel: AT 3-5200 Ext: 337

Puerto Rico

San Juan:
Area Public Works Office Caribbean
Navy No. 116, FPO
New York, New York
Mr. Frank Andino
Tel: San Juan 20080 Ext: 746



PARTS AND MATERIALS for the maintenance of a single fleet, such as American Airlines, will cost approximately $25-30 million annually.

Airline Purchasing Rate Climbs Annually

By James R. Ashlock

New York—Airline purchasing, which involves billions of dollars a year for a vast variety of products, is increasing at a rate between 7-8% annually, industry officials report.

Airlines are primarily bulk buyers, maintaining inventories that run into millions of dollars. In one respect they view themselves as a "captive" market, since many of the items they require are regulated by federal standards and availability from a limited number of suppliers.

This is particularly so with airframes, aircraft systems and engines. Once an aircraft and engines are bought, the manufacturers become the source of all replacement parts, including cockpit instruments.

"There are some cases where we may buy items directly from the original manufacturer, provided it is consistent with FAA specification for the aircraft or engine and we have been certified to install it," says Lee Glasgow, vice president of purchasing and supply for American Airlines. "But for the most part, we buy through the airframe or engine manufacturer."

Such procedure assures that the original design and certification specifications are maintained.

Vast subcontracting system is necessary for support of the airline industry, benefiting a wide variety of manufacturers. An airplane seat is one example.

Only the seat frame is built by the seat supplier, who concentrates on design for strength and comfort. Related materials like upholstery, cushions and seat belts come from subcontractors in practically every instance.

Definition of "captive" buyer does not apply, however, in the broad area of airline purchasing outside the airframe and engine market. Between 40-45% of airline expenditures is for salaries. Millions also go into property leases, such as airport space and locations for ticket and business offices.

Glasgow says American's three largest expenditures are for fuel, $60-65 million annually; materials and parts, $25-30 million, and food, $17-18 million.

American, like all carriers, spreads its fuel purchasing over a number of oil companies. Glasgow says oil consumption by aircraft of just one airline is greater than any single company could supply.

"We pay about 12 cents per gallon for jet fuel," Glasgow says. "An aircraft on a transcontinental flight will burn about 90,000 lb., or 15,000 gal."

The large expense for materials arises from the frequent replacement nature of much airline equipment, such as tools in maintenance bases, maintenance for ramp equipment and office materials.

"Our printing bill alone for stationery, manuals, ticket forms and other such items runs about $15 million a year," Glasgow said. "It would be even higher if we didn't have our own print shop at La Guardia Airport."

Airlines practice centralized buying, maintaining a central supply point and supplying their systems through requisition orders. American doesn't buy beyond a three-month supply period, although it may issue purchase orders for a full year to provide lead time.

"Our volume of purchases has been increasing between 7-8% a year," Glasgow said. "At the same time, prices have been advancing about 5% annually, and we expect this rate to continue for the next five years or more."

Expenditures by airlines are high primarily because of the large cost of many items they need. Glasgow cites the constant speed regulator for an aircraft's generator, which is driven by the engine.

"You can hold it in your hands," he says, "and it costs $12,000—the price of two Cadillacs."

Glasgow cites the airlines' main purchasing problem as being inventory, with the related difficulty of obsolescence due to rapidly advancing technology.

"Our spare parts inventory runs about $65 million" he says, "and it appears it will go to $90 million."

He says the airlines are constantly striving to get the aircraft and engine manufacturers to maintain this inventory for the carriers, the same as is done by automobile builders.

"Of course, the commercial field runs second to the military as a market for aircraft," Glasgow says. "And since the military maintains its own parts inventory, the manufacturer is reluctant to provide the service just for commercial buyers."

Glasgow says the airlines must anticipate a good lead time when ordering parts, since the engine and airframe manufacturers won't initiate the supply procedure until they have the carrier's purchase order in hand.

Airlines are working collectively through the Air Transport Assn. of America to improve parts procurement procedures. Most practical tool yet developed is ATA's Specification 200 plan, whereby integrated data processing techniques are used in controlling a carrier's purchasing program.

Most of the major aircraft suppliers are already using the system, as are several of the larger airlines. Its use is expected to become more widespread in the industry during 1963.

Specification 200 should help alleviate the lengthy lead time now required to fill orders. Lead time now averages 180 days from many suppliers, and the airlines think it should be no more than 30.

Better coordinated purchasing program should also enable a reduction in the cost of many items. Many parts manufacturers, airlines complain, insist on producing individual job lots, rather than wait for a group of orders and then mass produce. Larger quantity production would help lower costs, and would also facilitate stock inventory for reorder, the airlines feel.

As an alternative to mass production, airlines working through ATA have asked suppliers to keep at least a small supply of the most frequently needed parts on hand. For those of lesser demand, dies and raw materials could be maintained to speed production. Little response has arisen to the request, airline sources say.

Airlines admit that some of their parts supply problem is self-created. By the time purchasers of the same aircraft complete their individual modifications and system installations, wide variances exist between airplanes of the same manufacture. This spawns the situation whereby parts manufacturers insist on filling orders in individual lots.

Glasgow says that carriers are at last coming around to more standardized airplanes—the Boeing 727 being the latest example. The 727s purchased by American, TWA, United and Eastern will be more alike over-all than any commercial aircraft since jets were introduced, he says.

Individual characteristics of each airline's planes have caused each carrier to maintain its own parts inventory. TWA, for example, stocks approximately 200,000 individual parts for its mixed fleet of Boeing and Convair jets and Lockheed Constellation piston aircraft.

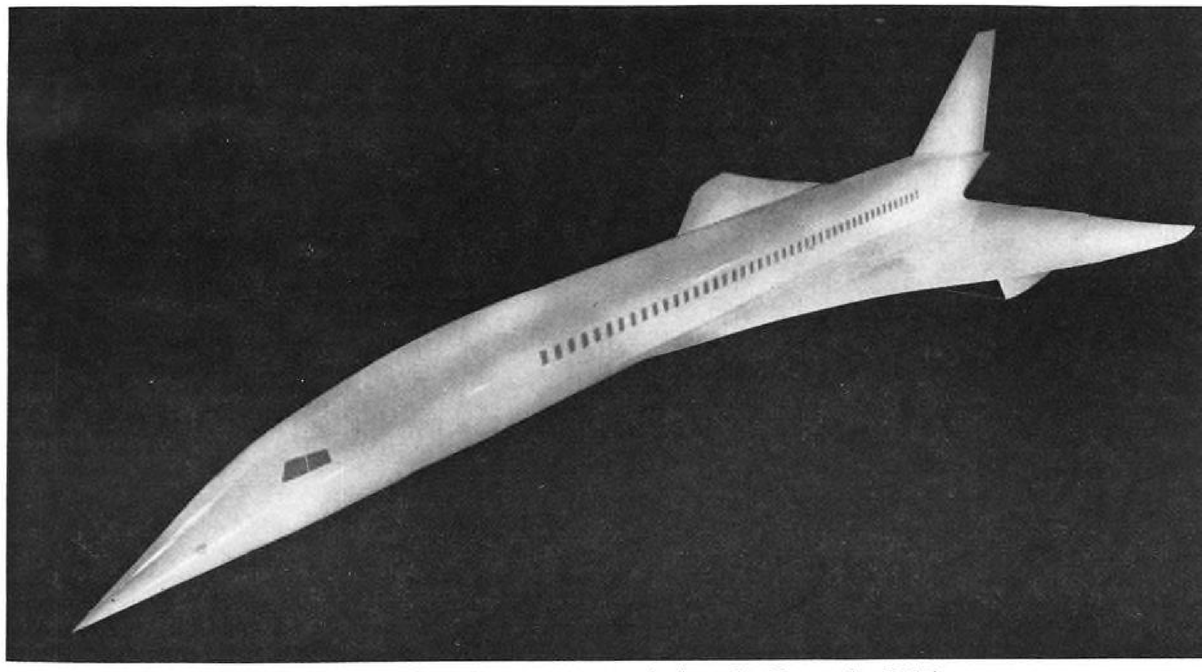
"This large inventory is the main reason why we're hit with a big obsolescence rate," Glasgow says. "When we converted our jets from turbojet to turbofan engines, we had to scrap $16 million in parts such as water injector systems and sound suppressors."

Sound suppressors cost the airlines approximately $28,000 apiece originally, or $112,000 per airplane.

With the industry rapidly converting to turbofan power, carriers are faced with no alternative but to scrap the expensive devices.

"To illustrate how costs are increasing," Glasgow said, "the forward cowling ring for our original turbojet engines cost $4,200. We received our bill the other day for 25 spare cowling rings for the turbofan powerplants. It was for $12,000 apiece."

Efforts are under way among airlines to reduce costs through parts pooling, thereby reducing inventories. However, Glasgow says, the industry's material requirements will continue to grow, making it an increasingly vital element in the consumer picture.



Model Shows Configuration of Anglo-French SST

Proposed Concorde Mach 2.2 transport, under development by a joint English-French design and manufacturing team, will normally cruise at 55-60,000 ft. Aircraft would be built by British Aircraft Corp. and Sud Aviation of France, with support from both governments.

ALLOY NOMENCLATURE

1. Table I—Nomenclature of Aluminum Powder Metallurgy Alloys

Alloy	Old Designation	$\%Al_2O_3$
XAP001	M257	6
XAP002	M583 & M658	8
XAP003	M470	11
XAP004	M430	14
XAP005	—	6

APM PRODUCTS

2. Table II—APM Product Chart X—Products have been fabricated on a production or experimental basis.

Alloy	Sheet	Plate	Forgings	Impact Extrusions	Extruded Shapes	Drawn Tube	Fasteners
XAP001	X	X	X	X	X	X	X
XAP002	X	X	X	X	X		
XAP003	X	X	X		X		
XAP004			X		X		
XAP005	X	X	X	X	X	X	X

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Alcoa research has developed a series of new high-temperature (600°F to 1,000°F) alloys *made from aluminum powder*. These remarkable Aluminum Powder Metallurgy (APM) Alloys have higher mechanical properties at these temperatures than any other aluminum alloy.

Alcoa's Aluminum Powder Metallurgy Alloys also exhibit several other attractive characteristics including:

1. Stable properties at temperature regardless of the length of exposure time at temperature.
2. Retention of original room temperature properties and dimensions after repeated elevated temperature exposures.
3. High modulus of elasticity at both room and elevated temperatures.
4. Strength without heat treatment. All APM alloys are used in the as-fabricated condition.
5. Low neutron capture cross section and rapid decay of induced radioactivity.

Take Alloy XAP001 for example: Check its minimum mechanical properties in Table 3 reprinted from Alcoa's Development Division Report. (This is the first time minimum guaranteed properties have ever been published for any aluminum alloy at temperatures up to and including 900°F.) In addition, XAP001 has corrosion resistance comparable to 6061-T6 and is immune to stress-corrosion cracking. It has been ultrasonically spot welded, flash-butt welded and eutectic bonded to itself and other aluminum alloys. Alcoa® Aluminum Alloy XAP001 can be spun, machined with a minimum of tool wear, and anodized, hardcoated or plated.

XAP001 is available in rods, forgings, extrusions, tubes, impacts and sheets—write us for procurement specifications on any of these items. Consider APM alloys for such applications as reactor core components, valves, pistons, piston rings, hydraulic and heating equipment, and jet engine accessories.

XAP005 exhibits mechanical properties similar to XAP001 but was developed for nuclear reactor applications.

Though extensive design information on XAP001, as well as on APM alloys XAP002, XAP003, XAP004, and XAP005, is already available, Alcoa will continue, as always, to investigate new APM alloys, new processes and improvements. Please keep in touch with us for current information.

NOTE: Graphs and data shown here were not compiled from special samples but are the results of many production runs.

3. Table III—XAP001 Extrusions, Minimum Mechanical Properties

ROOM TEMPERATURE	Longitudinal	Transverse
Ultimate Strength PSI	32,000	30,000
Yield Strength PSI	20,000	17,000
Elongation % in 4D	10	7
600°F		
	Longitudinal	**Transverse**
Ultimate Strength PSI	13,000	12,000
Yield Strength PSI	11,000	9,000
Elongation % in 4D	5	3
900°F		
	Longitudinal	**Transverse**
Ultimate Strength PSI	8,000	Not established
Yield Strength PSI	6,500	Not established
Elongation % in 4D	3	Not established

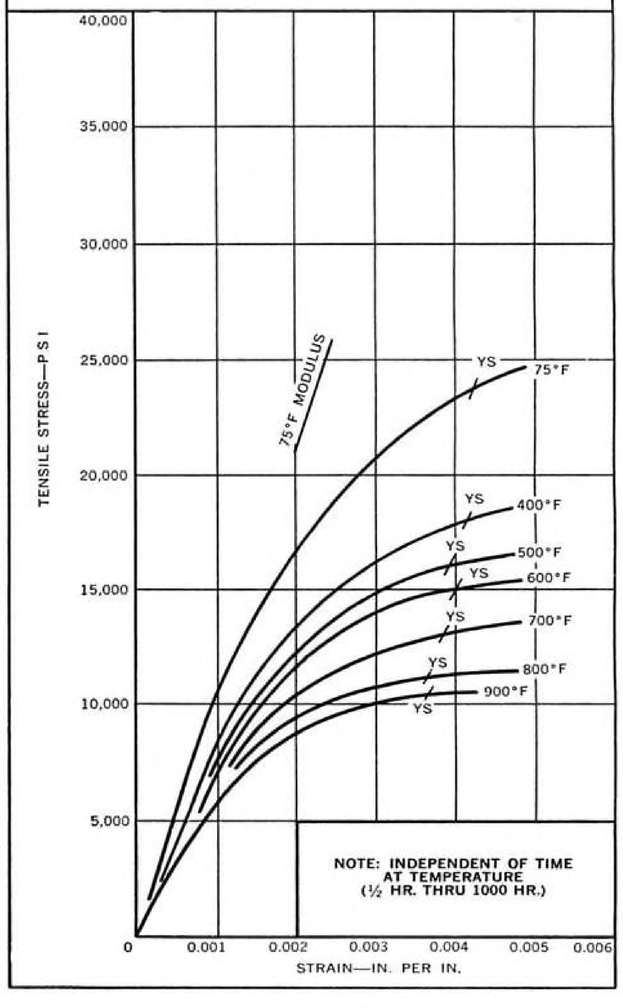
4. Table IV—Physical Properties of Alcoa's APM Alloys

		XAP001 XAP005	XAP002	XAP003	XAP004
Specific Gravity		2.74	2.74	2.75	2.77
Density, lb/cu. in.		0.099	0.099	0.099	0.100
Electrical Conductivity at 25°C (77°F) % IACS		47	44	39	34
Thermal Conductivity	75°F	0.43	0.40	0.36	0.32
CGS Units	400°F	0.44	0.43	0.39	0.36
(Calculated on	500°F	0.45	0.43	0.40	0.37
Basis of Electrical	600°F	0.45	0.43	0.41	0.38
Conductivity)	700°F	0.45	0.44	0.41	0.38
	800°F	0.45	0.44	0.42	0.39
	900°F	0.45	0.44	0.42	0.40
	1000°F	0.45	0.44	0.42	0.40
Average Coefficient of Thermal Expansion per °F x 10^{-6}					
Temp. Range, °F	68-212	12.0	11.8	11.5	11.1
	68-392	12.6	12.4	12.0	11.7
	68-572	13.1	12.9	12.5	12.1
	68-752	13.6	13.3	12.8	12.3
	68-842	13.9	13.8	13.0	12.5
Melting Range of Aluminum Phase (°F)		Solidus for All Alloys = 1180-1200 Liquidus for All Alloys = 1215 Oxide Phase Melts at 3700 (approx.)			
Specific Heat (cal/g) (Calculated)					
68°F		0.213	0.212	0.211	0.210
212°F		0.225	0.224	0.223	0.223

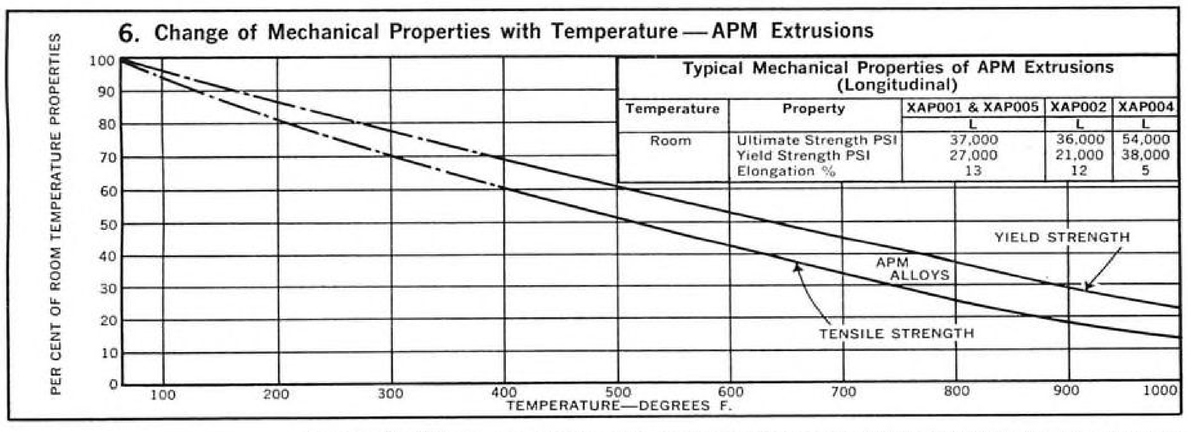
Damping

Tests made at Alcoa Research Laboratories on 0.250" thick XAP001 and XAP004 plate showed that these alloys have 1½-2½ times as much damping capacity as other bare wrought aluminum alloys. Alclad products also exhibit unusually high damping capacity.

5. Tensile Stress—Strain Curves for Alloy XAP001 at Elevated Temperatures



6. Change of Mechanical Properties with Temperature—APM Extrusions



Typical Mechanical Properties of APM Extrusions (Longitudinal)

Temperature	Property	XAP001 & XAP005 L	XAP002 L	XAP004 L
Room	Ultimate Strength PSI	37,000	36,000	54,000
	Yield Strength PSI	27,000	21,000	38,000
	Elongation %	13	12	5

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STARTERS

Air Turbine, built for most large turbine engines today, are designed to operate using either ground compressors or crossbleed from other engines already running on a multi-engine aircraft. Units serving two functions, engine starting and accessory drive, are not being produced.

Hot Gas Turbine Starters provide fast and self-contained starting. Bendix Utica pioneered the fuel-air combustion starter now being used throughout the world.

Direct Cranking Electric Starters for aircraft have been built by Bendix for more than 35 years. Again, Bendix pioneered an aircraft type unit completely waterproofed for use in ordnance off-the-road vehicles.

PUMPS

Variable Displacement Hydraulic Pumps. A typical example is a pump rated at 7.5 gpm at 3000 psi pressure used on all operational J79 engines. It is capable of complete reversal of the fluid flow. Its fast response assures quick action of the piston type actuator in the system.

Air Pumps. The Bendix Utica air pump is designed primarily for use in pneumatic de-icer systems. All pressure to inflate the de-icer boots and vacuum to operate instruments, and to prevent automatic inflation of the boots, is furnished from this unit.

FLEXIBLE POWER TRANSMISSION SHAFTS AND COUPLINGS

The Bendix Utica metal diaphragm type flexible joint makes this shaft or coupling ideally suited for high-speed operation. No lubrication is required for the power transmitting members. Over three thousand of these shafts are now in field use. Some units have demonstrated almost three thousand hours' service without maintenance.

HOT GAS GENERATORS AND PRIME MOVERS

Designed for missile and space vehicle applications, the Bendix Utica hot gas generator will supply a constant pressure over a propellant flow range variation up to 500 to 1. The flow of the hydrogen peroxide working fluid is controlled through a pneumatic setback system.

ICE PREVENTION AND ELIMINATION SYSTEMS

The pneumatic de-icing system is approved for all types of icing conditions. The system consists of air pumps, pressure regulating valves, pressure and vacuum release valves, check valves, oil separators, timers, distributing valves, and other similar items as required to fulfill the needs of a specific aircraft.

AIR TURBINE DRIVE ACCESSORIES

Generators. A Bendix Utica bleeding air turbine generator, capable of operation with air inlet conditions of 1000°F., supplies all the AC and DC power for the F8U aircraft. The thousands of service hours accumulated on these units has proven their dependability.

Constant Speed Drives. Drives with integral control systems, capable of maintaining a constant output speed within plus or minus ¼%, are common in production items. They will operate for reasonable periods of time at zero G conditions.

Fuel Pumps. Turbine-driven centrifugal fuel pumps for either after burner or main engine fuel supply have been built at Bendix Utica. The two-stage turbine prevents overspeed of the unit and, in the event the pump is unloaded during operation, primary fuel controls can be built in as integral parts of the pumps.

Water Injection Pumps are designed with the same two-stage turbine feature to provide overspeed as used in the fuel pumps. Pressure relief valves are built into the unit to provide over pressure in the system.

PNEUMATIC VALVES

Pressure reducing valves for use in 3000 psi systems have demonstrated their dependability by the thousands now in the field service use. Shut-off valves for operation in smaller high-pressure systems are also available.

FREE-FLEX® PIVOTS

Frictionless bearings for limited angular rotation are now available from Bendix Utica. They are excellent for applications exposed to the hard vacuum of space. They are all metal and require no lubrication. They are insensitive to dirt and are not affected by wide temperature range.

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Bendix Utica Division

THE Bendix CORPORATION

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PRODUCTION of Piper Cherokees is carried out at Piper's new facility at Vero Beach, Fla.

Business Flying Grows as Major Market

By Erwin J. Bulban

Dallas, Tex.—General aviation today is a $2-billion-per-year business—counting sales of aircraft, fuel, oil, parts, supplies and services.

About 75,000 operating airplanes in the general aviation category annually log more than triple the number of hours flown by U.S. scheduled commercial airliners and are by far the greatest users of the nation's airports and communications and navigation facilities.

Dominant share of these general aviation expenditures and flying hours stems from the business flying category—airplanes utilized by corporations and companies, distributors, salesmen and myriad other business people.

Business airplanes account for nearly half the fleet of general aviation aircraft, but fly more than half the 12 million-plus hours logged by the total privately owned aircraft fleet. And it is to this segment of the general aviation market that the business aircraft manufacturers, sales and service companies have keyed their major efforts.

Manufacturers have more than tripled the dollar volume and unit delivery volume of private airplanes in the past decade in exploiting the need of businesses for private air transportation. Only five years ago the customer had a choice of 25 models. Today the list includes more than 40 models, with approximately one-third of them multi-engine aircraft.

All signs point to general aviation, and business flying in particular, going one way—up. Beech Aircraft Corp., one of the more conservative representatives of the industry, predicts that the present business airplane population will double in the next 10 years.

This is echoed by findings of other studies, including those by the Federal Aviation Agency, which foresee annual dollar volumes of manufacturers of airframes alone climbing steeply from the current level of approximately $150 million to $750-$800 million by 1970.

Since there is no accurate system of reporting on the activities of the industry's far-flung field organization and the numerous independent sales and service companies providing ground support for this fast-growing private aircraft fleet, it would be difficult to project how much the current $2 billion annual level of industry sales and service will rise to keep pace with the numbers of business planes that will be in operation. But current production levels are theoretically providing sufficient airplanes to fill several new airports of 200-plane capacity per month, a Beech executive points out. Attendant requirements for selling, hangaring and servicing this volume clearly points toward the need for facilities for pumping considerable additional quantities of fuel and oil, equipment for towing these airplanes about, shops and tools to service them and restaurant facilities to accommodate their passengers.

To handle their products and build sales volume, the manufacturers seek to double their current number of distributors and dealers in this country over the next few years. To this could be added the many fixed base operators who are enlarging their facilities or expanding the number of bases they operate.

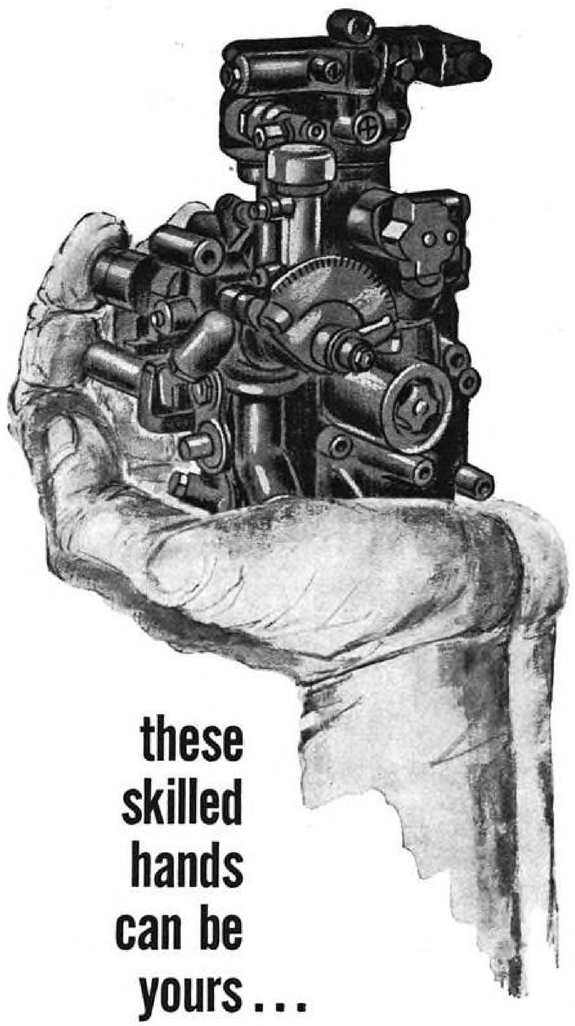
The extent to which the business aircraft service business has grown can be understood by looking at the operations of one of the larger companies, 30-year-old Southwest Airmotive Co., of Dallas, which now has a payroll of $3 million.

Diversified to include jet and piston engine overhaul for the military and airlines, and with a parts distribution

Business Aircraft Sales and Forecasts

1950	$ 25,542,600
1955	$ 91,012,000
1960	$200,000,000
1965 (Est.)	$400,000,000
1970 (Est.)	$800,000,000

Retail dollar volume, years 1950-1960, is based on deliveries reported by manufacturers to Aerospace Industries Assn. Years following are based on industry projections.



these skilled hands can be yours . . .

for DESIGN, DEVELOPMENT and PRODUCTION of Gas Turbine Accessories

Holley started to design and build aircraft fuel controls in 1927—the year of Lindberg's historic flight. We've been a major supplier of fuel metering devices ever since—right through today's jet age. Aircraft gas turbine control devices are Holley Aircraft's business . . . and we know our business well. Hands that are skilled in research—design—development—and precision manufacture of gas turbine components should be yours. Try them—see how they will help!

HOLLEY Aircraft

Call or write for further information, and your copy of Holley Aircraft's Facilities Book.

A-31-A

Division of

HOLLEY CARBURETOR CO.

11955 E. Nine Mile Road, Dept. A, Warren, Michigan

division that spends $2.5 million annually keeping up its inventory for resale to fixed base operators and airlines, Southwest Airmotive has a total facility whose replacement value is estimated by management to be in the neighborhood of $8 million. In addition, it is developing a facility at Meacham Field in Ft. Worth which will require an investment of more than $150,000 in hangars, fuel tank farm, fuel trucks and aircraft servicing equipment over the next year.

That the company is a large purchaser of many products and supplies is evident in scanning data on recent operations—in the first six months of 1962 it took care of approximately 13,500 airplanes, into which its trucks pumped nearly 2.1 million gal. of fuel at Love Field. Last year, the service firm estimates it spent approximately $300,000 on shop supplies, such as chemicals and solvents, light-duty shop equipment and the like for day-to-day operation, about $20,000 for office supplies, some $50,000 on building maintenance supplies and more than $100,000 on utilities.

Franchised distributors and dealers, which are the backbone of the manufacturing operation, do an annual volume of business many times that of airframe sales alone. The distributors and dealers of Beech Aircraft Co. alone have done gross annual business, including sales of new and used airplanes, parts, service, fuel and training, approximately equal to the entire business plane manufacturing industry's sales of new airplanes.

Like other manufacturers, Beech is scouting new dealers to add to its lineup, with the realization that they can find a share in the industry's sales volume of some $900 million annually in aircraft accessories and services. Like the independent operators, these outlets provide ready markets for new ground servicing equipment, tools, buildings and supplies necessary to conduct their business.

Sales and service business runs into large volume, according to an FAA survey. Approximately 18,000 engine overhauls are done on general aviation aircraft in the U. S. each year, and it is estimated that a retrofit market for radio equipment alone in this market currently exceeds $60 million.

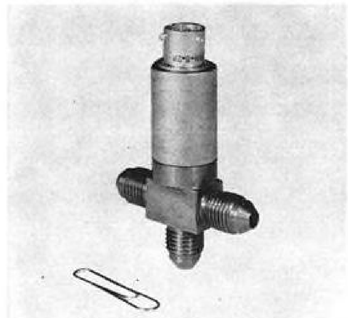
Manufacturers are a primary market for supplies and services. Cessna, with a line of 19 different models planned in the year ahead, which it expects to be the best in its history, is planning a production plant expansion program costing more than $1 million to handle its anticipated increased output.

Last year this company spent some $26.8 million with vendors and suppliers for such things as engines, propellers, radios, upholstery materials, sheet metal, plastics and associated hardware for its business plane line.

NEW AEROSPACE PRODUCTS

Miniaturized 3-way Solenoid Valve

High pressure, 3-way miniaturized solenoid valve is designed for applications requiring high speed control of actuators and as a remote check-out device for pressure switches and transducers at pressures up to 3,000 psi.



Device has operating times in the five millisecond range, features compactness and has all ports in a single plane.

Orifice sizes range from .010 to .030 in. The valve is made with ⅛ in. and ¼ in. tubing connections as standard.

Flodyne Controls, Inc., 1701 Elizabeth Ave., Linden, N. J.

Precision Clinometer

Precision clinometer reads angles to five seconds of arc, and by estimation to one second.

The instrument, Model TB-96, permits reading over a 360 deg. range. The horizontal plane is indicated by a precision level; inclination is read directly from a high-accuracy circular glass scale through the reading microscope.

The glass circle, divided from 0 to 360 deg. at 10-min. intervals and figured every degree, rotates with the spirit level about a horizontal axis. Subdivision of the 10-min. graduations is made by an optical micrometer, the scale of which is divided at 5-sec. intervals. Eyepiece is inclined at a 45 deg. angle and can be rotated to position for most convenient reading.

Applications include inertial guidance test stands, and control equipment, radar antennas, and angular work on industrial machine tools.

Engis Equipment Co., Div. of Engineering and Scientific Instrumentation, 431 S. Dearborn St., Chicago 5, Ill.

High Vacuum Manipulator

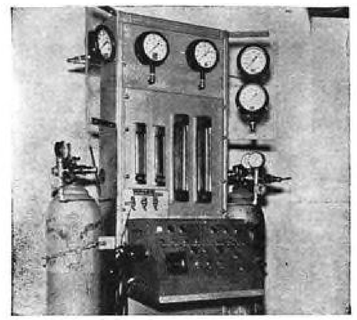
Manipulator, MRC V4-120, is designed to grasp, lift, turn or move in vacuums in the 10^{-7} region.

Device is made of stainless steel and aluminum and sealed with Viton O rings on a ball joint. Movement is within a 60 deg. cone. Quality is assured by helium leak check and 100% inspection, the manufacturer says.

MRC Manufacturing Corp., Orangeburg, N. Y.

Rocket Test System

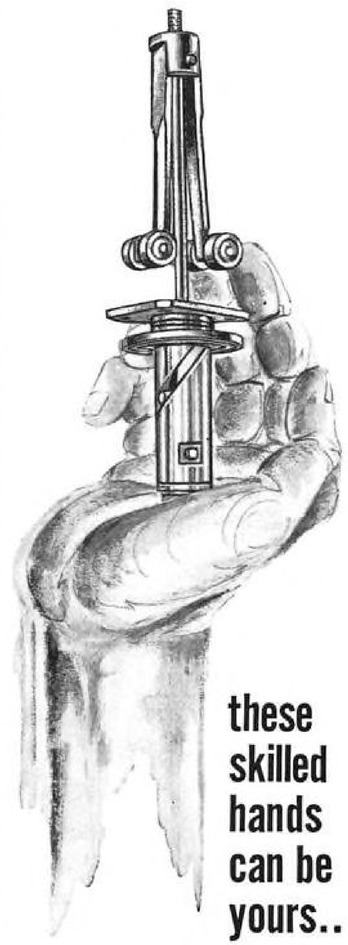
Portable rocket engine test stand equipped with a small rocket engine and associated controls and instrumentation is designed for use as a research tool in materials, propellant or plume studies or as an advanced training aid.



Called Labroc Model V, the system simulates the characteristics of current liquid propellant rocket test engines in terms of combustion efficiency, flame temperature, Reynolds number and nozzle temperatures. Console displays a continuous monitoring of thrust, combustion chamber pressure, fuel flow, oxidizer flow, coolant flow, oxidizer feed pressure, fuel feed pressure, coolant inlet and outlet temperatures. Rocket engine is a watercooled bi-propellant engine producing one to five of thrust.

Special rocket testing experience is not necessary since propellant storage, handling and safety devices have been built into the system, the manufacturer says.

Astrosystems Inc., 1275 Bloomfield Ave., Caldwell Township, N. J.



these skilled hands can be yours..

for PRODUCTION of Your Own Precision Parts

Look close-up at the fuel controls on one of today's jet aircraft engines. Intricate? Complicated? That's for sure, and you'll appreciate that it takes "skilled hands" to build them. Holley Aircraft has those hands . . . performance-proven and available to you for precision manufacture of your own designs.

HOLLEY Aircraft

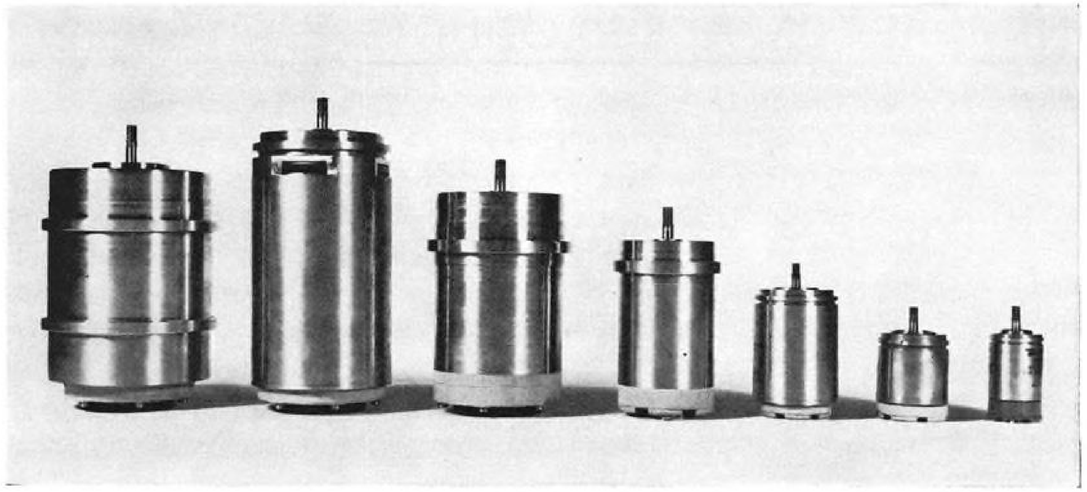
Call or write today for facilities information, or to arrange a meeting.

A-31-B

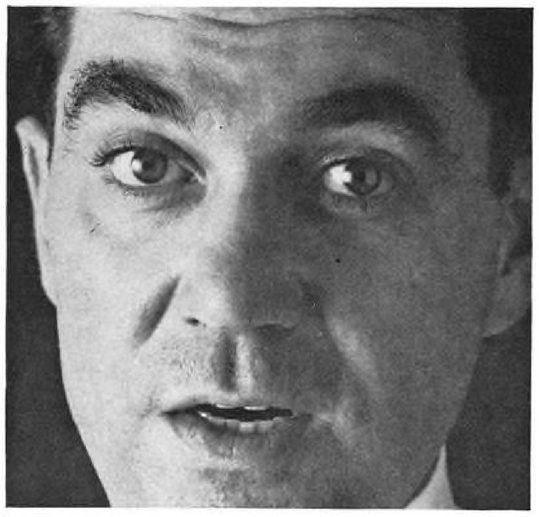
Division of

HOLLEY CARBURETOR CO.

11955 E. Nine Mile Road, Dept. B, Warren, Mich.



Need a synchro?



Send for one of these

or one of these.

One of the advantages you'll find in coming to us for Autosyn® synchros is the personal touch. Our sales engineers work very closely with our customers.

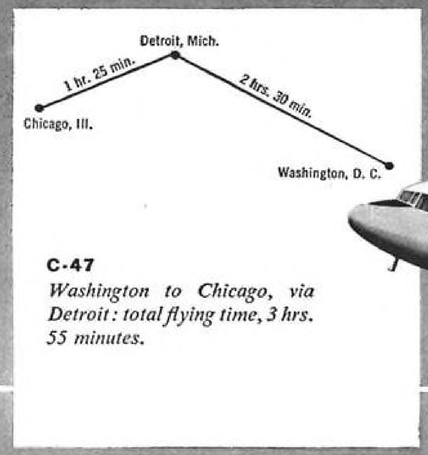
Another advantage, of course, is the complete line that we offer. We manufacture and sell close to a thousand different types of synchros. Some of the parts have measurements as close as 50 millionths of an inch. All parts are ultrasonically cleaned before assembly.

We are currently working on units that will operate efficiently in temperatures as high as 1200°F. And we are supplying synchros that are resistant to nuclear radiation and are capable of efficient operation at 800°F.

Our test and assembly facilities have been expanded to an area covering 14,000 square feet. New equipment is permitting production of parts accurate enough for use in space and missile applications. So you see, there's nothing we can't handle in the way of synchros. Call us in South Montrose, Pa.; Phone Montrose 570, TWX 199.

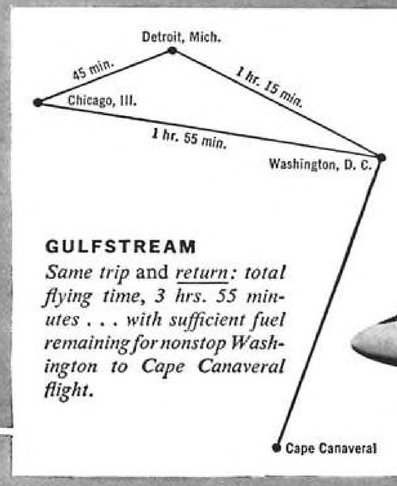
Montrose Division THE Bendix CORPORATION

Circle Number 86 on Reader-Service Card

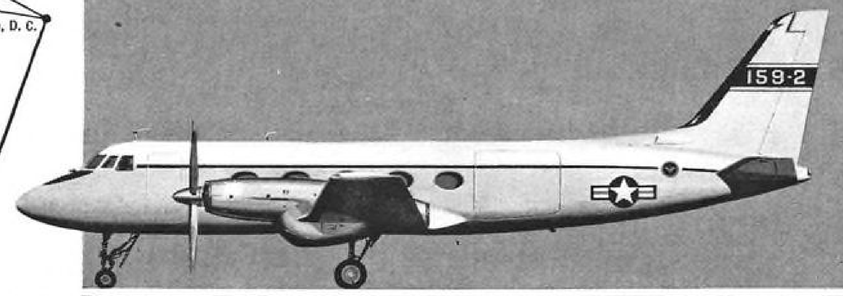


C-47
Washington to Chicago, via Detroit: total flying time, 3 hrs. 55 minutes.

GREAT OLD WORKHORSE



GULFSTREAM
Same trip and *return: total flying time, 3 hrs. 55 minutes . . . with sufficient fuel remaining for nonstop Washington to Cape Canaveral flight.*



GREAT NEW WORKHORSE

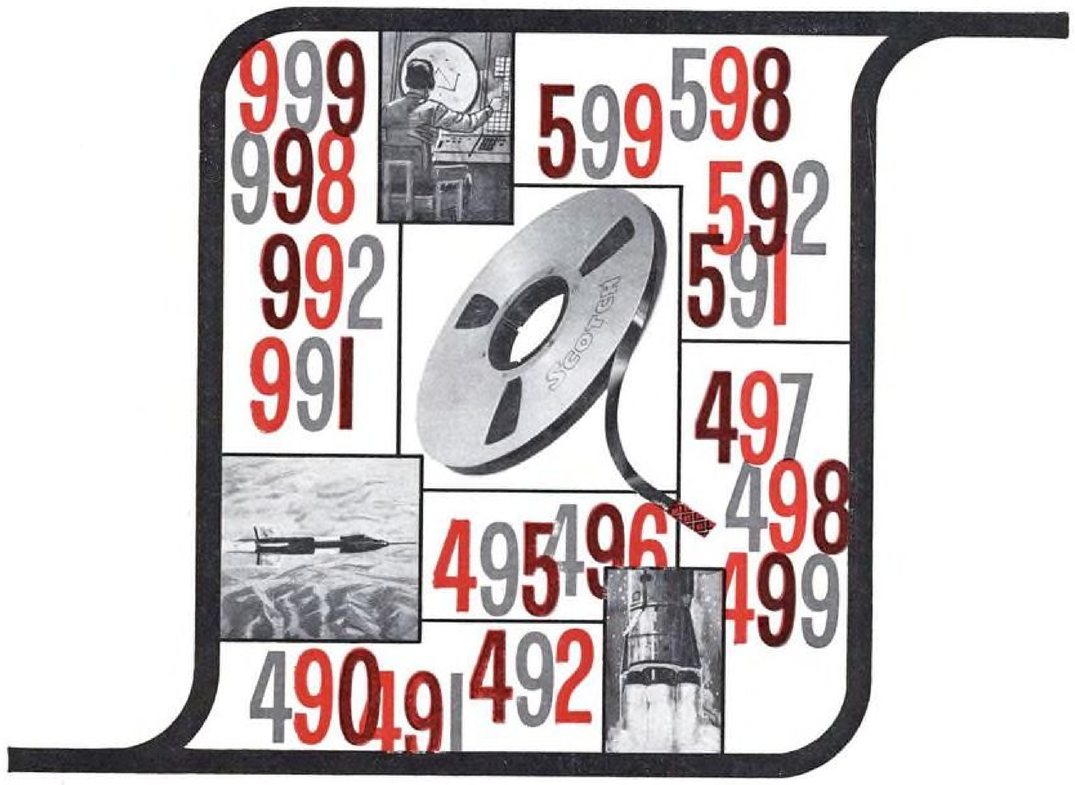
The turboprop Gulfstream—available now without major modification for high-priority personnel (24), cargo, airways checking, navigational training. Cruising speed: 350 mph to 30,000 feet altitude. Range: transcontinental. Payload: 10,000 lbs. Lands, takes off from virtually any military airfield. Not a "stopgap" airplane. The Gulfstream has been designed to fit long-range logistics planning for the next 20 years. Utility, performance, low operating costs. That's why nearly 90 Gulfstreams are now in operation with worldwide corporations and the Federal Aviation Agency.

Grumman

GRUMMAN

AIRCRAFT ENGINEERING CORPORATION
Bethpage • Long Island • New York

First as a matter of record... SCOTCH® BRAND Instrumentation Tapes



World's widest tape selection offers heavy-duty constructions for every instrumentation need!

Today's stepped up pace for data recording calls for magnetic instrumentation tapes that stay cool despite ever-increasing transport speeds, greater tensions, high heat build-up at recording heads. And the "SCOTCH" BRAND Instrumentation Tape line, with a tape for every instrumentation requirement, now includes 16 heavy-duty constructions that conquer difficult operating environments.

"SCOTCH" Heavy Duty Instrumentation Tapes are made with a special high-potency oxide and binder formulation that minimizes rub-off, withstands temperatures from −40°F to as high as 250° F! Field tests prove these tapes last a minimum of 15 times longer than ordinary tapes—capture signal with certainty despite high pressures and speeds.

The oxide coating affords nearly 1000 times greater conductivity than conventional tapes—drains off dust-attracting static charges to assure a clean tape pass every time! And exclusive Silicone lubrication protects against head wear, extends tape life! These three series of heavy duty tapes are available in a variety of widths and lengths . . .

"400" series heavy duty tapes feature exceptionally long wear, excellent high and low frequency resolution. 8 constructions—.18 and .43 mil oxide coatings on .65, 1, 1.5 mil polyester backings; .56 mil coatings on 1 and 1.5 mil backings.

"500" series heavy duty tapes combine long wear, outstanding smoothness to assure sharp resolution of extremely high frequencies. 4 constructions—1 or 1.5 mil polyester backings; .18 or .43 mil oxide coatings.

"900" series heavy duty tapes, designed especially for Mincom CM-100 series Recorder/Reproducers, provide ultra-smooth recording surfaces for critical short wave length requirements. 4 constructions—1 or 1.5 mil polyester backings; .18 or .43 mil oxide coatings.

Whatever your tape requirements—standard, high output, high resolution, sandwich or heavy duty—there's a right "SCOTCH" Instrumentation Tape. Consult your nearby 3M representative for helpful technical details. Or write Magnetic Products Division, Dept. MCJ-122, 3M Company, St. Paul 1, Minn.

"SCOTCH" AND THE PLAID DESIGN ARE REGISTERED TRADEMARKS OF MINNESOTA MINING & MANUFACTURING CO., ST. PAUL 1, MINN. EXPORT: 99 PARK AVE., NEW YORK. CANADA: LONDON, ONTARIO. © 1962, 3M CO.

Magnetic Products Division 3M COMPANY

Circle Number 88 on Reader-Service Card

Aviation Week & Space Technology

BUYERS GUIDE SECTION

PRODUCTS AND SERVICES page 90
More than 2,000 aerospace products and services are listed alphabetically. Aerospace companies in the U.S., Canada, United Kingdom and Western Europe are represented. This listing spans 98 full pages and is the aerospace industry's most comprehensive source of product information and suppliers. Research and development organizations are included, as well as manufacturers, test and service companies and suppliers of basic materials. Names of BUYERS GUIDE ISSUE advertisers appear in boldface capital letters, followed by the page numbers for their advertisements.

INDEX OF PRODUCTS AND SERVICES page 235
Alphabetical listing gives the names and page numbers of all products and services contained in the PRODUCTS AND SERVICES section.

MANUFACTURERS INDEX page 241
Names and addresses of all organizations represented in the PRODUCTS AND SERVICES section are listed alphabetically in the MANUFACTURERS INDEX. Names of BUYERS GUIDE ISSUE advertisers appear in boldface capital letters, followed by the page numbers for their advertisements.

READER SERVICE page 257
Additional free information about products and services advertised can be obtained by using the Reader Service postcards contained in this BUYERS GUIDE ISSUE. Each advertisement has a Reader Service number. Circle this number on the postcard, fill out the card and mail it.

DISTRIBUTORS INDEX page 261
Names and addresses of aerospace distributors are listed alphabetically. Names of distributors advertising in the BUYERS GUIDE ISSUE appear in boldface capital letters, followed by the page numbers for their advertisements.

U.S. AIR CARRIERS AND FREIGHT FORWARDERS page 263
Corporate names and addresses of certificated air carriers, supplemental air carriers and air freight forwarders—interstate and international—are listed.

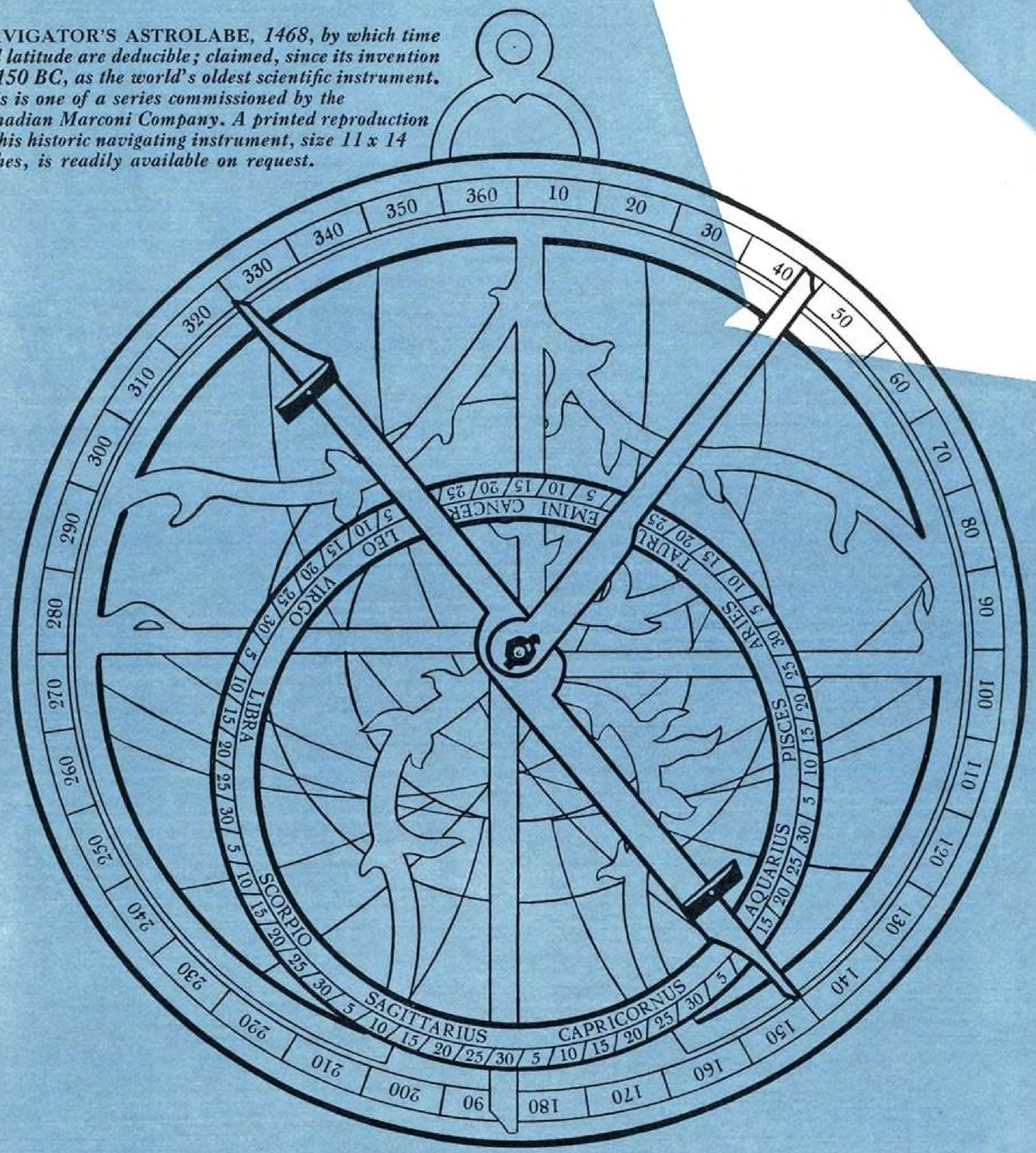
INDEX OF PRODUCTS ADVERTISED page 265
Alphabetical product listing provides quick reference to the product information contained in advertisements appearing in the BUYERS GUIDE ISSUE.

FEDERAL AVIATION AGENCY CERTIFICATED REPAIR STATIONS page 267
Aviation repair stations in the U.S. and overseas which are certificated by FAA are listed by region. Names and addresses of repair stations are followed by code numbers which show the type of repair services performed.

SEARCHLIGHT: Products and Services Index page 286
Products and services offered by SEARCHLIGHT advertisers in the BUYERS GUIDE ISSUE are listed.

ADVERTISERS INDEX page 292
Alphabetical listing of all BUYERS GUIDE ISSUE advertisers.

NAVIGATOR'S ASTROLABE, *1468, by which time and latitude are deducible; claimed, since its invention in 150 BC, as the world's oldest scientific instrument. 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.*

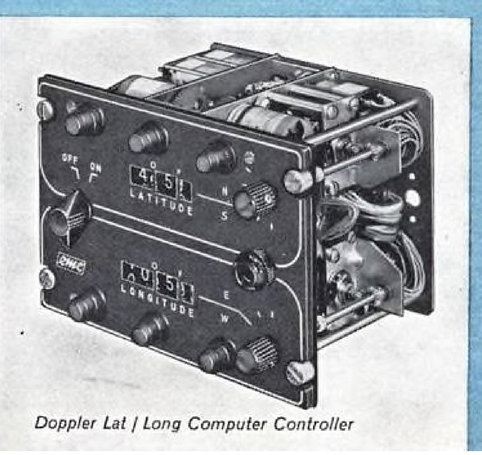


Circle Number 98 on Reader-Service Card

2113 years before DOPPLER

Between the astrolabe and Doppler lie 2113 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 Lat / Long Computer Controller

Sinclair TURBO-S OILS

SPACE-AGE OILS DEVELOPED FROM SINCLAIR RESEARCH

- Used in commercial jet-liners for reliability
- Used in military jets and missiles for reliability
- Used in space exploration rockets for reliability

There is no better proof of reliability—*YOU CAN RELY ON TURBO-S OILS*

Sinclair AIRCRAFT OILS Sinclair

SINCLAIR REFINING COMPANY • 600 FIFTH AVENUE • NEW YORK 20, N. Y.

100 Circle Number 100 on Reader-Service Card

10,000 ACRES OF HELL

...for continuous environmental testing of Caterpillar-developed military vehicles, their components, and the full range of Caterpillar diesel electric power plants

A rugged complex of steep hills, sand flats, thick woods and rocky bluffs, the two Caterpillar proving grounds provide a wide range of terrain and climate conditions... 10,000 acres of mud, dust, snow and ice... desert and subzero temperatures.

Located near Phoenix, Arizona, and Peoria, Illinois, the sites are in constant use by Caterpillar's 1300-man Research Department. Once a basic design has been approved and a prototype developed, equipment is subjected to a series of rigorous tests. Through modern instrumentation, performance data is quickly obtained and evaluated.

Mobile instrument laboratories, like this dynamic measurements van, allow Caterpillar researchers to probe deep into the heart and liver of machines in actual field operation. The van's crew is putting Caterpillar's mobile, rubber-tired eight-ton GOER through a strenuous test, simultaneously measuring 16 different operational characteristics.

In addition to the comprehensive proving grounds facilities, Caterpillar maintains an extensive field testing and research organization wherever Caterpillar equipment is used—from baking deserts to arctic ice shelves. These experienced specialists work with other Caterpillar engineers and manufacturing people in every stage of equipment development—from basic concept to final manufacturing. It's all part of Caterpillar's continuing program for the development of new concepts in military vehicles, their components, and power packages.

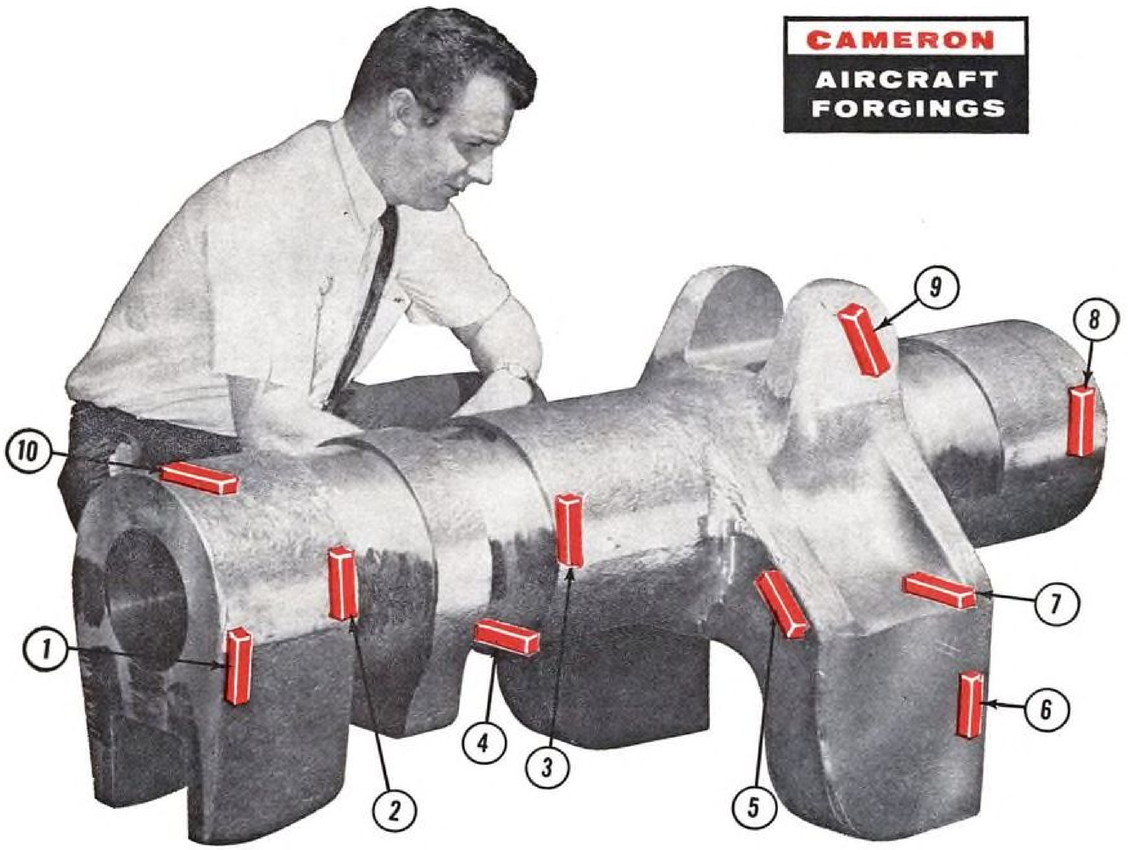
For more information, write Defense Products Department, Caterpillar Tractor Co., Peoria, Illinois.

CATERPILLAR

Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

Caterpillar Tractor Co., General Offices, Peoria, Illinois · Caterpillar Americas Co., Peoria, Illinois · 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

Circle Number 101 on Reader-Service Card



COMPLEX SHAPES—MAXIMUM MECHANICAL PROPERTIES

This Aircraft Main Landing Gear Cylinder, 60″ long and weighing 2400 pounds, is hollow forged in one press operation by Cameron's split-die multiple ram process. Starting with steel produced by Cameron and vacuum degassed to meet rigid specifications, Cameron's 11,000 and 20,000 ton forging presses and advanced forging techniques produce forgings of complex shape and uniform high strength. Note on the Certificate of Test, the greater elongation and reduction of area in the test of the samples cut from the forgings as compared to the test of the samples cut from the billet. Observe also the uniform properties of forging test bars regardless of location or direction. These improved properties over the starting bar material are the result of Cameron's forging techniques. Cameron produces forgings of Carbon Steel, Alloy Steel, Stainless Steel, Molybdenum, Titantium, Tungsten, Tantalum and Columbium for aircraft, jet engines, missiles, nuclear components and industrial use. If you require forgings of these alloys with maximum mechanical properties and cleanliness, call on Cameron.

CAMERON IRON WORKS, INC.
Houston, Texas

CERTIFICATE OF TESTS

[redacted]

20 July 1962

Customer Order No.	C.I.W. Sales Order No.	Specification
412689	G-1523-2	MIL-S-5000B & AMS 2310

Description of Material: Forging, rough machined outer cylinder [redacted] 141 Main Gear #2571306 Rev. B

Pilot Forging Mechanical Properties: CIW Heat Code C-1584, CIW Ser. No. 1

Test No.	Ult. T.S. PSI	Y.S. PSI	Elong.%	R.A.%
1	280,800	236,000	12.5	40.8
2	284,400	228,000	12.5	43.2
3	284,300	229,000	12.5	39.0
4	285,600	226,000	10.9	34.5
5	283,200	228,000	12.5	43.2
6	282,000	228,000	14.0	49.0
7	287,200	230,000	10.9	36.9
8	281,200	225,000	10.9	36.3
9	282,400	226,000	12.5	47.8
10	285,600	228,000	12.5	42.6

Transverse Tensile Test Results:*

Heat No.	Mid-Radius Test Location	Ult. T.S. PSI	.2% Offset Y.S. PSI	Elong. %	R.A. %
C-1584	T1-1	266,500	223,000	7.3	20.6
	T1-2	264,500	221,000	7.0	20.2
	B1-1	267,500	226,000	1.5	7.3
	B1-2	270,000	226,000	3.9	6.6
	T4-1	269,500	229,000	5.4	13.4
	T4-2	267,500	224,500	5.4	13.7
	B4-1	268,000	227,500	7.8	20.6
	B4-2	269,000	225,000	7.0	19.2

* Heat Treatment of Specimens: Normalize 1650°F. one hour. Austenitize 1500°F. one hour. Quench in oil at 120-160°F. Temper 450°F. four hours.

Macro-Etch Exam. Results: CIW Heat Code C-1584	Bar No.	Top	Bottom
	1	A2	C1
	2	A2	C1
	3	A2	C1
	4	A2	C1

NOTE

the increase in tensile strength and ductility in Forging Samples

tensile strength and ductility in Billet Samples

Cameron

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

CAMERON IRON WORKS, INC.
Houston, Texas

CERTIFICATE OF TESTS

Date 20 July 1962

Ship To:

412689	G-1523-2	Specification MIL-S-5000B and AMS 2310

Description of Material: Pilot Forging: Rough machined outer cylinder [redacted] 141 Main Gear #2571306 Rev. B

C.I.W. Part Number	Heat No.	Chemical Analysis C	Mn	P	S	Si	Cr	Ni	Mo	Heat Qualification Acceptance No.
61374-1	C 1584	.40	.79	.019	.011	.30	.79	1.97	.23	TR-1005

" CIW Produced Steel "

Note: The above material was vacuum degassed.

C.I.W. Part No. or Size	Quantity	Heat No.	Mechanical Properties					
			Yield PSI	Tensile PSI	% Elong. In.	% Red. Area	Charpy Impact	Hardness
61374-1	Ser.# 1	C 1584	See attachment for Pilot Forging Test Results.					

Forging Hardness: 255-302 BHN

Forging normalized and tempered per drawing. Enclosure: Photographs of grain flow sections.

Test material produced from same heat as forging. See attached W-Form for test specimen locations.

C.I.W. Heat No.	Jominy Hardenability	Grain Size	Magnetic Particle
C 1584	J-55 - 20, J-52 - 32	# 5	F/S = .09/.0325

(See attachment for Macro-Etch Exam. Results and Transverse Tensile Results.)

Subscribed and Sworn to before me this 20th Day of July 1962

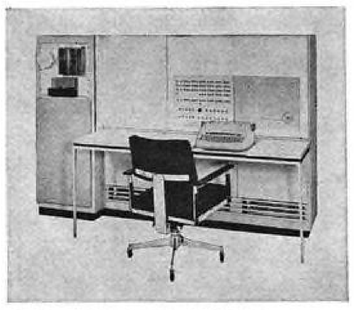
Notary Public
G. A. Tolchstein
Notary Public in and for Harris County, Texas
My Commission Expires June 1, 1963

I certify these tests to be correct as contained in the records of the company.

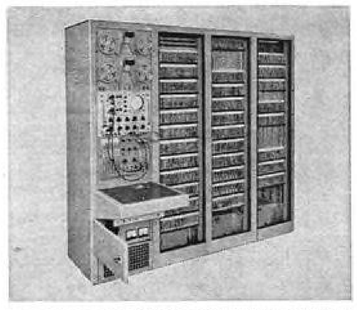
E. D. Banks, Metallurgist

Circle Number 111 on Reader-Service Card

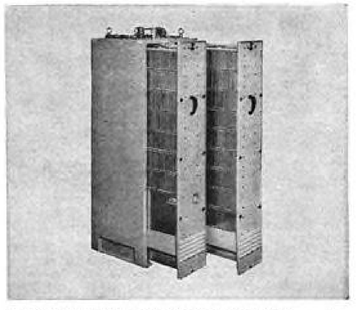
For 10 years, Computer Control Company has designed, developed and delivered a broad range of specialized digital systems



DDP-19 DIGITAL DATA PROCESSORS are high-speed general purpose computers designed for advanced scientific and engineering applications. A strong command structure makes the DDP-19 faster than comparable medium-size computers. Memory cycle time: 5 microsecs. A simple add operation takes 10 microsecs. Features include program controlled data transfer, multichannel interrupt with character and word buffer, parallel transfer, asynchronous full-interrupt.



REAL TIME COORDINATE CONVERSION COMPUTER continually positions two eighty-five foot parabolic antennas used to track orbiting satellites and space probe vehicles from a West Coast site. The antennas, computer, and a microwave data link form the closed loop tracking system. Computer Control has also developed a Coordinate Conversion Computer now in use as part of an airborne telescope tracking system designed to photograph missiles during re-entry.

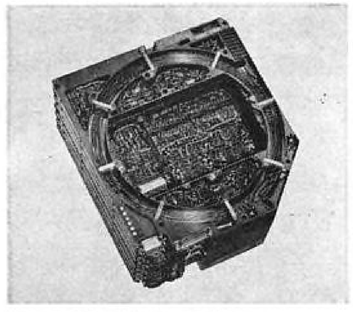


DELAY LINE TIME COMPRESSION (DELTIC) equipments are in tactical use aboard submarines, permitting extension of signal detection capabilities. DELTIC circuits digitize input signals and hold them in active storage, greatly compressing them in time for real-time signal correlation. 3C DELTIC equipment provides significant reduction in the complexity and size of signal processing equipment for application to sonar, radar, telemetry and audio spectrum analysis.

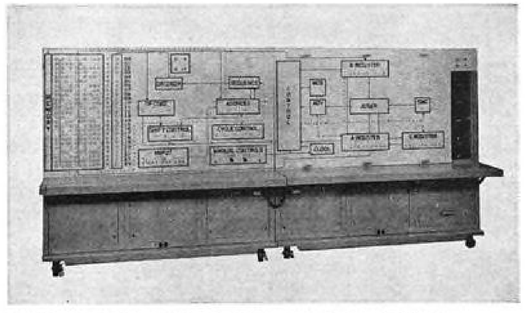
3C DIGITAL SYSTEMS ACTIVITIES

- ☐ Missile tracking and radio astronomy positioning
- Industrial process and machine tool control ☐
- ☐ Data monitoring
- High-speed stored program scientific computers ☐
- ☐ Real-time business data processing
- Time compression for signal processing ☐
- ☐ Digital logic and computer training devices
- Computer language translation ☐
- ☐ Information storage and retrieval
- Pulse pattern and range time code generation ☐
- ☐ Digital positioning systems
- Complex test and simulation ☐
- ☐ Space vehicle instrumentation and simulation

For more information on 3C accomplishments, write for 36-page digital systems brochure. Engineers and scientists: growth opportunities exist at Computer Control Company. An Equal Opportunity Employer. Write Mr. M. Sandler, Professional Placement, Dept. AW, Computer Control Co., Framingham, Mass.



SPACE DATA AUTOMATION SYSTEMS are solid state systems designed to make possible receipt of technical data from unmanned spacecraft scientific experiments, and to act on command sequences sent to the spacecraft. The 3C/SDAS allows unmanned spacecraft to vary their command sequences by internally pre-programmed sequences of events, external signals sensed by experiments, or by radio commands. SDAS systems operate on less than 1 watt of power.

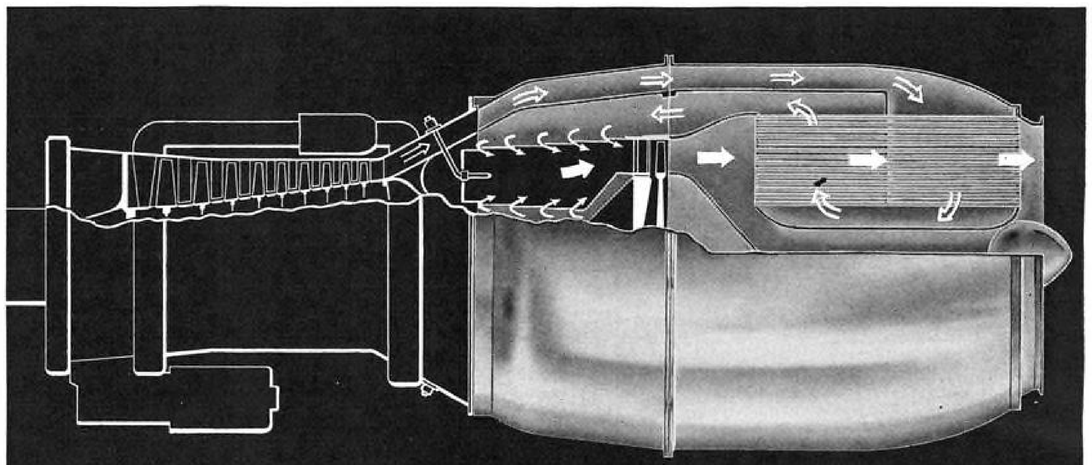


DIGITAL COMPUTER DEMONSTRATORS AND LOGIC TRAINERS are employed in teaching large classes the fundamentals of digital computer organization, programming, and operation. These units convert from a general purpose computer to a versatile logic demonstrator with removal of the front panels. The trainer permits an entire class to follow each instruction step by step through the machine. When used as a logic demonstrator, various types of logic modules with large MIL-standard symbols are plugged into the front panel for logic interconnection by the instructor or students. Computer Control Company has produced a variety of digital training systems for industry and the military.

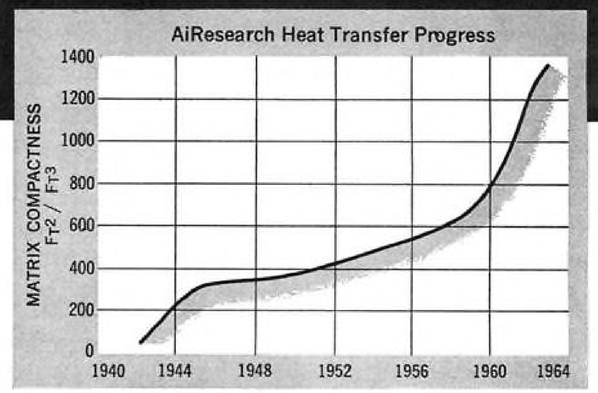
3C

COMPUTER CONTROL COMPANY, INC.

OLD CONNECTICUT PATH, FRAMINGHAM, MASS. • 2251 BARRY AVENUE, LOS ANGELES 64, CALIF.



Optimum Recuperator Match for Shaft Power Gas Turbines



Garrett-AiResearch recuperators improve specific fuel consumption up to 40%, with minimum size and weight ratios and highest reliability

To be competitive, new military and industrial gas turbines will require *optimum* recuperator design and fabrication. Garrett-AiResearch experience in specialized heat transfer systems includes:

PRODUCTION

More than 684,000 heat transfer systems fabricated

ENVIRONMENT

Thermal stress: 1000°F differential across unit
Vibration testing: 0 to 1500 cps, 150 Gs
Temperature range: —420 to 2200°F
Heat transfer fluids: liquid metals, air, fuel, oil, gases, cryogenic fluids

RELIABILITY

AiResearch fixed boundary recuperators have no moving parts, require minimum maintenance
More than 700,000 hours already accumulated on production heat recovery units

Garrett-AiResearch uses this experience in a recuperator optimization computer program to: (1) match *all* heat transfer parameters to engine manufacturers' requirements, (2) interpret parametric analysis, (3) select optimum design and material, and (4) fabricate reliable equipment.

Garrett-AiResearch is working on recuperator optimization programs with more than half the military and industrial gas turbine manufacturers in North America, and is fabricating and testing complete units. For further recuperator information, write to the AiResearch Manufacturing Division, Los Angeles.

GARRETT

AIRESEARCH MANUFACTURING DIVISIONS • *Los Angeles 9, California • Phoenix, Arizona*

Systems and Components for:

Aircraft, Missile, Spacecraft, Electronic, Nuclear and Industrial Applications

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hydraulic power

CUSTOM DESIGNED FOR AIRCRAFT, MISSILE, AND GROUND SUPPORT EQUIPMENT

Pesco

INTEGRATED HYDRAULIC POWER SUPPLIES

PRESSURES TO 5000 PSI

FLOW RATES TO 50 GPM

As a single source manufacturer of both pumps and drives, Pesco has a unique capability to custom-engineer hydraulic power supplies. Requirements of size, weight, configuration, power input and power output can be met by matching Pesco electric or hydraulic motors with Pesco fixed displacement gear pumps or variable displacement piston pumps. Pesco hydraulic power supplies are now specified for major aircraft and missile programs . . . proof of Pesco's capabilities to design, build, test, and deliver power supplies demanding high performance and reliability.

PISTON PUMPS: Fixed or Variable Displacement

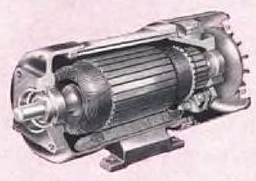
High speed pumps with high power output and uniform flow rates with 97% volumetric efficiency and 92% torque efficiency.

pressures: to 4000 psi
speeds: to 24,000 rpm
flow: 0.5 to 28 gpm
op. temp. range: —65°F to +700°F

GEAR PUMPS: Fixed Displacement

Feature patented pressure-loading design, sustained high suction and uniform flow rates with 97% volumetric efficiency and 92% torque efficiency.

pressures: to 5000 psi
speeds: to 24,000 rpm
flow: 0.2 to 50 gpm
op. temp. range: —65°F to +600°F



DC ELECTRIC MOTORS

Available in seven basic frame sizes from 1.75 to 5.0 inches in diameter. Meet MIL-M-8609 specifications.

voltage: 6-112v
horsepower: .005 to 10.0
amb. temp.: —65°F to +250°F
type: open-ventilated, enclosed or explosion-resistant

AC ELECTRIC MOTORS

Available in six basic frame sizes from 2.0 to 9.0 inches in diameter. Meet MIL-M-7969 specifications.

voltage: 115v, 208v or 416v
cycle: 400
phase: 1 or 3
amb. temp. —65°F to +250°F
type: open-ventilated, sealed or explosion-proof

Hydraulic motors and turbine drives are also available as drives for Pesco power supplies

Request brochure and data sheets from

PESCO PRODUCTS DIVISION
BORG-WARNER CORPORATION
24700 North Miles Road • Bedford, Ohio

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36 S. Wabash Avenue, Chicago 3, Illinois

PESCO DESIGNED HYDRAULIC POWER SYSTEMS

Pesco builds complete hydraulic power systems for aircraft and missiles which include PESCO pumps and motors, reservoirs, fluid level indicators, filters, check valves, controls, pressure switches, temperature sensing elements, radio noise filters, connectors and fittings.

10931-PC

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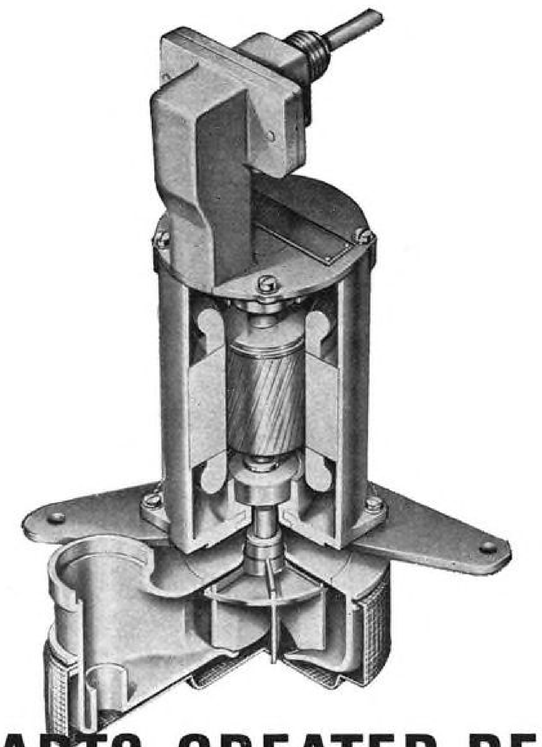

FEWER PARTS, GREATER RELIABILITY

With Lear Siegler Centrifugal Pumps

With only four moving parts – impeller, rotor and frictionless bearings – Lear Siegler Power Equipment Division centrifugal pumps are slow to wear out . . . are service-free . . . maintain constant efficiencies. AC motor driven pumps have guarantees up to 2400 hours of trouble-free service life. Motors on submerged centrifugal pumps can be cooled by liquid flowing through the motor. This eliminates seals, increases reliability and utility.

Lear Siegler centrifugal pumps fit any precision application: fuel booster pumps for missiles, aircraft and helicopters; centrifugal pumps for ordnance vehicles and specialized industrial and commercial uses. They have standard or custom-designed mountings, wet or dry AC and DC motors, line-mounted or integral radio noise filters, discharge ports to fit standard or special fittings. They pump any non-corrosive liquid.

We can design the centrifugal pump for your aerospace, ground support or industrial application. Tell us the basic parameters of your application. Or, if you desire technical data on any of our present line of pumps, ask for our data file.

RG12100 RR12030

DC Motor Driven Centrifugal Pumps with flows from 150 gph to 3400 gph; weigh from 2 pounds to 12 pounds.

RG11920 RR11700

AC Motor Driven Centrifugal Pumps with flows from 300 gph to 15,000 gph; weigh from 3 pounds to 17 pounds.

LEAR SIEGLER, INC.

POWER EQUIPMENT DIVISION

Formerly Lear-Romec Division

241 SOUTH ABBE ROAD, ELYRIA, OHIO

RO-35

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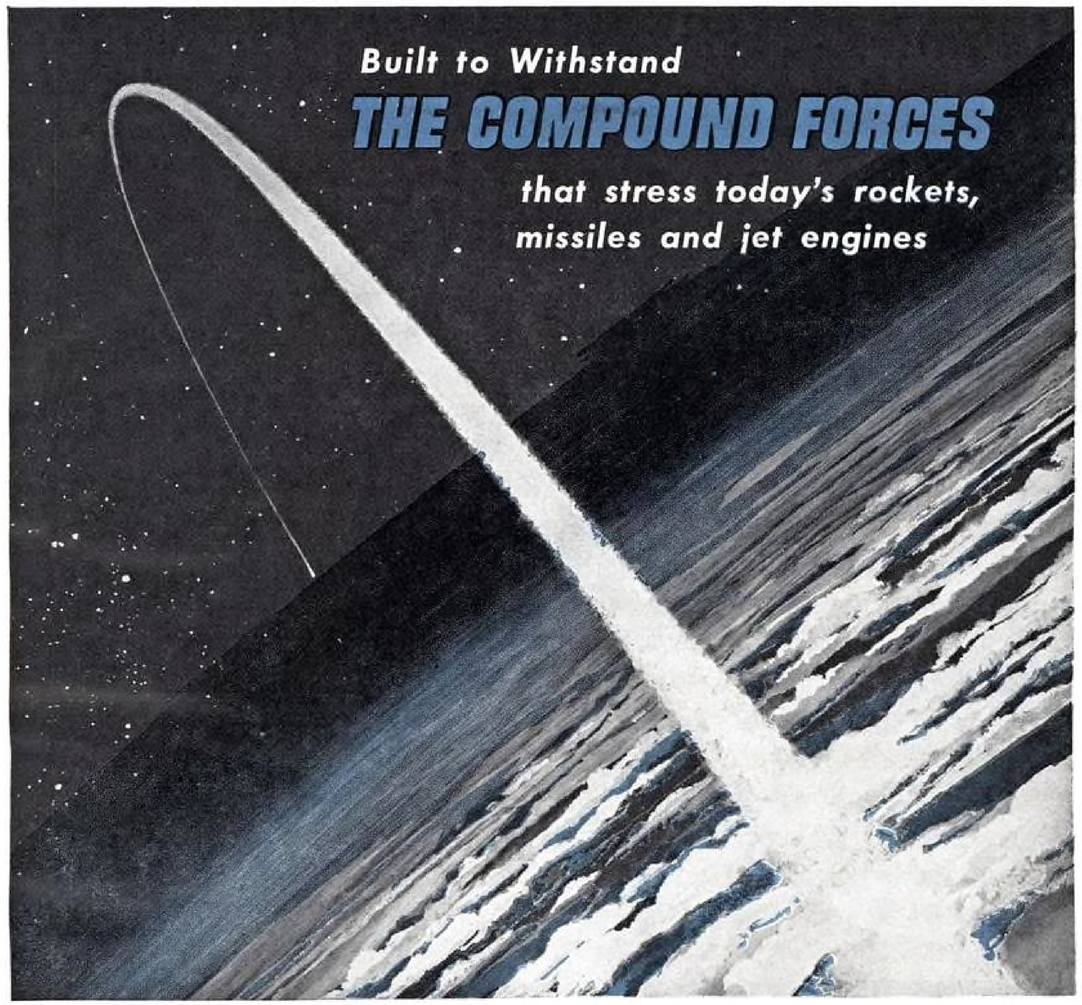

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— designed for the space age

Acceleration and deceleration shocks! Multiple G forces, both radial and axial! Plus thermal variations in the extreme! Each makes new demands on design and materials. All require advanced concepts in the alloying, melting, forging, grinding, dimensioning and stress relief of high-temperature, tight-tolerance bearing metals.

Already operational in out-front aeronautical applications, new and more sophisticated Rollway Precision Radials are on the boards or undergoing R&D for top aircraft producers.

For a quick view of dynamic capacities, load ratings, limiting speeds, etc., ask for Precision Radial Catalog No. AR159. For a glimpse into potentials, let our R&D men discuss the possibilities with you. Rollway Bearing Company, Syracuse, N. Y.

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Circle Number 125 on Reader-Service Card

AMP PUTS AN END TO EVERY CIRCUIT PROBLEM

A patented Compression-Crimp Technique . . . the finest research and testing facilities in the industry . . . an exclusive plating process . . . a sales and service organization that spans the world . . . all these are factors contributing to AMP's recognition as the undisputed leader in the field of Solderless Wire Termination. Shown here is a representative sampling of the more than 15,000 electrical/electronics products we design and manufacture. All are designed to provide you with more reliable circuitry. All are available for immediate delivery. From basic ring tongue terminals to intricate programming systems . . . from one-crimp coaxial connectors to compression-crimp fine wire splices . . . whenever a circuit needs completion, AMP delivers the best, fastest and most economical answer.

COAXIAL CABLE AND SHIELDED WIRE PRODUCTS

COAXICON® CONNECTORS—Quick connect/disconnect for coaxial wire with one crimp termination of inner conductor, outer braid and cable support . . . an exclusive AMP feature. Multiple and single-in-line types, in standard, miniature and subminiature models. RG/U sizes .075 to .250". Gold over nickel contact plating . . . standard with AMP.

1

MINIATURE—(TYPE IV CONTACT)
—12 and 20 positions.

2

STANDARD—18, 24 and 34 positions. Special configurations available on request.

3

COAXICON Connectors
and Pin and Socket mix.

4

TNC—Standard and miniature sizes. Plus hardware version of COAXICON Contacts for through panel installations.

5

BNC — Bayonet coaxial connector for a quick connect/disconnect of maximum reliability. Noise free because of exclusive A-MP® crimp. Meets requirements of MIL-C-3608.

TERMASHIELD® SPLICES AND FERRULES — both pre-and-post insulated, for single and multiple conductors with nylon or TEFLON insulation. Line includes special heat-resistant ferrules and a new pre-insulated ferrule for printed circuit boards.

6

PIN AND SOCKET MULTIPLE CONNECTORS

AMPin-cert® Pin and Socket connectors satisfy and exceed applicable Military and commercial requirements. Complete range of sizes and configurations. Feature crimp, snap-in contacts. Available in stamped and formed and screw-machine processed types, in single-piece or strip form for application with A-MP® hand, semi-automatic or fully automatic crimping tools. Gold over nickel contact plating . . . standard with AMP!

Connectors conforming to MIL-C-8384

7

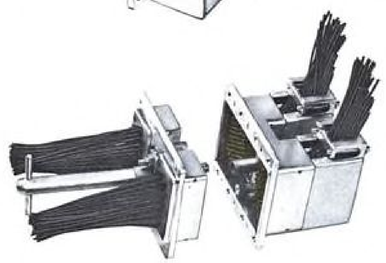
TIER BLOCK
—10 position
modular stacking unit

8

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

9

SERIES "D"—78 position



10

SERIES "DD"—156 position

11

SERIES "W"
26 and 40 position

12

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 26-32. Insulation support.

13

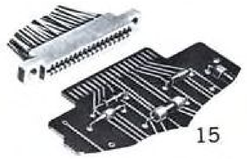
*Trademark of AMP INCORPORATED.

PRINTED CIRCUIT CONNECTORS

AMPin-cert one and two piece printed circuit connectors, available in a wide variety of sizes and configurations. Utilize crimp, snap-in contacts. Unique design insures controlled contact pressures for reduced surface wear. Exceed requirements of all applicable MIL specifications. Connectors are alpha-numerically coded, not pre-loaded and feature gold over nickel contact plating . . . standard with AMP! Complete range of hand, semi-automatic and fully automatic application tooling.

14

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



15

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

16

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.

17

18

CIRCUITIP® TERMINALS — 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.

TAPER TECHNIQUE

Miniaturized components for high density applications. Both pre-and-post insulated, stamped and 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 and 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.

19

TAYP-AIR ASSEMBLY

20

STANDARD ASSEMBLY

INSULATED and NON-INSULATED

STACKED TAPER BLOCKS

21

TERMINALS AND SPLICES
Industry's most complete line of pre-and-post insulated compression-crimp terminals and splices. Accommodate solid, stranded and irregularly shaped conductors in all AWG wire sizes. Single-piece or strip form for application with AMP hand, semi-automatic or fully automatic crimping tools.

24

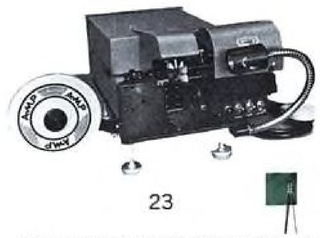
DUO-TYNE® LEAF CONNECTOR—new modular design connector with virtually unlimited application possibilities. Individually housed crimp contacts snaplock into aluminum mounting plates which can be designed to any size or configuration desired.

22

TERMI-BLOK® CONNECTORS — modular design terminal block connector for high density circuitry. Permits infinite variation in wiring logic and stack configurations. No need for insertion/extraction tools.

25

200 CONTACT CABLE CONNECTOR — crimp, snap-in contacts. Connector can be electrically disengaged without mechanical uncoupling. Cable outlet positioned at either 45° or 90°.



23

AMP-FINE-Y-R® SPLICE TECHNIQUE—compression-crimp method for joining 34 to 44 gage magnet wire to lead wires of 26 AWG or finer. Special air and electric crimping machine strips the wire and applies the splice. Takes just 12 seconds. Up to 300 finished splices per hour.

26

AMP-BLADE® MULTI-CIRCUIT FEED-THRU CONNECTOR—commoning block for rack-mounted systems. Density potential of 192 connections in a cubic area of 3.375". Crimp, snap-in contacts.

PROGRAMMING DEVICES

27

PATCHCORD—both universal and shielded construction. Standard rack mounted types and a new "space-saver" model which mounts into rather than onto the panel. Double-wiping action of crimped contacts. New double-detent patchcord. Spring retention member makes accidental dislodgement next to impossible.

28

"240" PATCHCORD — compact, lightweight programming system. Permits in-flight programming of electrical/electronic circuits in a matter of seconds.

29

PINBOARD — ideal for matrix programming. Factory pre-wired with standard or special silk screen legends.

ENVIRONMENTAL TERMINALS AND SPLICES

30

STRATOTHERM® — terminals and splices—for high temperature applications. Conform to MIL-T-7928.

31

TERMINYL® — pre-insulated terminals and splices for large wire sizes (8-4/0). Conform to MIL-T-7928.

32

SEALED HELICON® DISCONNECT — pre-insulated and environmentally sealed disconnect for all high-reliability circuits. Wire range 22-10. Exceeds requirements of MIL-T-7928.

33

CERTI-SEAL® SPLICE — prevents moisture breathing in aircraft and missile applications. Wire range 22-10. Exceeds requirements of MIL-T-7928.

TOOLING

A complete range of compression-crimp tooling to handle the most diverse wire application problems. Matching tool and terminal design insures reliable, uniform terminations of maximum tensile strength and electrical conductivity. Resistant to heat, vibration and corrosion.

34

"T"-HEAD® HAND TOOLS—lightweight, compact, hand crimping tools designed to handle a wide range of AMP Products in wire sizes 26-14 AWG. Color and numerical assembly coding. Ratchet-in prevents opening of crimping dies until complete crimp has been made.

35

AMP-TAPEMATIC® TOOLS—highly versatile, portable, semi-automatic crimping tools featuring tape-fed application of terminals and splices. Combine the speed and power of a bench-press with the compactness and light weight of a hand tool.

36

AMP-O-LECTRIC® AUTOMATIC MACHINE—up to 4,000 uniform connections per hour are possible with this automatic, electrically powered crimping machine. Bench-mounted, easily moved. Handles a variety of AMP tape and strip mounted terminals, splices and connector contacts.

CAPITRON® PRODUCTS

Over 2,500 specially designed power supplies, pulse units, transformers, capacitors, etc. available as off-the-shelf items. Exceed requirements of all applicable military and commercial specifications.

37

PULSE NETWORKS — designed to specifications covering all combinations of pulse widths, impedances and charging voltages with exact compliance to pulse shape, rise time and ripple tolerances.

38

RADAR PULSE NETWORKS—quadrupled power in the same cube. Charging choke, pulse forming networks, supply, and pulse transformers combined in one balanced unit.

39

CAPACITORS—a variety of special high voltage capacitors in oil-filled hermetically sealed cases, encapsulated in epoxy resin, of openframe construction and of other special types.

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A

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
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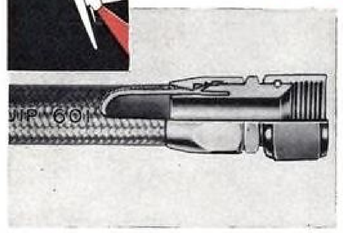
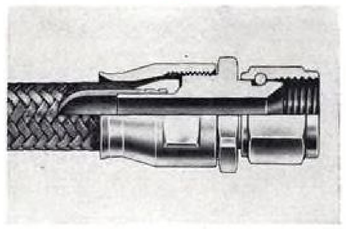
For complete information on the products shown, circle keyed numbers on the reply card on page 3.

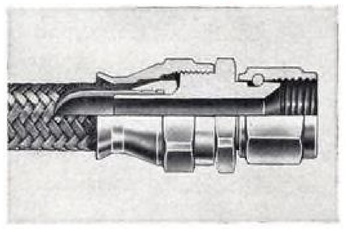
Aeroquip Quality Products Simplify



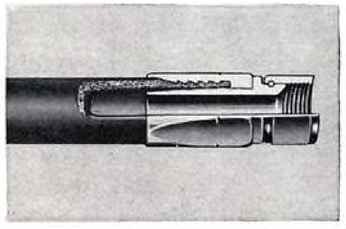
Aeroquip 601 Lightweight Engine Hose and reusable ***"little gem"*** Fittings for engine fuel and oil lines. Temperature range −65° to +300°F. Hose sizes -3 to -24. Fittings in steel for -3 to -5, aluminum -6 to -24. Catalog 105.



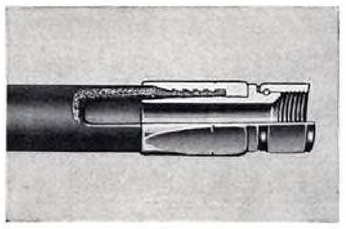
Aeroquip 666 and 667 Hose of Teflon* and reusable ***"super gem"*** Fittings for 1500 psi. systems in accordance with MIL-H-27267 (USAF). Hose sizes —3 to —20. Fittings in stainless steel, carbon steel and aluminum. Catalog 106.



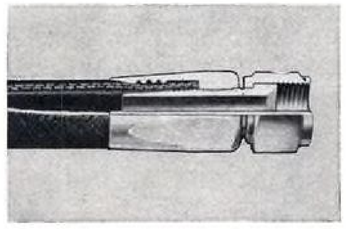
Aeroquip 677 Hose of Teflon and reusable ***"super gem"*** Fittings for 3000 psi systems in accordance with ARP604A. Hose sizes available —4 thru-12. Fittings in stainless steel and carbon steel. Catalog 106.



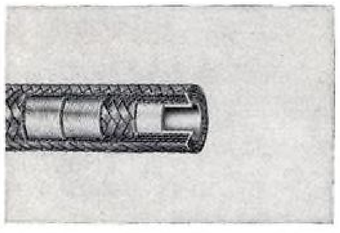
Aeroquip 611 and 602 Hose and reusable fittings for SKYDROL ** fire-resistant hydraulic fluid systems; 611 Hose for 3000 psi systems; 602 Hose for 1500 psi systems. Hose and fittings conform to military specifications. Hose sizes -4 to -20. Catalog 105.



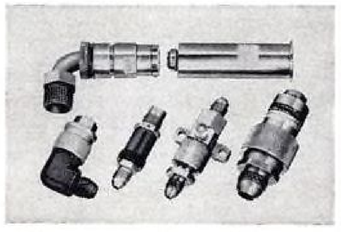
Aeroquip 309 Hose and reusable fittings for 3000 psi hydraulic and pneumatic systems in accordance with MIL-H-8790. Hose sizes -4 to -16. Fittings conform to MS28760 and MS28761. Catalog 105.



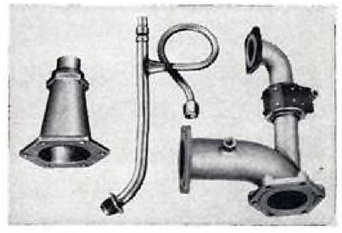
Aeroquip 303, 302A Hose and reusable fittings for aircraft hydraulic, pneumatic, fuel, oil and coolant systems in accordance with MIL-H-8795. Hose sizes -3 to -48. Fittings conform to MS28740. Catalog 105.



Aeroquip high pressure Pneumatic and Oxygen Hose for Ground Support Equipment. High density polyethylene hose for pneumatic applications to 6000 psig and Hose of Teflon for extreme temperatures gaseous applications. Write for Catalog 106.

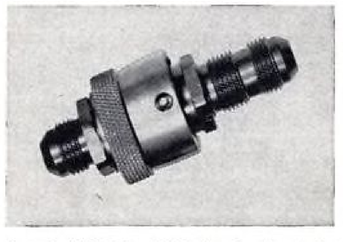


Aeroquip Special Quick Disconnect Couplings can be designed and produced to meet practically any requirement on aircraft, missile, ground support and electronic equipment; for hydraulic, pneumatic, fuel, lube oil, corrosive fluids, gases and electronic coolants. Write for Bulletin 254.

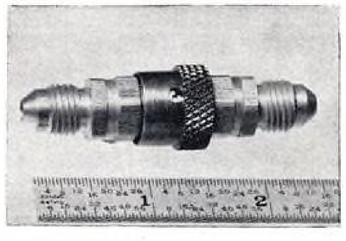


Aeroquip Precision Tube and Fitting Assemblies to specification. Capable of bend ratios less than 1 to 1 and with controlled wall thin out. Seamless aluminum, carbon or stainless steel, titanium, monel and others in standard and thin wall. Certified welding and brazing facilities. Write for information.

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-17.



Aeroquip 3750 Series Self-Sealing Coupling for fuel and lubricating oil systems. Conforms to MIL-C-7413A, Types 1 and 11. Operating pressures to 1500 psi. Available in sizes -4 through -32 and all end styles. In push-pull or screw type connections. Bulletin AEB-40.

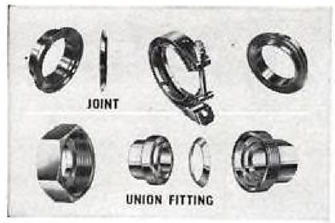


Aeroquip 1010 Series Self-Sealing Couplings are miniaturized (¼" tube O.D.) for use in pneumatics, hydraulics, and electronics cooling. The coupling is aluminum, seals are Viton A; temperature range —65° to +400° F., operating pressures to 1000 psi. and a weight of only .037 lb. make it unique. Bulletin AEB-42.

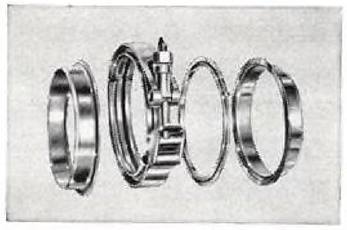
"super gem" Fitting U.S. Patent Nos. 2,833,567 and 2,731,279

*Du Pont trade name for its tetrafluoroethylene resin. **Monsanto trade name for its phosphate-ester base hydraulic fluid.

Aircraft and Missile Design Problems

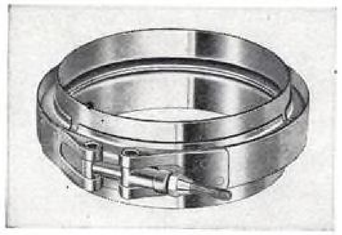


Marman All-Metal CONOSEAL Joints for connection of tubing and ducting of dissimilar metals subject to extreme temperatures, pressures and linear deflections. Temp. range —425° to +1500°F; up to 4500 psi, union fitting 16,000 psi. Standard sizes for 1" to 12" O.D. tubing. Catalog 800. *MARMAN DIVISION.*



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.*

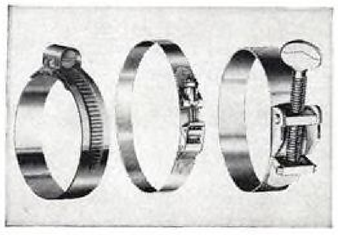
Marman V-Band Couplings and Flanges connect and seal all types of tubing, piping, ducts, and containers. Sizes are available from 1" through 12" tube O.D. Temperature range —65° F. to +800° F., operating pressures to 840 psi. Catalog 800. *MARMAN DIVISION.*



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.*

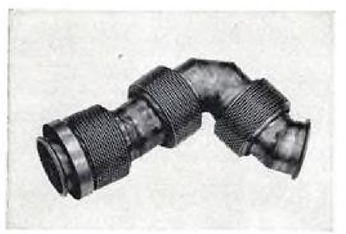
Barco Ball Joint for Cryogenic Piping handles fluid fuels and oxidizers including liquid oxygen. Temperatures: —320°F to +275°F. Pressures: 200 psi operating, 300 psi proof, 700 psi burst. Sizes 3"—12". Write for information. *BARCO DIVISION.*

Barco Aircraft Type Swivel Joints for 3000 to 4000 psi operating pressures in accordance with MIL-J-5513A. Lightweight, compact design saves space, installs easily. Plane and self-aligning types. Catalog 269-B Rev. *BARCO DIVISION.*



Marman Hose Clamps, Straps and Band Clamps for support and connection of components and accessories. Wide range of styles and sizes 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.*

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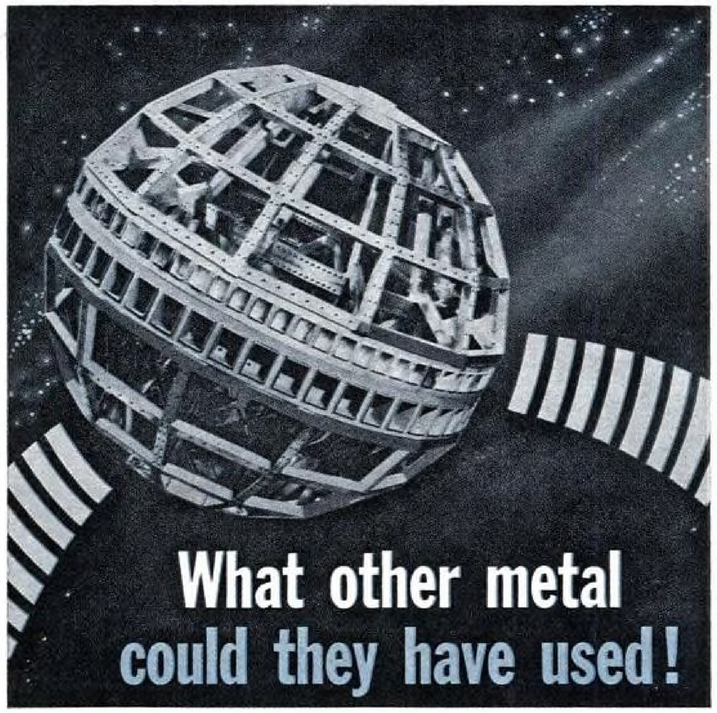

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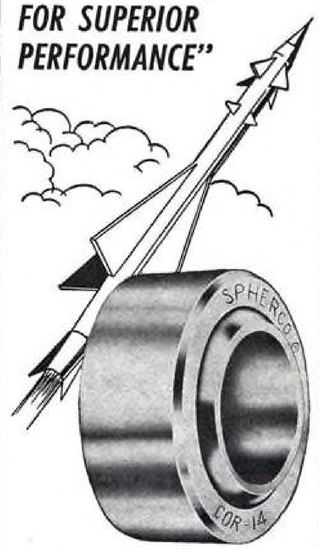

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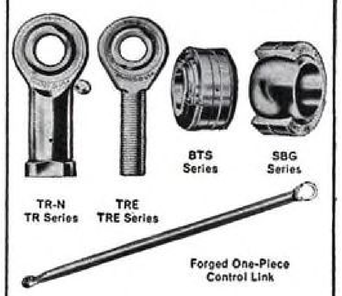
- Wide range of metals for races



WRITE FOR BULLETIN 560

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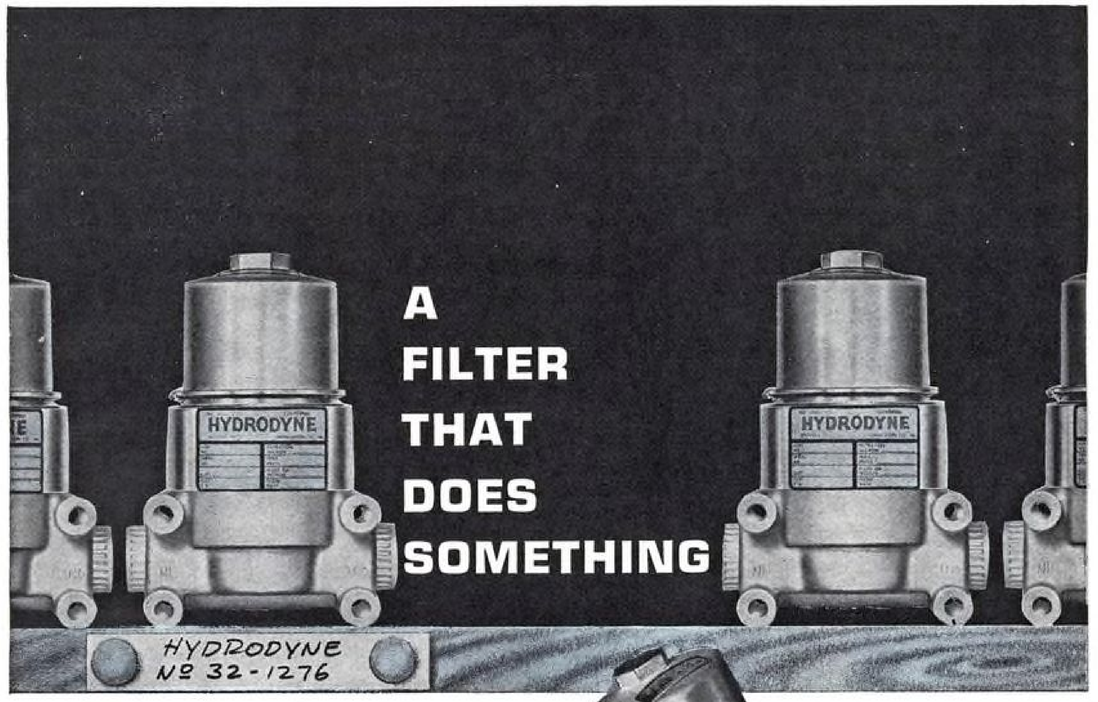

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Extensive design and manufacturing experience with the accuracies demanded in aerospace fluid handling enables Hydrodyne to put its reputation for excellence on the line . . . a line of fluid filters for every air and space application.

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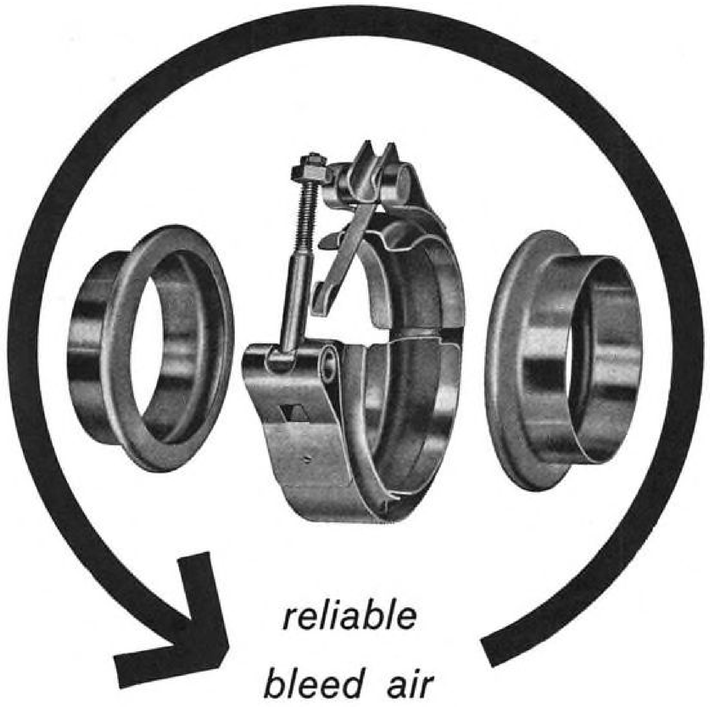

duct couplings

If your concern includes the reliability of pneumatic duct couplings in aerospace applications, take a look at the Janitrol line. Janitrol bleed air couplings have industry-wide acceptance because they provide virtually 100% sealing with low nut torque; lower stresses mean higher reliability. Absolutely no gaskets are required. For the ultimate in safety specify Dubl-Lock® couplings that seal even if the bolt is disconnected. Janitrol clamps, flanges, duct supports and other hardware are used in the 707, 880, 990, DC-8, F-105D, F4H, F-110, F8U and other high performance aircraft.

Janitrol standard and Dubl-Lock couplings are described in our 56-page catalog, a valuable reference for designers.

Janitrol also designs and builds couplings for special applications—extreme high temperature and pressure, and cryogenics. Request catalog JA 142 from Janitrol Aero Division of Midland-Ross Corporation, 4200 Surface Road, Columbus 4, Ohio.

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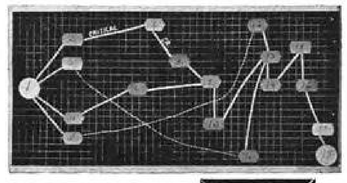

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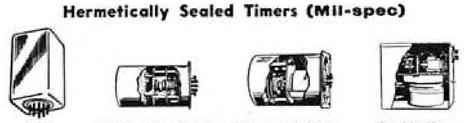
3 BASIC TYPES

1. Load contact closes (or opens) after a predetermined time . . . remains until reset.
2. Load contact closes (or opens) during timing interval. Automatically resets at end of preset time. Used with momentary contact to start.
3. Load contact is "ON" and "OFF" for predetermined times continuously until voltage is removed. Write for Bulletin 850.

Hermetically Sealed Timers (Mil-spec)



Solid state timers | Motor driven timers Quick reset | Escapement timer | Combination motor/escapement timers

Programming Timers (Mil-spec)

Microflex timer & counter | Cycl-flex, "plug-in" timer & counter | HM Multiflex reset or repeat cycle timer | MT heavy duty step switch

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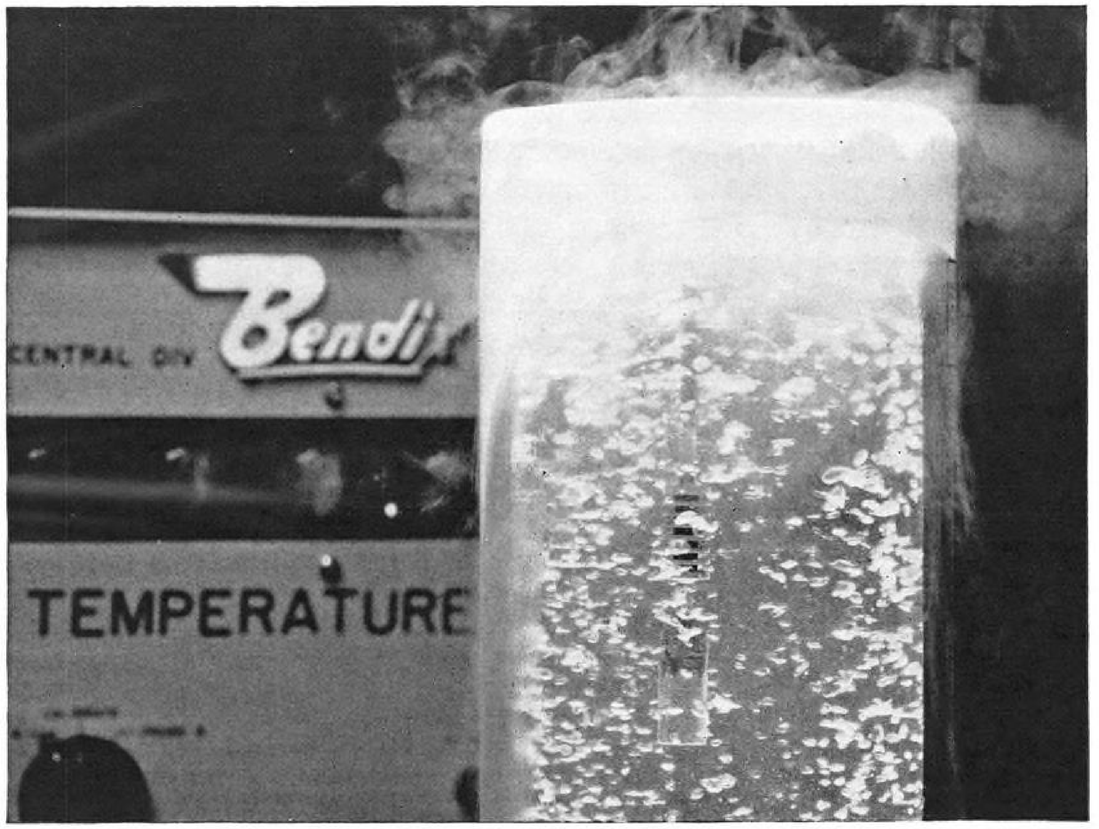
We are heavily involved in exotic instrumentation.



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In modern, fully equipped cryogenic development laboratories, a unique combination of Bendix experience is available to help meet your cryogenic instrumentation requirements. Our experience includes 11 years—liquid hydrogen, 23 years—liquid oxygen, and 42 years—precision instrumentation.

Perhaps one of your requirements is the precise measurement of temperature between 20°K and 400°K with digital readout. We can meet this and other cryogenic instrumentation requirements.

In addition to cryogenics, we are also active in the development of life support systems (both aircraft and manned missiles), propellant measurement and control, precision special-purpose electronics.

Tell us what you are working on. Tell us what you need. Let us help you. Write us in Davenport, Iowa, Dept. A.P.R.

Pioneer-Central Division

THE Bendix CORPORATION

Circle Number 163 on Reader-Service Card

Here's your guide to HONEYWELL PRECISION SYSTEMS and COMPONENTS

HONEYWELL SWITCHES

1 THE MANUAL SAFETY SWITCH is an O-ring sealed, seven pole, double-throw, manually operated switch. Rotation from "safe" to "armed" position accomplishes the switching action. The device breaks and grounds all circuits when the switch is in the "safe" position.

2 MODEL G2315 ACCELERATION SWITCH is a non-integrating inertial switch with nominal 700-g threshold and 100 to 2800-g operating range. It is characterized by a ball as the sensitive element.

3 MODEL G2305 INERTIAL SWITCH is an acceleration-actuated device which measures the product of acceleration and time—or velocity. It is used as a missile safing component to guarantee a safe separation.

The device is a mechanical system consisting of a magnet-weight-spring combination that establishes the threshold of 3.5 g's and an air dashpot piston that provides the single integration of acceleration or velocity signal at a nominal value of 310 fps over the 3.5 to 60 g applied acceleration range.

4 MODEL G2310 INERTIAL SWITCH consists of a temperature compensating piston mass traveling through a close-fitting, inert gas-filled cylinder under the influence of acceleration. Integration of the applied acceleration is attained from gas pressure forces restricting movement of the piston.

5 MODEL G2275 DIFFERENTIAL PRESSURE SWITCH consists of two sets of electrically independent, normally open contacts, pneumatically coupled in parallel, that close with an increase in differential pressure. A thin, convoluted diaphragm acts as the moving contact which deflects against a fixed contact when subjected to a differential pressure.

6 MODEL G2309 ACCELOSWITCH is an acceleration sensitive device with one normally closed and two normally open circuits. The normally closed circuit assures proper reset of the switch. The operating acceleration range is 12 to 60 g's.

HONEYWELL POWER DEVICES

7 TRANSISTOR POWER CONVERTER (G2184) is a DC to DC converter which is specifically designed for operation from a battery to supply high voltage for missile telemetering applications requiring light weight (63 watts/pounds), small size (14 cubic inches) and high efficiency (83%).

8 SOLID-STATE SERVO CONTROLLERS efficiently convert d-c or a-c power to proportional, bidirectional electrical power. These lightweight (50 watts/pound) controllers use controlled rectifiers (SCR's) to provide regulated, high-power (a-c or d-c) outputs from low-level a-c or d-c input signals.

9 MODEL G2389A INVERTER This 50 VA, 400 cycle, sine wave, regulated inverter operates from a fuel cell source for wide voltage variations from 18 to 30.5 volts. It supplies AC power for the guidance and control equipment of the Gemini space capsule and reflects a design goal of 70% efficiency with a minimum weight of 6 lbs. and maximum reliability of 7,000 hours MTBF.

10 FASTAX CAMERA POWER SUPPLY, PORTABLE, supplies compact, portable power for operating the Wollensak Optical Fastax Camera at speeds up to 4,750 frames/second.

11 SOLID-STATE INTEGRATED POWER SUPPLY operates from 108 to 122 volts, 400 cycle ± 20 cycles, 3 phase Y power source and provides 9 highly regulated, 3 phase outputs; 3 regulated constant current outputs; and 9 regulated DC outputs.

12 MODEL G2348A INVERTER—This 400 cycle, sine wave inverter provides precision frequency AC power for the guidance and control equipment in the Scout missile. The circuit consists of a crystal oscillator, frequency divider, power amplifier, SCR regulator and harmonic filter network.

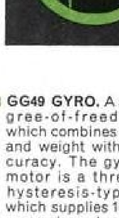
HONEYWELL INERTIAL COMPONENTS

13 GG49 GYRO. A single-degree-of-freedom gyro which combines small size and weight with high accuracy. The gyroscopic motor is a three-phase hysteresis-type motor which supplies 10^5 gm-Cm^2/sec. of angular momentum at a speed of 24,000 RPM.

14 GG53A CAGEABLE DISPLACEMENT GYRO. Serves as a vertical reference in flight control, radar stabilization and telemetering systems requiring angular position reference. The gyro has a drift rate of only 0.3° per minute.

15 GG56 MINIATURE PENDULOUS ACCELEROMETER is an electromagnetically-restrained floated pendulum linear accelerometer. It is a compact, rugged, reliable unit having low threshold capabilities and wide dynamic range (5x10-5g to 10g). This unit is designed basically for analog operation.

16 GG79 RATE GYRO. This spring-restrained rate gyro is designed for a wide variety of applications—from light aircraft autopilots to missile control systems. It has demonstrated an actual mean time between failures of well over 8,000 hours on high-performance aircraft.



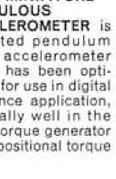
17 GG87 GYRO weighs less than one pound and occupies less than eight cubic inches. Designed to accommodate applications where up to ± 60.0° of input angular freedom is required. Measures movement rates as low as 10^{-6} radians per second.

18 GG99 DISPLACEMENT GYRO. Designed for missile and manned aircraft applications which require light weight (less than 4 lbs.) and high performance (drift rate 0.3° 1 min.). When used as a vertical gyro, verticality is obtained within seconds without the use of relays, switches or amplifiers.

19 M-100 RATE GYRO is a miniature constant damped spring restrained rate gyro. The unique quadrilever spring replaces standard torsion bar to improve performance and increase resistance to environmental stress. Production proven reliability and light weight (6 oz.) are added features.

20 MS-100 is a self-check version of the M-100. The spin motor running detector (SMRD) and gimbal torquer can check seven vital performance requirements. Self-check features are isolated and in no way affect gyro reliability.

21 GG116 MINIATURE PENDULOUS ACCELEROMETER is a floated pendulum linear accelerometer which has been optimized for use in digital rebalance application, although it operates equally well in the analogue mode. Improved torque generator design has resulted in low positional torque uncertainties.



22 GG125 MINIATURE ANGULAR ACCELEROMETER consists of a floated inertia element, a moving iron signal generator, a moving coil d.c. torquer, and a viscous damper. Threshold is less than 3 x 10^{-5} radians per second^2 and maximum range is ± 25 radians per second^2.

23 GG143 AND GG162 PENDULOUS GYRO ACCELEROMETERS are inertial grade integrating accelerometers offering excellent threshold, superb long term scale factor stability and long life. A Honeywell pendulous miniature integrating gyro used as the acceleration sensor insures accuracy, stability, and ruggedness in adverse environments.

24 GG159 GYRO . . . highly advanced, essentially frictionless, gas bearing spin motor of ceramic design and pivotless gimbal suspension. Gas bearings eliminate degradation and life problems generally associated with ball bearing motors, and reduce power requirements.

25 GG177 HINGED PENDULUM ACCELEROMETER is an electromagnetically restrained linear accelerometer combining high accuracy with compact size. In this design concept torque rebalance is applied to a flexure-supported pendulous mass. Threshold for this unit is less than 1 x 10^{-6}g with a range to 60g's.

26 GG249 GYRO is a special adaptation of the GG49 Miniature Integrating Gyro which features a separate torquer and signal generator at either end of the gimbal so as to reduce cross coupling effects. Provides higher accuracies while operating in varying temperatures.

27 HONEYWELL LA-800 is the smallest linear accelerometer of its kind available today offering a variable reluctance pickoff and an essentially constant damping ratio over such a wide temperature range. Excellent threshold resolution and linearity.

28 GG8001 GYRO is a single-degree-of-freedom gyro approximately 2" in diameter by 2¾" long. It features a permanent magnet torquer capable of torquing rates up to 8000°/hr at .01 linearity through the torquing range. Motor characteristics are similar to the GG49.

29 GOLDEN GNAT. The Gnat is a high-performance miniature rate gyro specifically designed for autopilot damping, radar antenna stabilization, and fire control system applications. Designed for a wide selection of design parameters with minor modification to the basic gyro construction.

30 GIMBALLESS ATTITUDE REFERENCE GYRO is a gas-powered two-degree-of-freedom gyro intended for operation under missile launch environment. With spin axis aligned to missile roll axis, this stable reference measures pitch and yaw deviations during the high g accelerations.

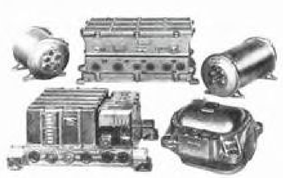
31 3-AXIS RATE GYRO package designed by Honeywell for the Saturn program is an example of many package designs. Gyros and/or accelerometer packages can be designed to meet any customer specifications.

HONEYWELL SYSTEMS

32 OPTICAL SYSTEMS AND CELESTIAL NAVIGATION SYSTEMS. Honeywell has wide experience in all phases of optical and electro-optical research, including two-and three-axis autocollimators; optical pickoffs for gyros; star simulators; catadioptric optical systems for startrackers; short range finders; stellar-optical system accuracies; radiation characteristics; in-orbit trajectory stabilization; and complete in-orbit start-up and alignment utilizing electro-optical hardware.

33 AIR FLOW CONTROL. Air flow schemes vary, depending upon the configuration of the inlet and mach range of the aircraft. The inlet configuration and inlet performance are basic design considerations and as such are the perogative of the aircraft designer. Honeywell, however, is skilled in the application and design of air flow controls, and can provide valuable assistance in the early design stages.

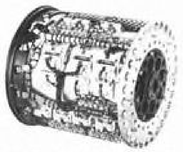
34 FLUID AND PROPELLANT MANAGEMENT SYSTEMS. As a pioneer in the development of fluid and propellant management systems, Honeywell possesses the capabilities and know-how to develop and manufacture a system to meet your needs. The systems now in operation include octane and jet fuels, oils, all cryogens, including liquid hydrogen and oxygen, and storable propellants such as N_2O_4 and UDMH.



35 NAVIGATION SYSTEMS. Minneapolis-Honeywell is capable of complete systems management responsibility for the design, development, manufacture and field support of any attitude or guidance control system. This is true regardless of the navigation problems involved . . . inertial, aided inertial, terrestrial, command, celestial or other.

36 ENGINE PRESSURE RATIO INDICATING SYSTEM. The Honeywell EPR system is composed of a transmitter mounting rack and an indicator. The system provides the pilot with instrumentation for engine power setting. By using this system, the pilot can quickly check the amount of thrust available for takeoff and easily fly at the proper setting to obtain maximum range while cruising.

37 REACTION CONTROL SYSTEMS. Honeywell has developed reaction controls utilizing "cold gas" and hypergolic bipropellants to meet various applications and requirements. These jets range in size from a few grams to many pounds of thrust. Conventional hypergolic and detonation hypergolic jets have been explored giving Honeywell a capability to meet almost any need.



38 MAGNETIC MEMORY DRUMS. The typical memory drum manufactured by Honeywell provides storage of instructions, data and timing signals. It is a conservative fixed head design with reliability and durability proven under severe environmental conditions. Rotor speed, 6,000 RPM; bit rate, 179 kc; bit density, 117 bits per inch.

39 INERTIAL PLATFORMS. These platforms range from two-axis, free gyro type to the miniature precision inertial platform. A 16-lb. subminiature platform 10¼ inches in length is also available. Differing platform versions have included: pulse rebalance of accelerometers; analog and digital outputs; three and four gimbal platforms; two and three accelerometer platforms.

40 INERTIAL CHECKOUT. These units incorporate a digit display of navigation information and time, and annunciator lights for the display of malfunctions and status information. A printer is provided to print hard copy of the status, etc.

41 PRECISION MAGNETIC OSCILLATORS are a family of low-frequency, precision time bases for use in timers and programmers. Oscillators, timers and programmers are designed to customer requirements.

42 ATMOSPHERIC COMPOSITION SENSING. Honeywell has developed sensing and control techniques ranging from atmospheric control of closed space cabins to determination of atmospheric characteristics of other planets. These techniques are also being utilized for meteorological research, upper atmosphere study, and efforts in weather prediction.

HONEYWELL COMPUTERS

43 AIR DATA COMPUTER is an integrated single-package system which responds to input parameters of total pressure, static pressure temperature, angle of attack, and power supply. Advantages are gained in the integrated single-package approach where a minimum number of servo loops are employed and direct driving of outputs can be achieved at the computation sources.

44 HONEYWELL AEROSPACE COMPUTER is manufactured in two packaging configurations: the air cooled version and radiation cooled version. Features of both are: large memory capacity of over 10,000 instructions, constants and working storage; ultra conservative circuitry with silicon transistors operating at 179 kc; environmental capability with circuitry capable of rated performance in ambient temperatures from −55° to +100°C.

45 HONEYWELL SUBMINIATURE (PICO) COMPUTER is an 18-lb., 700 cu. in. radiation cooled digital computer utilizing a biax non-destructive magnetic core memory capacity. The computation rate is about double the aerospace computer listed at left.

46 HONEYWELL DIGITAL DIFFERENTIAL ANALYZER is a high capacity (256 Integrator) computer designed to withstand a 25 g force and ambient temperature variations from −65° to +100°C. Weight: 36 lbs. Volume: 1,690 cubic inches.

HONEYWELL INSTRUMENTS

47 ADVANCED DISPLAYS. Honeywell is currently engaged in the design and fabrication of advanced presentations for high-performance manned vehicles, including vertical displays with extended range and spherical displays with attitude capabilities.

48 HONEYWELL DEW-POINT HYGROMETER works on a radioactive absorption technique. A metallic radioactive foil is attached to a thermoelectric cooler. A solid state detector is placed one millimeter away from the radioactive source. When no condensate is evident on the surface of the radioactive source, the detector will give a maximum signal.

49 RADAR ALTIMETERS. Honeywell has developed a series of extremely accurate radar altimeters for low-altitude sensing by applying millimicrosecond pulse techniques to precise distance measurement. Honeywell altimeters utilize advanced pulse transmission and tracking techniques, thus eliminating the averaging and doppler errors inherent in FM continuous-wave devices.

Honeywell radar altimeters are available for a variety of applications in altitude ranges from 0 to 5000 feet.

50 HONEYWELL TAPE READERS. Photoelectric Tape Readers, available in 8- or 16-channel configurations, are recommended for a variety of applications requiring a high-reliability, medium-speed input device, such as pre-flight test and checkout, pre-launch test sequences for missiles, and airborne computer loading and verification.

51 ANALOG-DIGITAL (SERVO) CONVERTER. Analog servos with digital-encoder output and the electronics required to serialize the outputs of the encoders have been designed by Honeywell. Subtraction of reference voltages from the incoming analog signal is performed to obtain analog voltage input.

52 MOTORIZED DIGITAL-ANALOG CONVERTER. Conversion is provided by the positioning of an analog output shaft using incremental pulses to position a stepping-motor geared to the output shaft. Comparison of computer stored address and encoder output represents present position.

53 MODEL 1B SEA SCANAR combines in one versatile piece of equipment the functions of both a conventional depthsounder and a high-definition, automatic scanning and ranging sonar set.

The Sea Scanar can be set to scan automatically, covering the entire forward 180-degree sector or any 90-degree sector within the forward 240 degrees.

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The USS Family of High Strength Steels for lighter, stronger ground support equipment

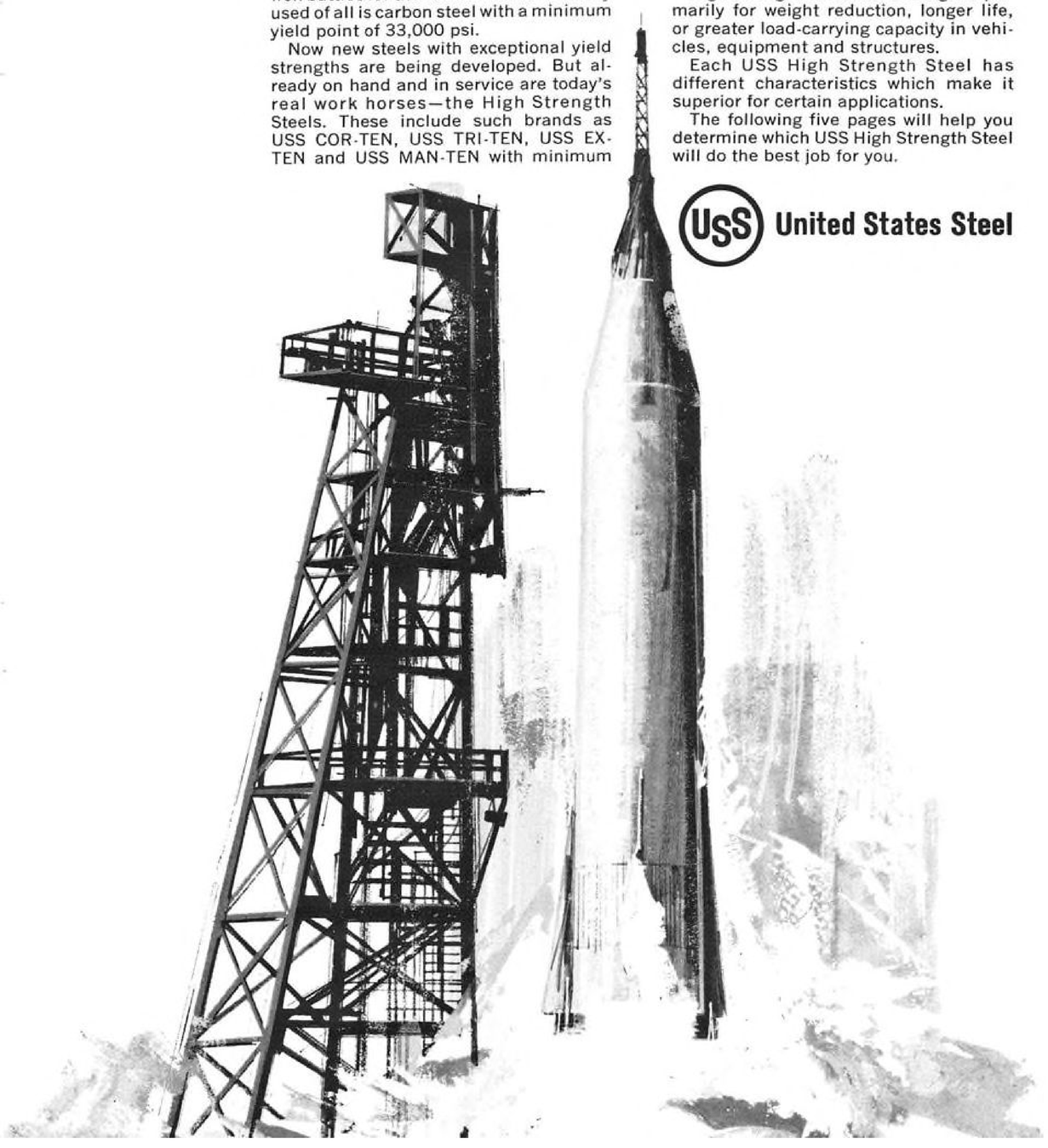
More than 10,000 different steels have been developed since Damascus blades won battles for the Turks. The most widely used of all is carbon steel with a minimum yield point of 33,000 psi.

Now new steels with exceptional yield strengths are being developed. But already on hand and in service are today's real work horses—the High Strength Steels. These include such brands as USS COR-TEN, USS TRI-TEN, USS EX-TEN and USS MAN-TEN with minimum yield points from 40,000 minimum to 65,000 psi minimum.

High strength steels were designed primarily for weight reduction, longer life, or greater load-carrying capacity in vehicles, equipment and structures.

Each USS High Strength Steel has different characteristics which make it superior for certain applications.

The following five pages will help you determine which USS High Strength Steel will do the best job for you.



USS United States Steel

USS COR-TEN Steel

This premier high-strength low-alloy steel, with its combination of greater strength and outstanding resistance to atmospheric corrosion, is desirable wherever weight reduction or longer life, or both, are prime considerations.

USS COR-TEN Steel is available in all rolled steel products—plates, structurals (including wide flange), bars, sheet and strip.

USS COR-TEN Steel provides:

- A minimum yield point of 50,000 psi for thicknesses up to 2½" inclusive.
- Atmospheric corrosion resistance 4 to 6 times that of carbon steel.
- A grade weldable in all thicknesses by the usual methods.

For the shielded-metal-arc welding process, the following practices are suggested:

Electrode	Thickness, Inches	Minimum Preheat or Interpass Temperature, °F.
Low-hydrogen type mild steel (E60 or E70 group)	2 and under	Not required
	Over 2 to 4	200
Ordinary covered mild steel (E60 or E70 group)	½ and under	Not required
	Over ½ to 2 incl.	200
	Over 2 to 4 incl.	300

The above welding practices for 2" to 4" also pertain to thicknesses over 4" except for designs involving severe restraint. Our Metallurgical Engineers are available to advise in these instances.

Mechanical Property Requirements	2½" and Under in Thickness	Over 2½" to 4" in Thickness	Over 4" to 8" in Thickness
Yield Point, min, psi	50,000	46,000	42,000
Tensile Strength, min, psi	70,000	67,000	63,000
Elong. in 8", min, per cent (0.180 in. & heavier)	19	19	19
Elong. in 2", min, per cent	22	24	24
Cold Bend (180° specimen bend) To ¾" incl.....180°D=1t Over ¾" to 1" incl.....180°D=1½t Over 1" to 1½" incl.....180°D=2t Over 1½" to 2" incl.....180°D=2½t Over 2".....180°D=3t	When sheet or strip products are specified as galvanized, cold rolled, or in coils, or when annealing or normalizing is specified for any product, the minimum yield point and tensile strength requirement will be reduced by 5,000 psi. The furnishing of cold rolled sheets to strength levels other than the above is subject to negotiation. ASTM Standard Specimens, minimum number of tests and ductility modifications apply.		

Chemical Composition

Thicknesses ½" and under	C	Mn	P	S	Si	Cu	Cr	Ni	V
Composition Ranges, per cent	.12 max	.20/.50	.07/.15	.05 max	.25/.75	.25/.55	.30/1.25	.65 max	—
Typical Composition, per cent	.09	.38	.09	.033	.48	.41	.84	.28	—
Thicknesses over ½"									
Composition Ranges, per cent*	.10/.19	.90/1.25	.04 max	.05 max	.15/.30	.25/.40	.40/.65	—	.02/.10
Typical Composition	.16	1.15	.02	.03	.20	.32	.50	—	.05

*U. S. Patent No. 2,845,345

Acid Soluble Al .01/.06 (Fine Grain Practice)

Additional Typical Properties For Engineering Guidance

Resistance to atmospheric corrosion.....4 to 6 times carbon steel
Compressive Yield Point, psi.....Equal to Tensile Yield Point
Shearing Strength, psi.....Equal to 60% Tensile Strength
Modulus of Elasticity, psi.....28,000,000 to 30,000,000
Endurance Limit, (Rotating beam—polished specimen) psi.....35,000
Charpy Impact, keyhole notch, (as rolled, room temp, avg) ft-lb.....40
Coefficient of Expansion per degree F, 70° to 200°F.....0000063

Fabricating Practice For Cold Forming

Thickness of Material	Suggested Minimum Inside Radius
Up to 1/16 in. incl.	1t
Over 1/16 to ¼ in. incl.	2t
Over ¼ to ½ in. incl.	3t

Hot forming is recommended for angle bending material over ½ inch in thickness.

USS COR-TEN Steels meet the requirements of the following specifications:

ASTM **A242** for plates, shapes, and bars
ASTM **A375** for hot rolled sheets and strip
ASTM **A374** for cold rolled sheets and strip
SAE **950D** for sheets, strip, plates, shapes, and bars ½" and under
SAE **950D** for plates, shapes, and bars over ½"*
MIL-S-**7809** for sheet, strip, plates, shapes, and bars*
MIL-S-**12505** for plates, shapes, and bars.
*Modified specification for all forms.

USS United States Steel

USS TRI-TEN Steel

USS TRI-TEN Steel is a high-strength low-alloy steel intended primarily for weight reduction by means of greater strength and toughness, in applications involving cold forming, metal-arc welding and moderately severe impact loading in low-temperature service, with atmospheric corrosion resistance slightly better than that of copper steel.

USS TRI-TEN Steel in heavy sections is particularly suitable for structural members of metal-arc welded bridges, earthmoving equipment, construction machinery and similar applications. The sheet, strip and light plate products are particularly suitable for applications where difficult cold forming is involved.

USS TRI-TEN is available in plates, structural shapes, bars, bar shapes, hot rolled sheets and strip as light as .071".

USS TRI-TEN Steel is sold to minimum mechanical properties shown here and meets the following specifications:

ASTM A242 for plates, shapes, and bars
ASTM A441 for plates, shapes, and bars
MIL-S-12505 for plates, shapes, and bars
MIL-S-13281 Class B, Grade 1 for sheet, strip, plates, shapes, and bars
MIL-S-13281 Class B, Grade 2 for sheet, strip, plates, shapes, and bars
SAE 945A for sheet, strip, plates*, shapes*, and bars*
SAE 950A for plates, shapes, and bars
SAE 950B for plates, shapes, and bars
*Modified specifications in forms indicated

Mechanical Property Requirements	*Sheets, Strip and Light Plate	Thickness Ranges: Plates, Structurals, CB's and Bars** ¾" and under	Over ¾ to 1½" incl.	Over 1½ to 4" incl.
Yield Point, min, psi	45,000	50,000	46,000	42,000
Tensile Strength, min, psi	60,000	70,000	67,000	63,000
Elong. in 8 in., min, %	19	18	19	19
Elong. in 2 in., min, %	25	—	—	24
180° Cold Bend (Specimen Bend)	(See below)	D=1t	Over ¾ to 1" D=1½t Over 1 to 1½" D=2t	Over 1½ to 2" D=2½t Over 2 to 4" D=3t
Sheets and Strip	Flat			
Light Plate	D=1t			

*When as-rolled plates ⅜" and under are required for severe cold forming or when produced on sheet or strip mills, the mechanical properties of the sheet and strip grade will apply.
**When plates or bars are ordered normalized or annealed or when severe cold forming is involved, both the minimum yield point and tensile strength requirements will be reduced 5,000 psi.
ASTM Standard Specimens; minimum number of tests and ductility modifications apply.

Additional Typical Properties for Engineering Guidance

Resistance to Atmospheric Corrosion	2 times carbon steel
Compressive Yield Point, psi	Equal to Tensile Yield Point
Shearing Strength, psi	Equal to ¾ Tensile Strength
Modulus of Elasticity, psi	28,000,000 to 30,000,000
Endurance Limit, (as rolled, avg.) psi	42,000
Charpy Impact, keyhole notch, (as rolled, room temp. avg.) ft-lb	42
Coefficient of Expansion per degree F., 70° to 200° F	.0000063

Chemical Composition, Percent	C	Mn	P	S	Si	Cu	V
Normal Composition Limits	0.22 max.	1.25 max.	0.04 max.	0.05 max.	0.30 max.	0.20 min.	0.02 min.
Typical Composition—Heavy Products	0.18	1.14	0.023	0.034	—	0.28	0.045
Typical Composition—Sheet, Strip & Light Plates	0.10	0.72	0.021	0.031	—	0.26	0.042

Fabricating Practice for Cold Forming

Thickness of Material	Suggested Minimum Inside Radius for 45,000 Y.P. Min.	50,000 Y.P. Min.
Up to 0.180" incl.	1t	—
Up to ¼" incl.	1½t	2t
Over ¼ to ½" incl.	2½t	3t

Hot forming is recommended for angle bending material over ½ inch thickness.

This mark tells you a product is made of modern, dependable Steel.

See following pages for additional information on USS High Strength Steels

USS MAN-TEN Steel

One of the least expensive yet most versatile steels. It features 50% higher yield point than ASTM A7 structural carbon steel at a moderate price (only about 20% more than A7). When MAN-TEN Steel's greater strength is fully utilized in design, it is one of the most economical constructional materials. MAN-TEN Steel has found wide use where either weight reduction or increased service life is desirable.

USS MAN-TEN Steel is furnished in two variations to meet different requirements. The properties for each of these are shown below.

USS MAN-TEN Steel is intended primarily for weight reduction by means of greater strength in applications involving moderate forming. It is considered weldable under controlled conditions. Suggested for earthmoving machinery, construction equipment, specialized containers and other material handling applications.

Mechanical Properties	14 Ga. to ½" incl.	Over ½" to 1½" incl.	Over 1½" to 3" incl.
Yield Point, Min., Psi	50,000	45,000	40,000
Tensile Strength, Min., Psi	75,000	70,000	65,000
Elong. in 8", Min., Per Cent*	18	19	19
Elong. in 2", Min., Per Cent	20	..	22
Cold Bend—180°	D=1T	D=2T	D=3T

The minimum yield point and tensile strength requirements will be reduced by 5,000 psi when annealing or normalizing is specified, or when furnished in coils.
*For all products except sheet and strip.

Availability:
Plates, structural shapes including wide flange beams, bars, bar shapes, hot rolled sheets and strip .071 inches and thicker.

Composition Range

	C	Mn	P	S	Si	Cu
Ladle	.25 max.	1.10-1.60	.045 max.	.050 max.	.30 max.	.20 min.
Typical	.22	1.40	.020	.036	.07	.27

Fabricating Practice for Cold Forming

Thickness of Material	Suggested Minimum Inside Radius
Up to ⅛ in. incl.	2t
Over ⅛ to ¼ in. incl.	2½t
Over ¼ to ½ in. incl.	3½t

Hot forming is recommended for angle bending material over ½ inch in thickness:

USS MAN-TEN (A440) Steel

USS MAN-TEN (A440) Steel meets all the requirements of ASTM Specification A440 for plates, structural shapes, and bars. This designation should be used on orders when A440 is required. This grade is intended for riveted or bolted bridges, buildings, towers, and other structures.

USS MAN-TEN also meets the requirements of the following additional specifications:
MIL-S-13281 Class B Grade 1 in sheet, strip, plates, shapes, and bars
MIL-S-13281 Class B Grade 2 in sheet, strip, plates, shapes, and bars
SAE 945 C in sheet*, strip*, plates*, shapes*, and bars*
SAE 950 C in sheet*, strip*, plates, shapes, and bars
*Modified specifications in forms indicated

Mechanical Properties	To ¾" incl.	Over ¾" to 1½" incl.	Over 1½" to 4" incl.
Yield Point, Min., Psi	50,000	46,000	42,000
Tensile Strength, Min., Psi	70,000	67,000	63,000
Elong. in 8", Min., Per Cent	18	19	19
Elong. in 2", Min., Per Cent	..	..	24
Cold Bend—180°	D=1T	Over ¾-1" D=1½T Over 1-1½" D=2T	Over 1½-2" D=2½T Over 2-4" D=3T

Fabricating Practice for Cold Forming

Thickness of Material	Suggested Minimum Inside Radius
Up to ¼ in. incl.	2½t
Over ¼ to ½ in. incl.	3½t

Hot forming is recommended for angle bending material over ½ inch in thickness:

Composition Range	C	Mn	P	S	Si	Cu
Ladle	.28 max.	1.10-1.60	.040 max.	.050 max.	.30 max.	.02 min.
Check	.32 max.	1.05-1.65	.050 max.	.063 max.	.33 max.	.18 min.
Typical	.26	1.45	.020	.036	.07	.27

United States Steel

USS EX-TEN Steel

USS EX-TEN Steel is the newest member of our High Strength Steel Family. It is a thrifty value—offering one of the highest strength-to-cost ratios of all steels.

USS EX-TEN Steel is intended to fill the need for an economical grade for applications in which greater strength, to gain weight reduction, is the primary requirement. USS EX-TEN Steel has good ductility and weldability. Its resistance to atmospheric corrosion is the same as that of carbon steel. This may be doubled by specifying copper .20 minimum.

USS EX-TEN Steel is suggested for such applications as automotive and truck parts, cargo containers, tote boxes, formed building members, LP gas cylinders, construction machinery, line pipe and many others.

USS EX-TEN Steels are sold to minimum mechanical properties shown here, and meet the following specifications:

MIL-S-13281 Class B Grade 1 EX-TEN 45 in sheet, strip, plates, shapes, and bars
MIL-S-13281 Class B Grade 2 EX-TEN 50 in sheet, strip, plates, shapes, and bars
SAE 945A EX-TEN 45 in sheet*, strip*, plates*, shapes*, and bars*
SAE 945C EX-TEN 45 in sheet, strip, plates*, shapes*, and bars*
SAE 950A EX-TEN 50 in sheet and strip
SAE 950B EX-TEN 50 in sheet, strip, plates, shapes, and bars
SAE 950C EX-TEN 50 in sheet* and strip*
ICC MC-303 EX-TEN 45
*Modified specifications in forms indicated.

This mark tells you a product is made of modern, dependable Steel.

Grade	Mechanical Properties				Product Availability and Chemical Composition, percent										
	Yield Point Min, Psi	Tensile Strength Min, Psi	Elongation		Plates Thickness, Inches			Structurals (Incl. WF) Web Thickness, Inches			Bars	H.R. Strip	H.R. Sheets	C.R. Sheets	Galv. Sheets
			Sh & St, % in 2"	Other, % in 8"	To ⅛", Incl.	Over ⅛ to ¼"	Over ¼ to 1½"	To ⅝", Incl.	Over ⅝ to ¾"	Over ¾"					
USS EX-TEN 65	65,000	80,000	16	15							To ⅛" Max. Th.				
			Carbon, Max.		.26						.26	.22	.22		
			Manganese, Max.		1.35						1.35	1.35	1.35		
			Columbium, Min.		.01						.01	.01	.01		
			Vanadium, Min.		.02						.02				
			Nitrogen, Max.		.012						.012	.012	.012		
USS EX-TEN 60	60,000	75,000	18	16							To ⅛" Max. Th.				
			Carbon, Max.		.26			.26			.26	.22	.22		
			Manganese, Max.		1.35			1.35			1.35	1.25	1.25		
			Columbium, Min.		.02							.01	.01		
			Vanadium, Min.					.02			.02				
			Nitrogen, Max.		.012			.012			.012				
USS EX-TEN 55	55,000	70,000	20	17							To ¾" Max. Th.				
			Carbon, Max.		.26	.26		.26	.26		.26	.20	.20		
			Manganese, Max.		1.35	1.35		1.35	1.35		1.35	1.25	1.25		
			Columbium, Min.		.01							.01	.01		
			Vanadium, Min.			.02		.02	.02		.02				
USS EX-TEN 50	50,000	65,000	22	18							To ¾" Max.Th.	Over ¾ to 1½"			
			Carbon, Max.		.22	.22	.26	.22	.22	.26	.22	.26	.20	.20	.20	.20
			Manganese, Max.		1.25	1.25	1.35	1.25	1.25	1.35	1.25	1.35	1.00	1.00	1.00	1.00
			Cb or V, Min.		.01			.01			.01		.01	.01	.01	.01
			Vanadium, Min.			.02	.02		.02	.02		.02				
USS EX-TEN 45	45,000	60,000	25*	19							To 1½" Max. Th.				
			Carbon, Max.		.22	.22	.22	.22	.22	.22	.22		.20	.20	.20	.20
			Manganese, Max.		1.25	1.25	1.25	1.25	1.25	1.25	1.25		1.00	1.00	1.00	1.00
			Cb or V, Min.		.01			.01			.01		.01	.01	.01	.01
			Vanadium, Min.			.02	.02		.02	.02						

*Elongation for cold rolled or galvanized sheets, EX-TEN 45 is 23.0%.

All EX-TEN Steels have Phosphorus .04 max., Sulphur .05 max.
ASTM Standard Specimens; minimum number of tests and ductility modifications apply.
When hot rolled products are ordered annealed or normalized, the mechanical property requirements listed above do not apply.

Additional Typical Properties for Engineering Guidance

Resistance to Atmospheric Corrosion	Same as Carbon Steel
Compressive Yield Point, psi	Equal to Tensile Yield Point
Shearing Strength, psi	60% Tensile Strength
Modulus of Elasticity, psi	28,000,000 to 30,000,000
Coefficient of Expansion per Degree F (70° to 200°)	.0000063

Fabricating Practice for Cold Forming

Thickness of Material	Suggested Minimum Inside Radius for Angle Bends				
	EX-TEN 45	EX-TEN 50	EX-TEN 55	EX-TEN 60	EX-TEN 65
Up to 0.180" Incl.	1T	1½T	2T	2½T	3T
Over 0.180 to .2299 (Sheets only)	1½T	2T	2½T	3T	3½T
Plates (1½" Max.)	2T	2½T	3T	3½T	4T

Hot forming is suggested for angle bending plates over ½" thick.

See following page for additional information on USS High Strength Steels

The USS Family of High Strength Steels for lighter, stronger ground support equipment

This mark tells you a product is made of modern, dependable Steel.

SEND FOR ONE OF THESE BOOKS.

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United States Steel

United States Steel Corporation
Room 6652
525 William Penn Place
Pittsburgh 30, Pennsylvania

Gentlemen:

Please send me information on the steels checked:

- ☐ Design Manual for High Strength Steels
- ☐ USS COR-TEN High-Strength Low-Alloy Steel
- ☐ USS TRI-TEN High-Strength Low-Alloy Steel
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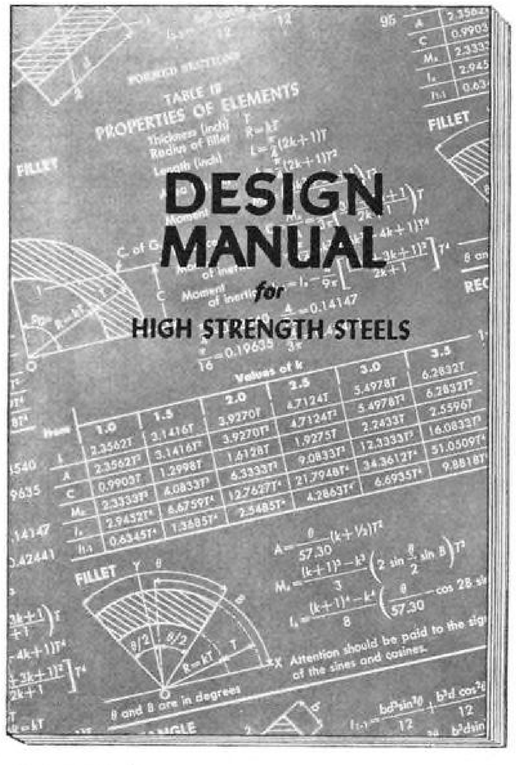

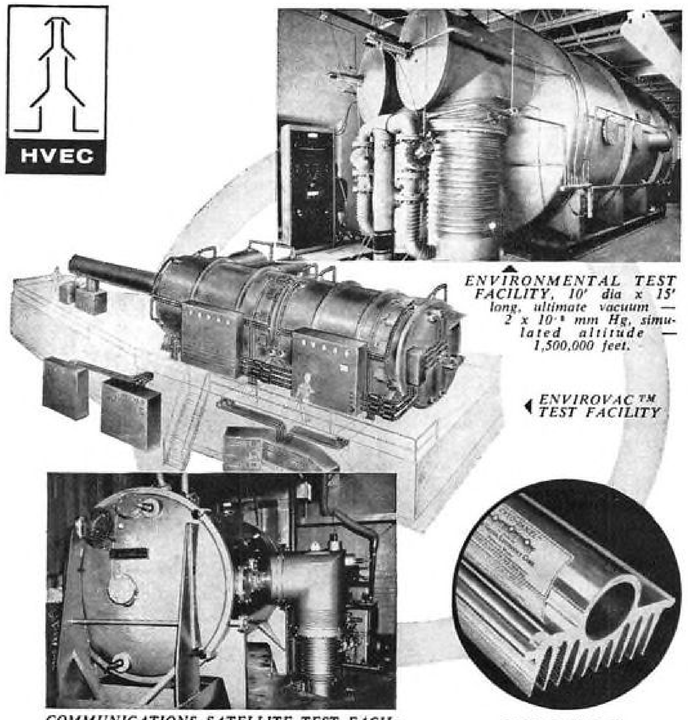

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Bulletin R43

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Randall Graphite Bearings, Inc.
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Shafer Bearing Div., Chain Belt Co.
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Torrington Co., The

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a. Clevis
b. Cotter
c. Dowel

ALLMETAL SCREW PRODUCTS CO., INC. SEE ADV. P. 41
Anti-Corrosive Metal Products, b, c
Bland Burner Co., The, Precision Threaded Products Div., a, c
BRILES MFG., a. SEE ADV. 4TH COVER
Bristol Co., The, c
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John Gillen Co., Sub. Stanray Corp., c
Hardware Specialty Co., Inc.
Jaros Aircrafters, a, b, c
Kaydon Engineering Corp., The, c
Lamson & Sessions Co., The, a, b
Lucas Aircraft Supply Co., a, b, c
National Screw & Mfg. Co., The, a, b
Qualified Air Components, a
Screw Corp., a
Y. W. Small Parts, Ltd., c
Standard Pressed Steel Co.
Standard Screw Co., Chicago, Hartford, Western Divs., c
Torrington Co., The, c

Pistons, Reciprocating Engine

ALUMINUM CO. OF AMERICA. SEE ADV. P. 80, 81
Canadian Pratt & Whitney Aircraft Co., Ltd.
Continental Motors Corp., Aircraft Engine Div.
FIAT S.P.A., DIVISIONE AVIAZIONE. SEE ADV. P. 30
Sperry Utah Div., Sperry Rand Corp.

Pitot Tubes

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Hooker Chemical Corp., a, j
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Nopco Chemical Co., Plastics Div., n
Norwalk Co., Inc., a
NUCLEAR ENTERPRISES, LTD., c, w. SEE ADV. P. 42
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Polymer Corp., The, b, n, r, s, w
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G. T. Schjeldahl Co., n, t, v, w
Seiberling Rubber Co., a, u, v
SEMI-ELEMENTS, INC., r, s, t, u, v, w. SEE ADV. P. 162
W. S. Shamban & Co., b, n, r, s
Sherwin-Williams Co. c, d, p, t
Societa Bombrini Parodi-Delfino, t
Adam Spence Corp., n, r
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Allison Div., General Motors Corp., c
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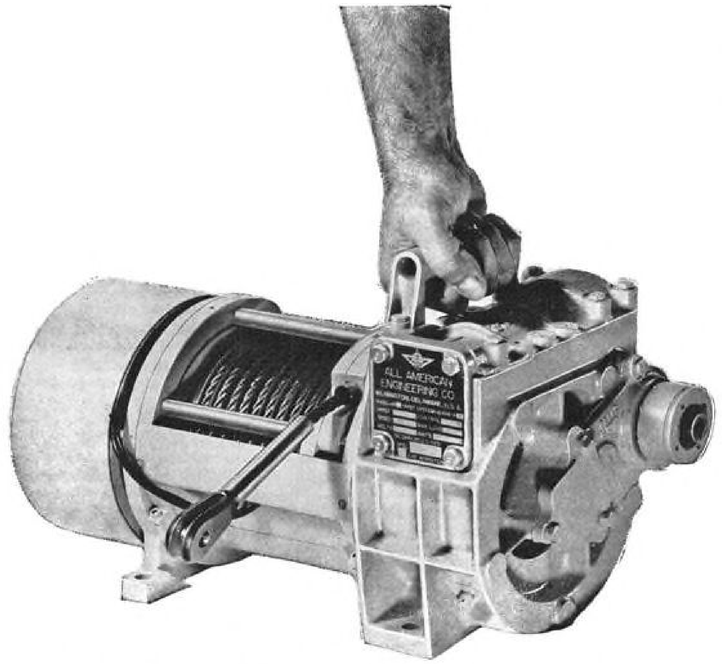

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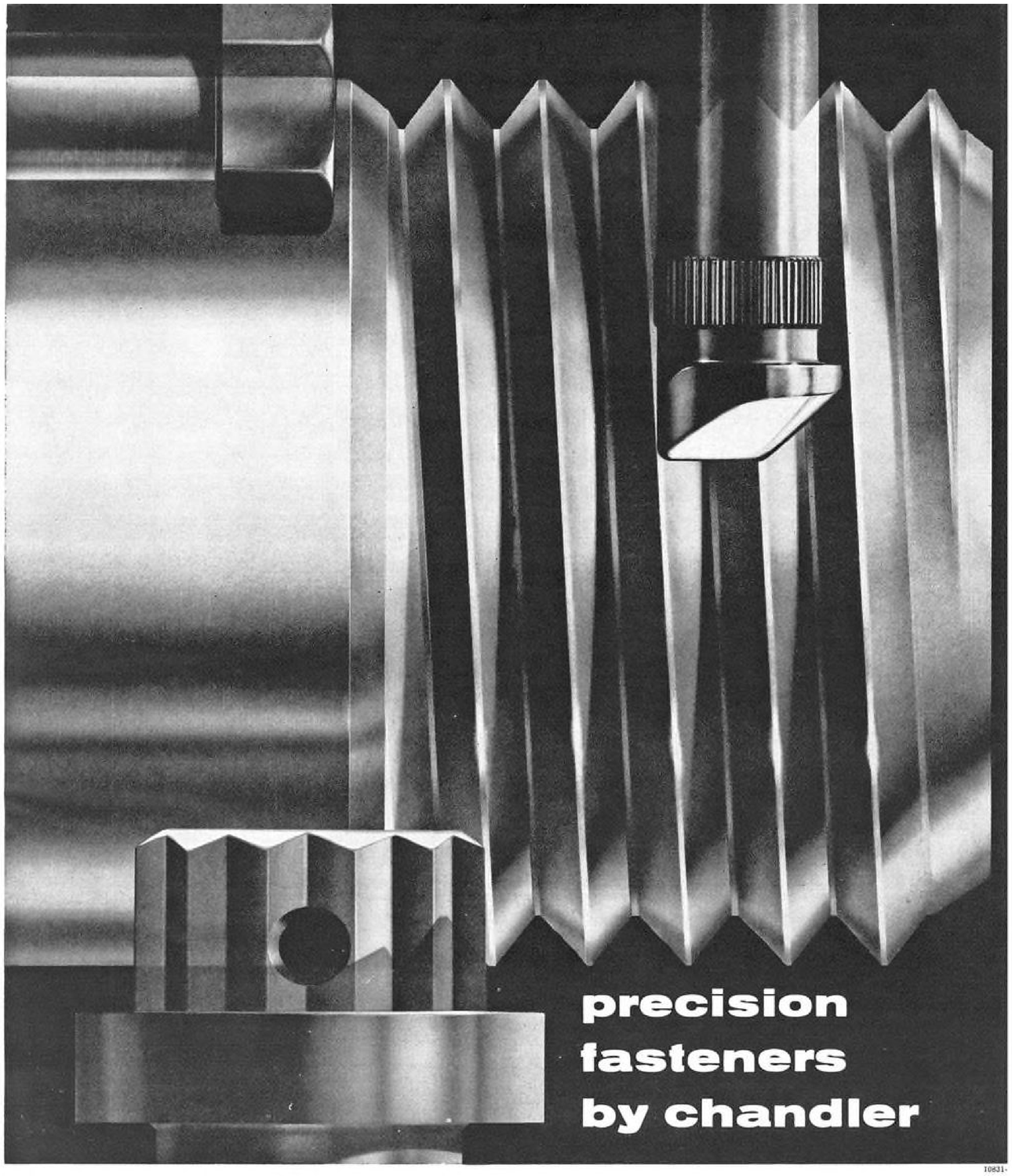

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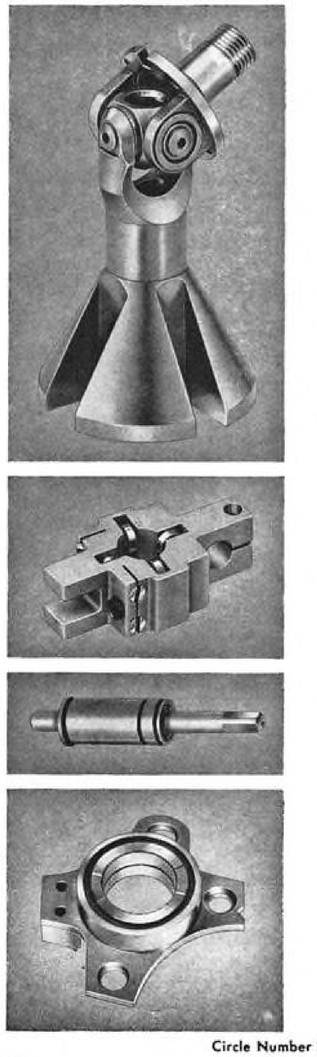

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Photo courtesy McDonnell Aircraft

Sundstrand starters specified for F-110 aircraft

Aeronautical Systems Division of Wright-Patterson Air Force Base has awarded an initial procurement order to Sundstrand Aviation, a Division of Sundstrand Corporation, for Sundstrand Cartridge-Pneumatic Starters for the new McDonnell F-110 aircraft.

Sundstrand Aviation, working closely with the Air Force, developed the first fully qualified cartridge-pneumatic starter in June, 1961. Since that time, the cartridge-pneumatic starting concept has gained growing acceptance. The dual-purpose starter is ideally suited for today's multiple mission requirements. It is designed to utilize conventional ground-support equipment for normal operational pneumatic starts. For alert starts, or remote base operations where ground power equipment is not readily available, you use the cartridge mode.

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There are still a limited number of copies of the technical papers given at the recent Cartridge Starter Symposium, sponsored by Sundstrand Aviation and sanctioned by Aerospace Industries Association. To get this informative cross section discussion of cartridge starting, direct your requests to Marketing Services, Sundstrand Aviation, Division of Sundstrand Corporation, 2421 11th Street, Rockford, Illinois.

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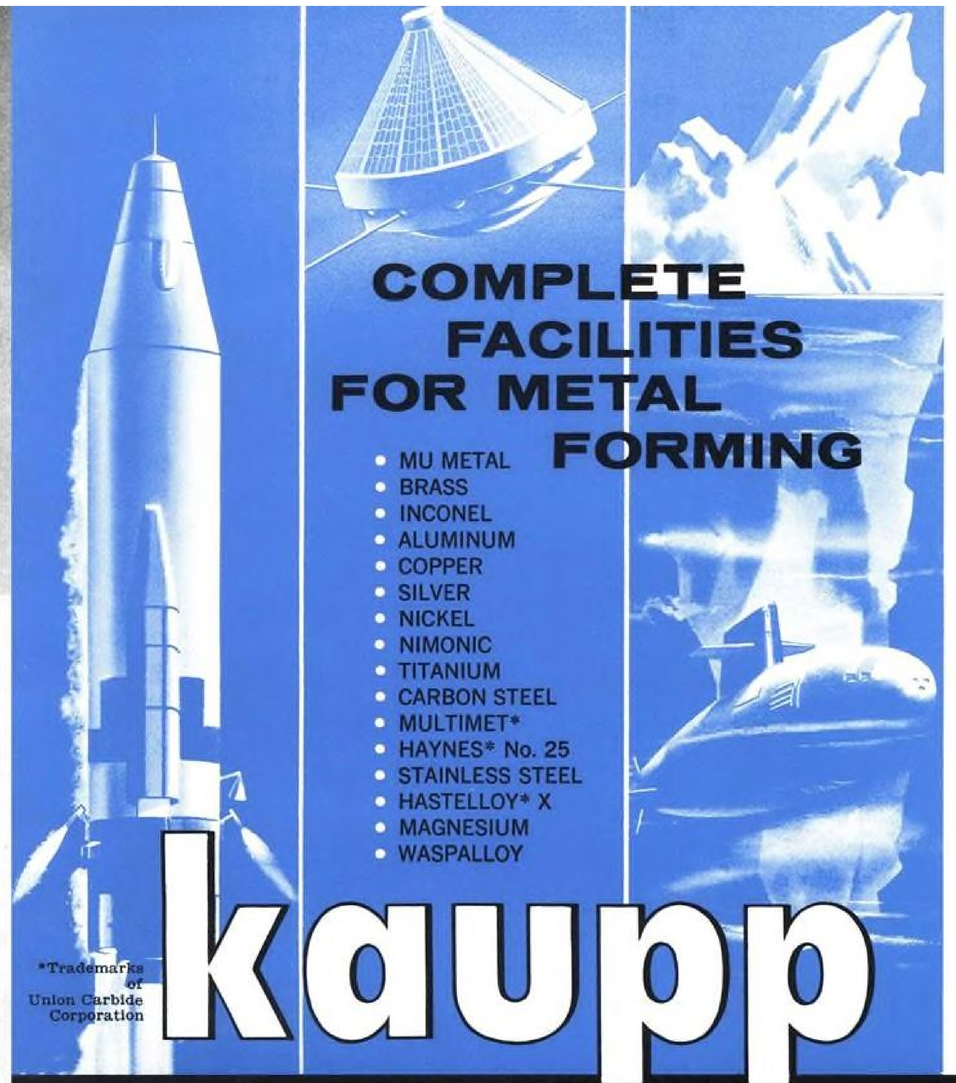

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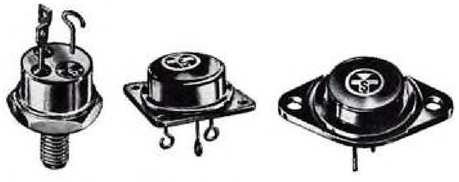

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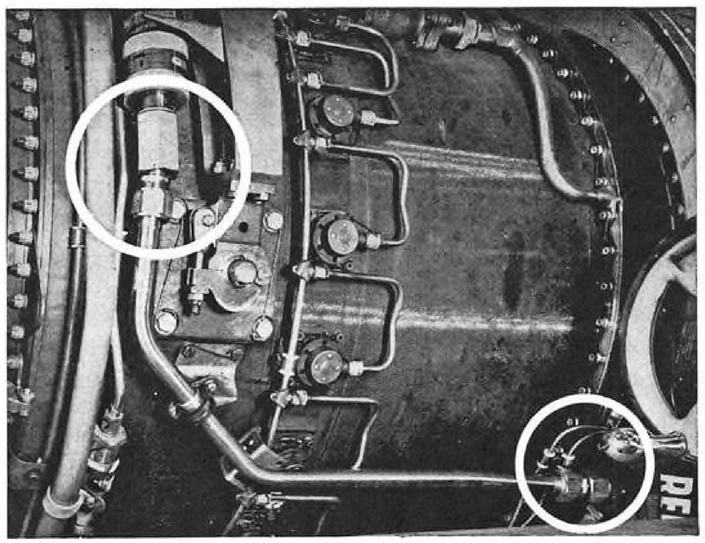

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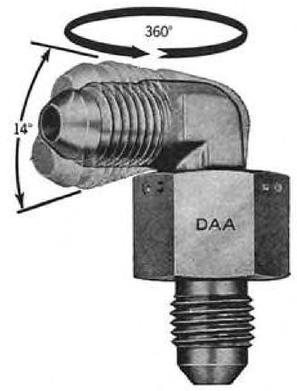

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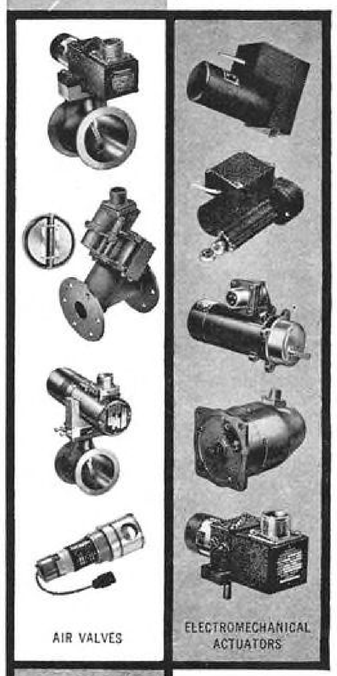

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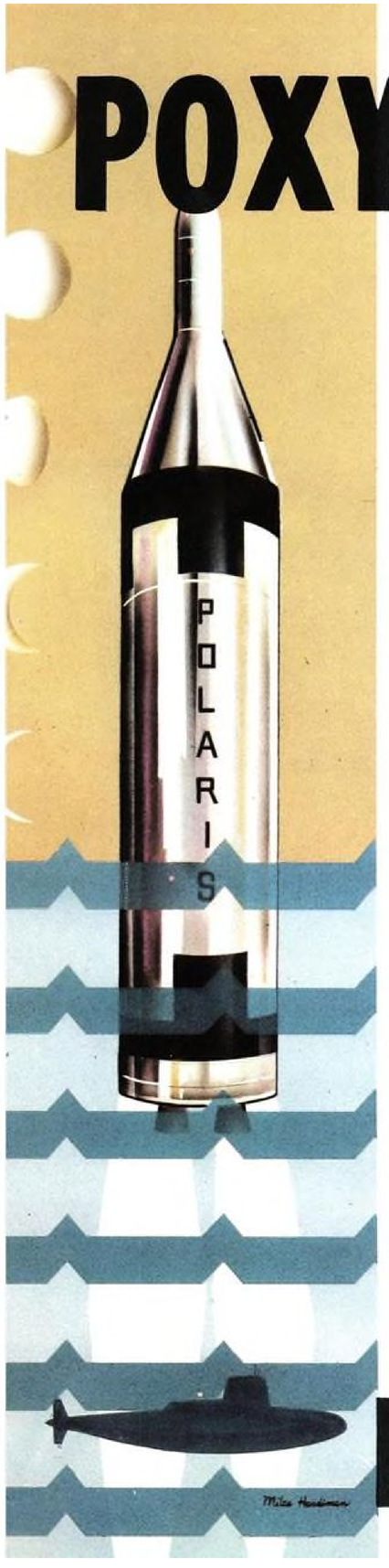

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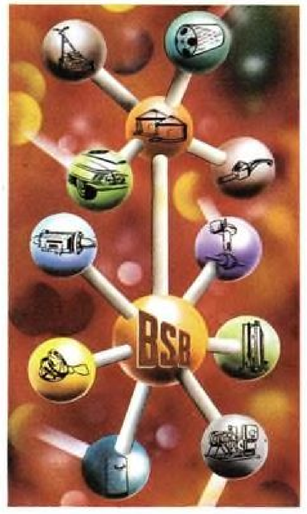

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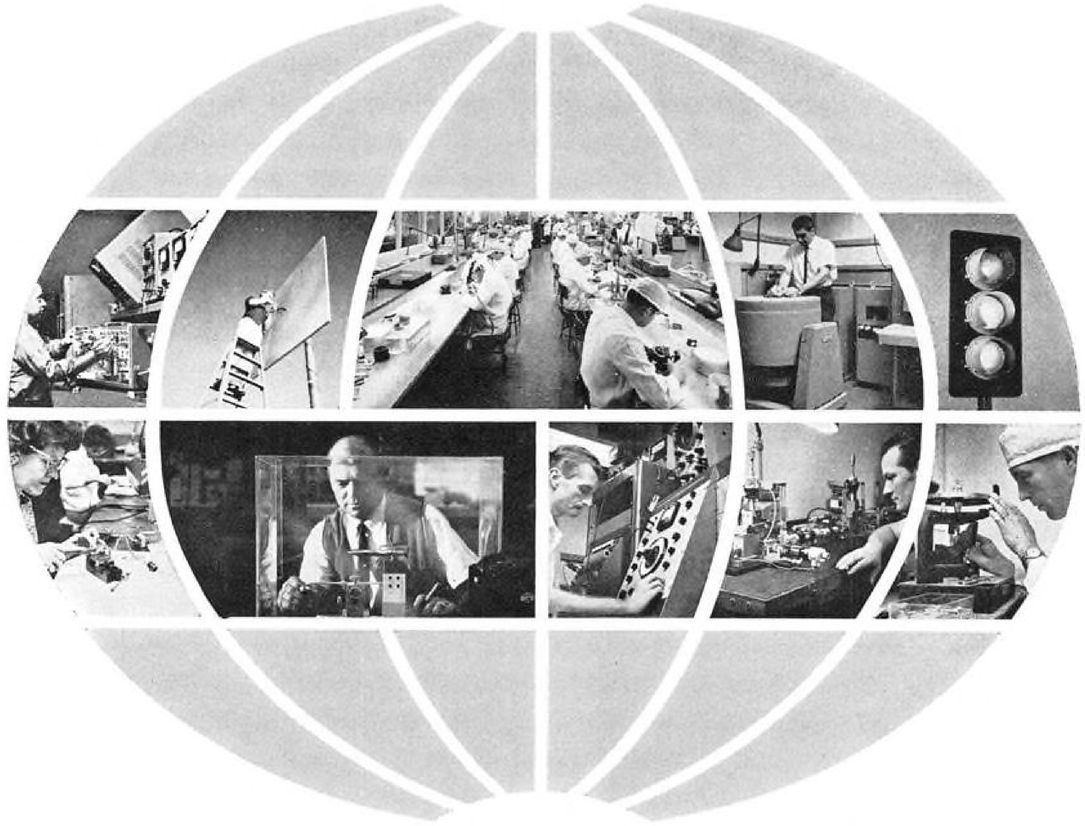

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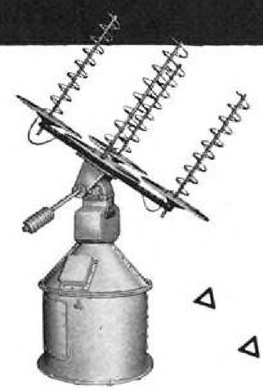

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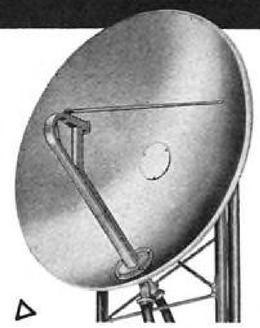

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ANTENNAS

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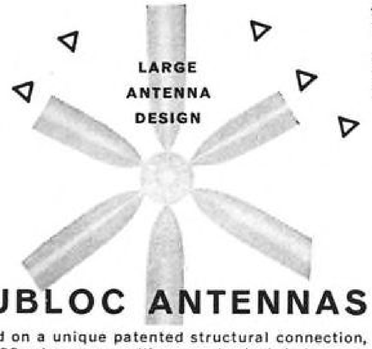

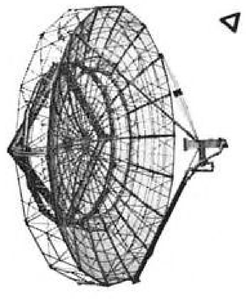

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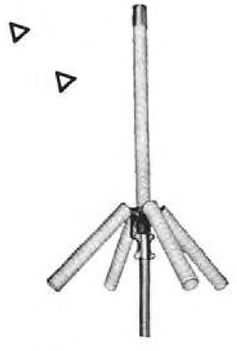

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Air Lanes Service, Inc., 16800 Waterloo Road, Cleveland, Ohio
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Anderson Express, Ltd., Cargo Bldg. 80, New York Int'l Airport, Jamaica 30, N. Y.
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Barnett Aircargo, Inc., 543 West 43rd St., New York 36, N. Y.
Peter A. Bernacki, Inc., (Jet Air Freight Division), 222 Spring Garden St., Philadelphia 23, Pa.
Bor-Air Freight Co., Inc., 307 West 36th St., New York 18, N. Y.
W. J. Byrnes and Company of New York, Inc., 95 Broad St., New York 4, N. Y.
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Benjamin H. Walder & Rubin Konlon, doing business as Chicagoland Air Freight, 1325 West Randolph St., Chicago 7, Ill.
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Airborne Freight Corp., P. O. Box 631, San Francisco International Airport San Francisco 28, Calif.
Airfreight Service Corp., Cargo Building No. 80, Room 222, New York International Airport, Jamaica 30, N. Y.
Alas Ibero Americanas, Inc., P. O. Box 48-85, International Airport, Miami 48, Fla.
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Andrews Air Service Corp., 27-29 Water St., New York 4, N. Y.
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Barnett International Airfreight Corp., 543 West 43rd St., New York 36, N. Y.
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W. J. Byrnes & Company of New York, Inc., 95 Broad St., New York 4, N. Y.
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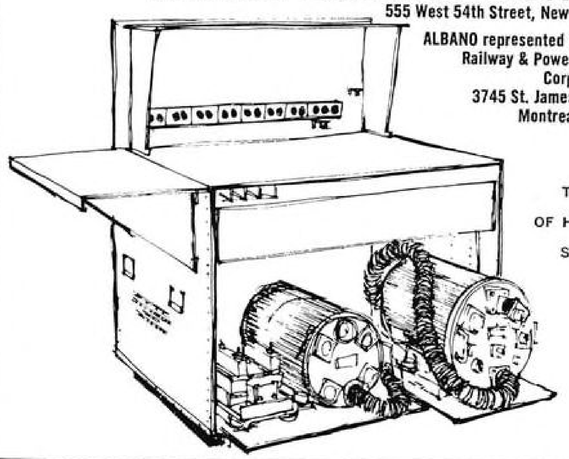

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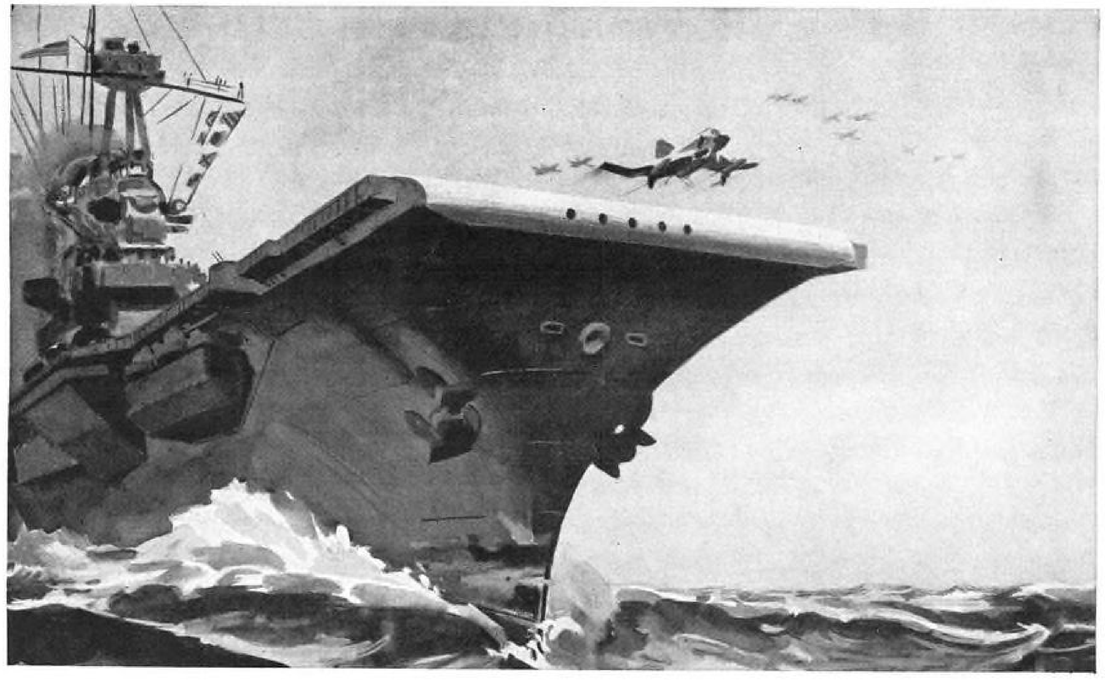

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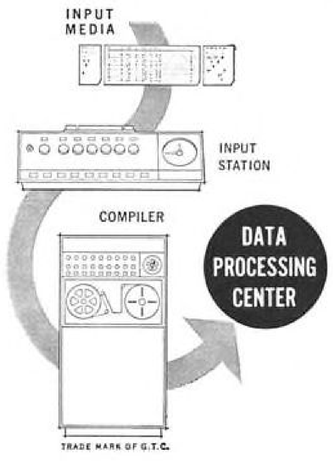

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Chandler-Evans Corp., Charter Oak Boulevard, West Hartford, Conn. AC-1, 2; L-AC, Cert. No. 4377

Harvard H. Ellis Regional Vocational Technical School, Maple St., Danielson, Conn. L-A; L-P, Cert. No. 113

Magnaflux Corp., 483 Park Ave., East Hartford 8, Conn. L-SS, Cert. No. 3997

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Pratt & Whitney Aircraft, Airport Department, 400 Main St., East Hartford 8, Conn. AC-1, 2; L-AC; L-P, Cert. No. 3990

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Friendship International Aviation Corp., Hangar #2, Friendship International Airport, Baltimore, Md. A-3; L-A; R-1, 2; L-R, Cert. No. 1047

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Consolidated Instrument Co., Inc., Teterboro Air Terminal, Teterboro, N. J. L-AC; I-1, 2, 3; L-I, Cert. No. 3501

Continental Can Co., Inc., Air Transport Department, Box 791, Morristown, N. J. A-3; L-A; R-1, 2; L-R, Cert. No. 4267

Curtiss-Wright Corp., Caldwell Wright Division, Passaic Ave., Caldwell, N. J. L-A; P-2, Cert. No. 241

Curtiss-Wright Corp., Electronics Division, 35 Market St., East Paterson, N. J. I-2, Cert. No. 1023

Curtiss-Wright Corp., Wright Aeronautical Division, Main St., Woodridge, N. J. L-P, Cert. No. 1059

Den-Air of New Jersey, Inc., 18 Label St., Montclair, N. J. L-SS, Cert. No. 1021

Eastern Airmotive Corp., 15 Union St., Lodi, N. J. L-A; L-SS, Cert. No. 1056

Eclipse Pioneer Division, The Bendix Corp., Teterboro, N. J. I-1, 2, 3, 4, Cert. No. 1003

Essex County Vocational & Technical High School, 209 Franklin St., Bloomfield, N. J. L-P; L-SS, Cert. No. 812

General Avionics, Inc., Building 17, Monmouth County Airport, Farmingdale, N. J. R-1, 2, Cert. No. 1060

General Electric Co., New York Aircraft Service Shop, 161 Elizabeth Ave., West Linden, N. J. L-AC; L-P; L-PR, Cert. No. 4140

Linair, Inc., Route #1, Linden Airport, Linden, N. J. I-1, 2, 3, 4, Cert. No. 4145

Magnaflux Corp., 39 Delevan Ave., East, Newark 4, N. J. L-SS, Cert. No. 3966

Magnaplate Testing Laboratories, Inc., 331 Main St., Belleville, N. J. L-SS, Cert. No. 3796

Mattituck Airbase Corp., Linden Airport, Linden, N. J. A-3; L-A, Cert. No. 3569

Midway Aircraft Instrument Co., 185 Berger St., Wood-Ridge, N. J. I-1, 2, 3, 4, Cert. No. 3559

Newark Air Service, Inc., Hangar #12, Newark Airport, Newark 5, N. J. A-3; L-A, Cert. No. 105

Radio Aircraft Co., Teterboro Air Terminal, Teterboro, N. J. R-1; L-R, Cert. No. 3942

Safair Flying Service, Inc., Teterboro Airport, Teterboro, N. J. L-AC; P-1, Cert. No. 3549

Smith-Meeker Engineering Co., Teterboro Airport, Teterboro, N. J. R-1, 2; L-R, Cert. No. 3599

Teterboro Aircraft Service, Teterboro Airport, Teterboro, N. J. L-A; R-1; L-R, Cert. No. 4395

United States Overseas Airlines, Inc., Cape May County Airport, P. O. Box 234, Wildwood, N. J. L-A; R-1, 2; L-R, Cert. No. 3575

New York

A & M Instrument Service, Inc., 48-01 31st Ave., Long Island City 3, N. Y. L-I, Cert. No. 4264

Academy of Aeronautics, La Guardia Airport, Flushing 71, N. Y. L-A; L-P, Cert. No. 1336

Aero Trades, Inc., MacArthur Airport, Ronkonkoma, N. Y. L-AC; A-1, 3; L-A, Cert. No. 115

Agawam Aircraft Products, Inc., Bay St., Sag Harbor, N. Y. L-AC; L-SS, Cert. No. 4386

Air Instro, Inc., 153-47 Rockaway Boulevard, Jamaica 34, N. Y. AC-2; I-1, 2, 3, Cert. No. 3548

Aircraft Electronics, Inc., Westchester County Airport, White Plains, N. Y. R-1, 2; L-R, Cert. No. 4146

Aircraft Instrument Development Serv., Inc., 71 Gazza Boulevard, Farmingdale, N. Y. I-1, 2, 3, 4, Cert. No. 3791

Aircraft Turbine Service, Inc., 1300 Shames Drive, Westbury, N. Y. L-AC, Cert. No. 3956

Airmar Radio Service, Inc., Hangar #17, N. Y. Int'l. Airport, Jamaica 30, N. Y. R-1, 2; L-R, Cert. No. 3597

Airmar Radio Service, Inc., MacArthur Airport, Ronkonkoma, N. Y. R-1, 2; L-R, Cert. No. 3598

Airponents, Inc., 25 Buena Vista Ave. & Rockaway Turnpike, Lawrence, N. Y. AC-1, 2, 3; L-AC; L-I, Cert. No. 3591

Aviation High School, 35th St. & Queens Boulevard, Long Island City 1, N. Y. L-SS, Cert. No. 267

Broome County Aviation, Inc., P. O. Box 904, Binghamton, N. Y. L-A, Cert. No. 1042

Buffalo Aeronautical Corp., Buffalo Airport, Buffalo 25, N. Y. A-1, 3; L-A; P-1; R-1; L-R, Cert. No. 175

Buffalo Air-Park, Inc., 4500 Clinton St., Buffalo 24, N. Y. L-A, Cert. No. 1063

Butler Aviation—La Guardia, Hangar #7, La Guardia Airport, Flushing 71, N. Y. AC-2; A-1, 3; L-A; R-1, 2; L-R, Cert. No. 3947

Carrier Air Conditioning Co., Aircraft Department, 760 Gifford St., Syracuse, N. Y. L-AC, Cert. No. 1044

Central Aviation & Marine Corp., MacArthur Airport, P. O. Box 300, Sayville, N. Y. AC-1, 2, 3; L-AC; L-SS, Cert. No. 3585

Collens Instrument Co., 380 Lafayette St., New York 3, N. Y. L-SS, Cert. No. 4273

Consolidated Airborne Systems, Inc., 900 Third Ave., New Hyde Park, N. Y. I-2, 4, Cert. No. 4391

Dot Airtronics, A Division of Dot Products Corp., Zahns Airport, Lindenhurst, N. Y. L-I; R-1, 2, Cert. No. 3992

Durham Aircraft Service, Inc., 56-15 Northern Boulevard, Woodside 77, N. Y. AC-1, 2, 3; I-1, 2, 3, 4; L-SS, Cert. No. 3532

Flight Electronics Corp., Westchester County Airport, Hangar "F", White Plains, N. Y. L-I; R-1, 2; L-R, Cert. No. 4399

General Electric Co., Flight Test Center, 130 Saratoga Road, Schenectady, N. Y. L-A, Cert. No. 3940

General Laboratory Associates, Inc., East Railroad St., Norwich, N. Y. L-AC, Cert. No. 1011

A. Grater & Co., Inc., 112 Marine St., Farmingdale, N. Y. L-AC, Cert. No. 1005

Hermetic Aircraft Instrument Corp., 99 East Hawthorne Ave., Valley Stream, N. Y. I-1, 2, 3; L-I, Cert. No. 4144

Industrial Testing Laboratories, Inc., 79 Herricks Road, New Hyde Park, N. Y. L-SS, Cert. No. 3952

Instrument Associates, 351 Great Neck Road, Great Neck, N. Y. AC-2; I-1, 2, 3, 4, Cert. No. 3564

International Aviation Industries, Inc., Westchester County Airport, White Plains, N. Y. A-1, 3; L-A; R-1, 2, Cert. No. 4269

Island Airmotive, Inc., Zahns Airport, Lindenhurst, N. Y. L-P, Cert. No. 1057

Jet Turbine Service, Inc., 129-15 92nd Ave., Richmond Hill 18, N. Y. L-AC, Cert. No. 4381

Johns-Manville Corp., Westchester County Airport, White Plains, N. Y. L-A; R-1, 2, Cert. No. 3793

Kail Aeronautical Corp., Tri-Cities Airport, Endicott, N. Y. L-A, Cert. No. 97

Lawrence Aviation Industries, Inc., Port Jefferson Station, Port Jefferson, N. Y. L-AC; L-SS, Cert. No. 4136

Lockheed Aircraft Service Co., A Division of Lockheed Corp., New York International Airport, Jamaica 30, N. Y. AC-1, 2, 3; A-1, 2, 3, 4; I-1, 2, 3, 4; R-1, 2; L-R; L-SS, Cert. No. 3527

Long Island Airways, Inc., MacArthur Airport, Ronkonkoma, N. Y. L-A, Cert. No. 1062

Magnaflux Corp., 128 Liberty Ave., Mineola, N. Y. L-SS, Cert. No. 3967

Maintenance and Service Aircraft, Inc., P. O. Box 68, La Guardia Field, Flushing 71, N. Y. L-A, Cert. No. 1033

Mars Aircraft Radio Service, Inc., New York International Airport, Hangar #1, Jamaica, N. Y. R-1, 2; L-R, Cert. No. 3592

Mattituck Airbase, Inc., Mattituck Airport, Mattituck, N. Y. L-AC; L-A; L-P, Cert. No. 3533

Mohawk Airlines, Inc., Oneida County Airport, Utica, N. Y. AC-1, 2; L-A; I-1, 2, 3; R-1, 2; L-R, Cert. No. 4265

Page Airways, Inc., Rochester Airport, Rochester, N. Y. A-1, 3; L-A; L-I; R-1, 2; L-R, Cert. No. 3964

Pan American World Airways, Inc., New York International Airport, Jamaica 30, N. Y. AC-1, 2, 3; L-A; I-1, 2, 4; L-P; L-PR; R-1, 2; L-R; L-SS, Cert. No. 1025

Pester's Propeller Service, Inc., South Terminal Drive, Plainview, N. Y. L-AC; PR-1, 2; L-SS, Cert. No. 182

The Port of New York Authority, Central Radio Shop, Room 1209, 111 8th Ave., New York City, N. Y. L-R, Cert. No. 1043

Republic Aviation Corp., Conklin St., Farmingdale, L. I., N. Y. L-A; L-PR, Cert. No. 2776

S. M. S. Instruments, Inc., New York International Airport, Jamaica 30, N. Y. AC-1, 2, 3; L-AC; I-1, 2, 3, 4; L-SS, Cert. No. 3500

Schweizer Aircraft Corp., Chemung County Airport, Elmira, N. Y. A-1, 3; L-SS, Cert. No. 4397

Scintilla Division, The Bendix Corp., Sherman Ave., Sidney, N. Y. L-AC, Cert. No. 1012

Simmonds Precision Products, Inc., 105 White Plains Road, Tarrytown, N. Y. L-AC, Cert. No. 3593

Speed's Flying Service, Inc., 23-11 Linden St., Flushing, N. Y. A-1, 3; P-1, Cert. No. 3959

Standair, Inc., Division of Standard Aircraft Equipment Co., Inc., 250 Merritt Road, Farmingdale, N. Y. L-AC; I-1, 2, 3, 4, Cert. No. 188

Swiflite Aircraft Corp., MacArthur Airport, Ronkonkoma, N. Y. L-R, Cert. No. 4141

Thompson Aircraft Tire Corp., 870 South Oyster Bay Road, Hicksville, N. Y. AC-1; L-SS, Cert. No. 3961

U. S. Industries, Inc., Aviation Division Hangar "E," Westchester County Airport, White Plains, N. Y. L-A, Cert. No. 1066

Union Carbide Corp., Aviation Department, Hangar "D", Bay 2, Westchester County Airport, White Plains, N. Y. L-A; L-R, Cert. No. 3960

Unipak Aviation Corp., 24-68 47th St., Astoria 3, Long Island City, N. Y. AC-1, 2, 3, Cert. No. 3797

Ohio

Aerodraulics Division, Truckstell Manufacturing Co., 3490 West 140th St., Cleveland 11, Ohio. AC-1; L-SS, Cert. No. 1018

Airborne Communications, Inc., Hangar #3, Lunken Airport, Cincinnati 26, Ohio. L-I; R-1; L-R, Cert. No. 4138

Aircraft Instrument Repair Station, c/o North American Aviation, Inc., 4300 East Fifth Ave., Columbus 16, Ohio. I-1, 2, 3, 4, Cert. No. 3747

Aircraft Radio and Communications, Old Terminal Bldg. Port Columbus, Columbus, Ohio. L-R, Cert. No. 1037

Aircraft Service, Inc., Hangar No. N-9, Cleveland-Hopkins Airport, Cleveland 35, Ohio. A-1, 3; L-A; L-I; R-1; L-R, Cert. No. 3946

Cincinnati Aircraft, Inc., Hangar #2, Lunken Airport, Cincinnati 26, Ohio. L-A; L-I; L-P; L-R, Cert. No. 4148

Clydesdale Aircraft Corp., 3850 East Fifth Ave., Columbus, Ohio. AC-1, 2; P-1; L-P; L-SS, Cert. No. 2723

Col-Air Co., Hangar #4, Port Columbus, Columbus 19, Ohio. L-I, Cert. No. 1026

Crow, Inc., R. R. #4, Box 268, Toledo Express Airport, Swanton, Ohio. L-A; L-P, Cert. No. 1061

Dayton Aviation Radio & Equipment Corp., Box 312, Troy, Ohio. R-1, 2, Cert. No. 3795

The ElectroSonics Div. of AiRadio Corp., 4920 East Fifth Ave., Columbus 19, Ohio. R-1, 2; L-R, Cert. No. 1009

Firestone Tire and Rubber Co., Flight Operations, Hangar #1, Akron Municipal Airport, Akron 6, Ohio. R-1, 2, Cert. No. 4134

General Airmotive Corp., Cleveland-Hopkins Airport, Cleveland 11, Ohio. AC-1, 2; L-SS, Cert. No. 272

General Aviation, Inc., Lost Nation Airport, Willoughby, Ohio. L-AC; L-A; L-P; R-1, 2, Cert. No. 1035

General Electric Co., Flight Propulsion Division, Mgr., CEO Quality—Bldg. #100, Cincinnati 15, Ohio. L-AC; L-P, Cert. No. 1008

General Electric Co., Cincinnati, Aircraft Apparatus Service Shop, 260 West Mitchell Ave., Cincinnati 32, Ohio. L-AC; L-I, Cert. No. 4390

The Goodyear Tire & Rubber Co., Flight Operations, Akron Municipal Airport, Akron 6, Ohio. R-1, 2; L-R, Cert. No. 3792

The M. A. Hanna Co., Flight Operations, Cleveland-Hopkins Airport, Cleveland 35, Ohio. L-A, Cert. No. 4147

Hartzell Propeller, Inc., 350 Washington Ave., Piqua, Ohio. PR-2, Cert. No. 4389

Koehler Aircraft Products Co., 401 Leo St., Dayton, Ohio. L-AC, Cert. No. 1055

Marion Air Service, Inc., Municipal Airport, Marion, Ohio. R-1; L-R, Cert. No. 1032

McCauley Industrial Corp., 1840 Howell Ave., Dayton 17, Ohio. PR-2; L-PR, Cert. No. 3993

National Flight Services, Inc., The Southwest Corner of National Airport, Toledo, Ohio. L-A, Cert. No. 1034

NEAR, Inc., Route No. 4, Swanton, Ohio. L-I; R-1; L-R, Cert. No. 4376

Nicholson Instrument Co., Hangar #1, Municipal Airport, Akron, Ohio. I-1, 2, 3, Cert. No. 3751

Ohio Aviation Co., P. O. Box 305, Vandalia, Ohio. AC-2; A-1, 3; L-A; L-I; P-1; L-P; L-PR; R-1, 2; L-R, Cert. No. 3719

The Ohio Oil Co., Findlay Airport, Findlay, Ohio. R-1; L-R, Cert. No. 1050

Ohio State University, Ohio State University Airport, Columbus 10, Ohio. R-1; L-R, Cert. No. 1038

Piqua Aircraft, Inc., R. R. #1, Box 35B, Piqua, Ohio. L-AC, Cert. No. 1015

Proctor & Gamble Distributing Co., Airplane Operations Department, Hangar #4, Lunken Airport, Cincinnati 26, Ohio. L-A; R-1; L-R, Cert. No. 3954

Remmert-Werner, Inc. of Toledo, Toledo Express Airport, R. R. #4, Swanton, Ohio. A-1, 3; L-A; R-1, 2, Cert. No. 4135

Richland Aviation, Inc., Mansfield Municipal Airport, Mansfield, Ohio. L-A; L-I; L-P; R-1; L-R, Cert. No. 1054

T. W. Smith Aircraft, Blue Ash Airport, Cincinnati 42, Ohio. L-P; L-R, Cert. No. 1045

Southern Ohio Aviation Co., Montgomery County Airport, Box 97, West Carrollton, Ohio, A-3; L-P, Cert. No. 4139

Standard Motor Parts, Inc., 200 Carroll St., Akron 4, Ohio. L-SS, Cert. No. 3995

Sundorph Aeronautical Corp., Cleveland-Hopkins Airport, Cleveland 35, Ohio. L-A; R-1; L-R, Cert. No. 1065

Tuscarawas County Aviation, Inc., Municipal Airport, New Philadelphia, Ohio. L-AC; A-1, 3; P-1, Cert. No. 3704

Valair-Tronics, Division of Valair Aircraft, Inc., Montgomery County Airport, 10600 Springboro Pike, Miamisburg, Ohio. L-R; R-1, Cert. No. 1027

Youngstown Airways, Inc., Municipal Airport, Youngstown, Ohio. R-1, 2, Cert. No. 3790

Zelair Corp., Box 262, Defiance, Ohio. A-1, 3; L-A; P-1, Cert. No. 3951

Oklahoma

American Airlines, Inc., Maintenance & Engineering Center, Tulsa Municipal Airport, Tulsa, Okla. AC-1, 2; L-AC; L-A; I-1, 2, 3, 4; L-P; L-PR; L-R; L-SS, Cert. No. 1019

Pennsylvania

Aero Service Corp., 210 East Courtland St., Philadelphia 20, Pa. A-1, 3; L-A, Cert. No. 1014

Aeronautical Research & Development Company of Pennsylvania, Box 126, Broad St., Tatamy, Pa. L-SS, Cert. No. 3994

Beckett Aviation Corp., Allegheny County Airport, Dravosburg, Pa. L-A; L-PR; R-1, 2; L-R, Cert. No. 4132

Bethlehem Steel Co., Aviation Services, Bethlehem, Pa. L-A; L-R; R-1, Cert. No. 1020

The Decker Corp., 45 Monument Road, Bala Cynwyd, Pa. I-1, 2, 3, 4, Cert. No. 3584

Ducasse Aircraft Instrument Service, North Philadelphia Airport, Philadelphia 36, Pa. I-1, 2, 3, Cert. No. 3563

T. A. Gall Aircraft Radio Service, R. D. #6, Butler-Graham Airport, Butler, Pa. R-1; L-R, Cert. No. 4383

Gulf Oil Corp., Allegheny County Airport, Dravosburg, Pa. L-A, Cert. No. 4393

Jacobs Aircraft Engine Co., P. O. Box 390, Pottstown, Pa. P-1, Cert. No. 4131

Karnish Instruments, Inc., Box 271, Lock Haven, Pa. L-AC; I-1; L-I, Cert. No. 4266

Kellett Aircraft Corp., P. O. Box 35, Willow Grove, Pa. L-A, Cert. No. 1029

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Keystone Instruments, Inc., P. O. Box #2, Lock Haven, Pa. I-1; L-I, Cert. No. 1040
Kutztown Aviation Service, Inc., Kutztown Airport, R. D. #3, Kutztown, Pa. L-SS, Cert. No. 3945
The Lance Call Co., Inc., Connellsville Airport, Connellsville, Pa. L-A; L-P; L-SS, Cert. No. 1064
Latrobe Aviation, Inc., Tri-City Municipal Airport, Latrobe, Pa. L-A, Cert. No. 1041
Lear, Inc., Eastern Service Facility, 6700 Allentown Boulevard, Harrisburg, Pa. L-I, Cert. No. 1030
Magnaflux Corp., 188 W. Wingohocking St., Philadelphia, Pa. L-SS, Cert. No. 3963
Piasecki Aircraft Corp., International Airport, Island Road, Philadelphia 42, Pa. L-SS, Cert. No. 3996
Pittsburgh Air Radio, Allegheny County Airport, Dravosburg, Pa. R-1, 2, Cert. No. 1022
Reading Aviation Service, Inc., P. O. Box 1201, Reading, Pa. AC-1, 2; A-1, 3; L-A; L-I; P-1; L-P; PR-2; L-PR; R-1, 2; L-R, Cert. No. 3535
Scholter Aviation Co., Graham Field, R. D. #6, Butler, Pa. L-A; L-P, Cert. No. 1162
Scranton Airways, Scranton Municipal Airport, Clarks Summit, Pa. A-1, L-A, Cert. No. 4137
Sensenich Corp., Box 1168, Lancaster, Pa. L-AC; PR-1, 2, Cert. No. 3528
L. B. Smith Aircraft Corp. of Pa., Radio Department, P. O. Box 264, New Cumberland, Pa. L-A; R-1, 2; L-R, Cert. No. 4382
Universal Technical Testing Labs, Inc., 312 Darby Road, Havertown, Pa. L-SS, Cert. No. 3957
Frederick B. Vietig D/B/A, Columbia Aircraft Services, Bloomsburg Municipal Airport, Bloomsburg, Pa. A-1; L-A; P-1, Cert. No. 2759
Williamsport Technical Institute, 1005 West Third St., Williamsport, Pa. L-A; P-1, Cert. No. 373

Rhode Island

Copters, Unlimited, Inc., State Airport, Warwick, R. I. L-A, Cert. No. 4392

Virginia

Aero Industries, Byrd Airport, Richmond, Va. A-1, 3; L-I; L-P; R-1; L-R, Cert. No. 4260
Shannon School of Aeronautics, Inc., P. O. Box 509 (Spotsylvania County), Fredericksburg, Va. L-A; L-SS, Cert. No. 1048
Virginia Propeller Service, Box 543, Alexandria, Va. L-AC; L-PR, Cert. No. 3586

West Virginia

Aeromech, Inc., Box 132, Clarksburg, W. Va. L-R, Cert. No. 1017
East Coast Flying Service, Inc., Martinsburg Municipal Airport, Martinsburg, W. Va. L-A; A-3; L-I; L-R, Cert. No. 1007
Helicopter Patrol, Inc., P. O. Box 605, 3 Miles East of Bridgeport, W. Va., Bridgeport, W. Va. L-A, Cert. No. 1031
Mercer Aircraft Radio, Mercer County Airport, Bluefield, W. Va. L-R, Cert. No. 1046
Parkersburg Aviation Radio, Stewart Air Park, Parkersburg, W. Va. L-R, Cert. No. 1036
Rubber Fabricators, Inc., Grantsville, W. Va. L-SS, Cert. No. 4143

Southwest Region

Assistant Administrator, Southwest Region, P. O. Box 1689, Fort Worth 1, Texas

Arkansas

Arkansas Aviation Sales, Inc., Municipal Airport, Little Rock, Ark. R; I, Cert. No. 2098
Central Flying Service, Inc., Adams Field, Little Rock, Ark. A; R, Cert. No. 3818
Skytravel, Inc., Adams Field, Little Rock, Ark. R; I; AC, Cert. No. 1176

Louisiana

Baton Rouge Aircraft, Inc., Ryan Airport, Baton Rouge, La. A; R; I, Cert. No. 2076
Campbell Air Service, Inc., Vivian, La. A; PR, Cert. No. 2024
Gerhardt's Inc., 819 Central Ave., New Orleans, La. AC, Cert. No. 2022
Louisiana Aircraft, Inc., East Baton Rouge Parish (Downtown) Airport, Baton Rouge, La. A; P; PR; R; AC, Cert. No. 2023
J. Ray McDermott & Co., Inc., Jimmie Wedell Hangar, New Orleans Airport, New Orleans, La. R; I, Cert. No. 2081
Pan Air Corp., New Orleans Airport, New Orleans, La. A; R; I; AC Cert. No. 3823
Petroleum Helicopters, Inc., Municipal Airport, Lafayette, La. A; P; AC; PR, Cert. No. 3695
Currey Sanders Aircraft Co., Inc., Downtown Airport, Shreveport, La. R; I; A, Cert. No. 4228
Southern Aviation Corp., Downtown Municipal Airport, Shreveport, La. A; P; PR; AC, Cert. No. 1374
Texas Eastern Transmission Corp., Aviation Dept., Greater Shreveport Airport, Shreveport, La. R, Cert. No. 2025
Trans Air Corp., New Orleans Airport, New Orleans, La. A; R; I, Cert. No. 2043
Union Producing Co., Aircraft Radio Corp., Shreveport Municipal Airport, Shreveport, La. R, Cert. No. 4343

New Mexico

Albuquerque Aircraft Radio, 820 San Pedro Drive, S. E., Albuquerque, N. Mex. R, Cert. No. 4048
Cutter-Carr Flying Service, Inc., West Mesa Airport, Albuquerque, N. Mex. R; PR, Cert. No. 4181
General Communications Co., Alameda Airport, Alameda, N. Mex. R, Cert. No. 2056
Metrigraph Instrument Co., Cree Meadows Airport, Ruidoso, N. Mex. R, Cert. No. 2092
Santa Fe Skyways, Inc., County Municipal Airport, Santa Fe, N. Mex. A; R; I, Cert. No. 2093
Southwest Air Contractors, Inc., Municipal Airport, Deming, N. Mex. A, Cert. No. 4157
Southwestern Skyways, Inc., Coronado Airport, Albuquerque, N. Mex. P; A; SS, Cert. No. 4168
Stahmann Farms, Inc., Stahmann Air Strip, LaMesa, N. Mex. A, Cert. No. 2096

Oklahoma

Aero Precision Industries, Inc., 4400 Newcastle Blvd., Oklahoma City, Okla. I; AC; SS; PR, Cert. No. 3835
Aerotron Radio Co., Municipal Airport, Tulsa, Okla. R; I, Cert. No. 3668
Aircraft Accessories, 2740 North Sheridan Road, Tulsa, Okla. AC, PR, Cert. No. 4333
Air Associates, Inc., 2208 North Sheridan Road, Tulsa, Okla. I, Cert. No. 3840
Aircraft and Engine Enterprises, 12th St. Airpark, Moore, Okla. AC, Cert. No. 3838
Aircraftsmen, Inc., Hangar #2, Will Rogers Field, Oklahoma City, Okla. A; P; PR; R; I; AC, Cert. No. 289
Allied Helicopter Service, Inc., Tulsa North Airport, Tulsa, Okla. A; P; PR, Cert. No. 2009
Catlin Aviation Co., Will Rogers Field, Oklahoma City, Okla. R; SS, Cert. No. 2008
Commander Service Center, Wiley Post Airport, Oklahoma City, Okla. A, Cert. No. 2082
Dallas Airmotive, Inc., 1241 West Main, Oklahoma City, Okla. AC; SS, Cert. No. 2003
Den Air of Tulsa, Division of Tom P. McDermott, Inc., 1402 South Boston Avenue, Tulsa 19, Okla. SS, Cert. No. 2026
Douglas Aircraft Co., Inc., Tulsa Municipal Airport, Tulsa, Okla. A, Cert. No. 4441
Downtown Airpark, Inc., Downtown Airpark, Oklahoma City, Okla. A; P; R; I, Cert. No. 2034
Eagle Industries, 8828 S. E. 29th St., Midwest City, Okla. I; AC; SS, Cert. No. 2046
Allan Edwards Mfg. Co., Inc., P. O. Box 7218, Tulsa 5, Okla. SS, Cert. No. 2067
Ellis Tire Mileage, Aircraft Division, 421 South Main, Altus, Okla. SS, Cert. No. 2019
Executive Flight, Inc., Tulsa Municipal Airport, Tulsa, Okla. R, Cert. No. 2085
Federal Aviation Agency, Will Rogers Field, Oklahoma City, Okla. A; PR; R; I; AC, Cert. No. 3680
Garwin, Inc., Hangar #4, Tulakes Airport, Bethany, Okla. I; AC, Cert. No. 4367
H. E. & Aircraft, Inc., 4025-4029 N. Barnes, Oklahoma City, Okla. AC; SS, Cert. No. 3829
H. & H. Enterprises, 4620 N. W. 10th St., Oklahoma City, Okla. AC, Cert. No. 2002
Page Airmotive, Inc., Cimarron Field, Yukon, Okla. P; AC; SS, Cert. No. 3808
Pan American Petroleum Corp., Tulsa Municipal Airport, Hangar #11, Tulsa, Okla. R; I, Cert. No. 3670
Pan Instrument Lab., 833 N. Vancouver Ave., Tulsa, Okla. I, Cert. No. 3842
Ross Aviation, Inc., Riverside Airport, Tulsa, Okla. R, Cert. No. 4450
Frank Say Airmotive Co., Inc., 906 U. S. 66 Drive, Clinton, Okla. AC; I, Cert. No. 3830
Service Pipe Line Co., Municipal Airport, Tulsa, Okla. R; AC, Cert. No. 4248
Soon "Air" Co., 7030 N. E. 23rd St., Oklahoma City, Okla. AC, Cert. No. 2049
Spartan Aircraft Co., Aviation Service Division, Municipal Airport, Tulsa, Okla. A; P; PR; I; AC; R; SS, Cert. No. 50
Thunderbird Aviation, Inc., Hangar 5, Wiley Post Airport, Oklahoma City, Okla. AC, Cert. No. 2083
Tri-State Instrument Laboratory, Inc., 3244 E. 15th St., Tulsa, Okla. I, Cert. No. 3730
Tulakes Aviation, Inc., Wiley Post Airport, Bethany, Okla. R; I, Cert. No. 2080
Tulsair Distributors, Inc., Tudsa Municipal Airport, Tulsa, Okla. A; I; PR; R; AC, Cert. No. 3667

Texas

Ad-Air Academy, Inc., Hangar 7, Stinson Field, San Antonio, Tex. A; P, Cert. No. 2090
Aero Accessories, 300 Fredericksburg, San Antonio, Tex. AC, Cert. No. 3698
Aero Communications, Lubbock Municipal Airport, Lubbock, Tex. R, Cert. No. 2021
Aero Electronics Co., Meacham Field, Fort Worth, Tex. R, Cert. No. 4359
Aero Instrument Service Sales, Love Field, Dallas, Tex. I, Cert. No. 4233
Aero Instrument Supply, Inc., 8512 Denton Drive, Dallas, Tex. I, Cert. No. 3814
Aeronetics, Inc., Meacham Field, Fort Worth, Tex. SS, Cert. No. 4247
Aero Prop Shop, 3762 Pleasanton Road, San Antonio, Tex. PR; AC; SS, Cert. No. 3813
Airborne Electronics, Inc., Highland Park Airport, Dallas, Tex. R, Cert. No. 2047
Air Carrier Electronics, Inc., Meacham Field, Fort Worth, Tex. R, Cert. No. 4337
Aircraft Carburetor Repair Co., Dallas-Garland Airport, Dallas, Tex. AC, Cert. No. 3661
Aircraft Engines, Inc., 9041 Wingtip, Houston 17, Tex. P, Cert. No. 2059
Aircraft Ignition Service, 1019 Parkside, Irving, Tex. AC, Cert. No. 4327
Aircraft Instrument Service, Inc., Cuddihy Field, Corpus Christi, Tex. I, Cert. No. 3812
Aircraft Sales Co., Meacham Field, Fort Worth, Tex. A; P; PR; AC, Cert. No. 1177
Aircraft Tank Service, Inc., Love Field, Dallas, Tex. SS; A, Cert. No. 2048
Air Flite Components, 2711 Brookfield Ave., Dallas, Tex. PR; AC, Cert. No. 2071
Airline Instrument Repair Co., Meacham Field, Fort Worth, Tex. I, Cert, No. 3685
Airnews Div. of Gen-Aero, Inc., International Airport, San Antonio, Tex. A; PR; R; AC; I; SS, Cert. No. 3844
Alamo Accessories, International Airport, San Antonio, Tex. AC, Cert. No. 3654
Alamo Aero Division of Alamo Aviation, International Airport, San Antonio, Tex. A; PR; R; AC; I, Cert. No. 3843
Alamo Aviation, Inc., International Airport, San Antonio, Tex. A; P; PR, Cert. No. 3674
All American Maintenance, Inc., San Antonio International Airport, San Antonio, Tex. A, Cert. No. 4349
Allied Instruments, Inc., 8222 Travelair, Houston, Tex. R; I; AC, Cert. No. 3800
American Flyers, Inc., Meacham Field, Fort Worth, Tex. R; I, Cert. No. 2084
Associated Radio Service Co., Inc., Redbird Airport, Dallas, Tex. R; I, Cert. No. 2073
Associated Radio Service Co., Inc., Love Field, Dallas, Tex. R; I, Cert. No. 3664
Aviation Instrument Mfg. Corp., 9033 Monroe Road, Houston, Tex. I, Cert. No. 3724
Barbee Instrument & Gyroscope Co., 10250 Almeda-Genoa Rd., Houston, Tex. I, Cert. No. 2097
Bell Helicopter Co., Hurst, Tex. I, Cert. No. 2095
Big State Industries, Inc., Municipal Airport, Mineral Wells, Tex. A; PR, Cert. No. 2011
Brady Industries, Inc., Curtis Field, Brady, Tex. A; PR; SS; AC, Cert. No. 2001
Carruth Laboratories, 2726 Lombardy Lane, Dallas, Tex. I, Cert. No. 3819
Champ's Aviation, Inc., International Airport, El Paso, Tex. R; I, Cert. No. 2051
Chrome Plate, Inc., 2805 South Flores St., San Antonio, Tex. SS, Cert. No. 2091
Coastal Inspection Serv. Co., Inc., 5109 Ashbrook, Houston, 36, Tex. SS, Cert. No. 2000
Collins Radio Co., Addison Airport, Addison, Tex. A; R; I; AC, Cert. No. 4240
Continental Radio Co., Inc., National Guard Hangar, Municipal Airport, Houston, Tex. R; I; AC, Cert. No. 3672
Copper Accessory & Propeller Repair, Inc., 2722 Burbank St., Dallas 55, Tex. PR; AC, Cert. No. 3662
Cross Roads Aviation, Inc., Love Field, Dallas, Tex. PR; I; R; AC, Cert. No. 4364
Cruse Aviation, Inc., Houston International Airport, Houston, Tex. A, Cert. No. 2016
Cummings & Groves Aviation, Inc., Houston International Airport, Houston, Tex. A; R, Cert. No. 4445
Dallas Aero Service, Inc., Love Field, Dallas, Tex. A; P; PR; R; I; AC, Cert. No. 168
Dallas Airmotive, Inc., 6114 Forest Park Road, Dallas, Tex. AC; P; SS, Cert. No. 3822
Dal-Tex Aviation, Inc., Addison Airport, Addison, Tex. R; I, Cert. No. 4347
Don's Aero Service, Stinson Field, San Antonio, Tex. A; SS, Cert. No. 2031
El Paso Natural Gas Co., Air Transportation Department, International Airport, El Paso, Tex. R; I; AC, Cert. No. 4335
Executive Aircraft Service, Inc., Love Field, Dallas, Tex. A, Cert. No. 2053
Executive Aircraft Service, Inc., Redbird Airport, Dallas, Tex. A; AC, Cert. No. 3834
Executive Instruments & Engineering, Addison Airport, Addison, Tex. I, Cert. No. 2055
Federal Aviation Agency, Meacham Field, Fort Worth, Tex. R, Cert. No. 4366
Flood Bros. Aircraft Service, Inc., San Antonio International Airport, San Antonio, Tex. A; P, Cert. No. 4357
Ford Aircraft Sales and Service, 10603 A Denton Drive, Dallas, Tex. AC, Cert. No. 2079
Ford's Carburetor Co., Inc., 2715 Brookfield Ave., Dallas, Tex. AC, Cert. No. 3845
Garner Instrument Co., Municipal Airport, Mineral Wells, Tex. I, Cert. No. 2061
General Electric Co., Apparatus Service Shop, 3202 Manor Way, Dallas, Tex. I, Cert. No. 3688
Vernon G. Gillette Co., Meacham Field, Fort Worth, Tex. I, Cert. No. 2782
Gulf Coast Aviation, Inc., Corpus Christi International Airport, Corpus Christi, Tex. A; R, Cert. No. 2052
Gulf Coast Dusting Co., 5334 Allison Road, Houston, Tex. PR, Cert. No. 2020
Hayes International Corp., Hondo Airfield Division, Hondo Airfield, Hondo, Tex. A; P; AC, Cert. No. 2086
Hinkle Aircraft, Inc., International Airport, Houston, Tex. A; SS, Cert. No. 2017
Horton Aero Service, Lubbock Municipal Airport, 915 Kent Rd., Lubbock, Tex. A; P; AC, Cert. No. 2087
Hou-Port Aviation, Inc., LaPorte Municipal Airport, LaPorte, Tex. A, Cert. No. 3837
Howard Aero, Inc., Manufacturing Division, International Airport, San Antonio, Tex. A, Cert. No. 2088
Howell Instruments, Inc., 3479 West Vickery Blvd., Fort Worth, Tex. I, Cert. No. 2039
Hutchinson Aircraft Service, Hutchinson County Airport, Borger, Tex. A; AC; PR, Cert. No. 4448
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Field, Fort Worth, Tex. A, Cert. No. 2042
Inter-Continental Engine Serv. Inc., International Airport, Brownsville, Tex. A; P; PR; R, Cert. No. 4353
J. B. Instrument Co., 106 Neuhaus St., Houston, Tex. I, Cert. No. 3677
LeTourneau Air Center, Gregg County Airport, Longview, Tex. A; P; PR; AC, Cert. No. 4239
Little Watch Factory, 1208 S. Riverside Drive, Fort Worth 4, Tex. I, Cert. No. 2063
Lone Star Aviation Co., Building 502, Addison Airport, Dallas, Tex. PR; AC; SS, Cert. No. 4442
McCreery Aviation Electronics, Miller International Airport, McAllen, Tex. R, Cert. No. 2068
McDonald A/C Engines, Inc., Building 400, Stinson Field, San Antonio, Tex. P; AC, Cert. No. 2018
Masco Instrument Co., 2822 Century St., Dallas, Tex. I; AC, Cert. No. 3804
Matthews Electronics, International Airport, San Antonio, Tex. R; I, Cert. No. 4235
Mooney Aircraft, Inc., Louis Schreiner Field, Kerrville, Tex. A, Cert. No. 2077
Charles A. Morse Co., Old Terminal Building, International Airport, Houston, Tex. P; AC; SS, Cert. No. 2033
National Aircraft Sales, Inc., 9215-A Weiss St., Love Field, Dallas, Tex. P; AC, Cert. No. 3824
Nayak Aviation Corp., International Airport, San Antonio, Tex. A, Cert. No. 2032
Northrop Corp.—Ventura Div., 6318 Montana St., El Paso, Tex. I, Cert. No. 2094
Pennington Channelcromium Co., Division of Electro-Coatings, Inc., 319 Dakota St., San Antonio, Tex. SS, Cert. No. 2012
Precision Aeromotive Corp., Municipal Airport, Houston, Tex. P; PR, AC, Cert. No. 386
Qualitron Aero, Inc., Meacham Field, Fort Worth, Tex. R, Cert. No. 2089
Ragsdale Aviation, Inc., Robert Mueller Airport, Austin, Tex. A; P, Cert. No. 4458
Rich-Air Co., P. O. Box 4727, Midland, Tex. A, Cert. No. 2069
Ritchey Flying Service, Inc., Meacham Field, Fort Worth, Tex. A; P; AC, Cert. No. 952
Seguin Aviation, Guadalupe County Airport, Seguin, Tex. A, Cert. No. 4443
Southern Avionics Co., Beaumont Municipal Airport, Beaumont, Tex. R, Cert. No. 4328
Southwest Airmotive Co., Love Field, Dallas, Tex. P; PR; AC, Cert. No. 195
Southwest Communications & Electronics, International Airport, El Paso, Tex. R, Cert. No. 4332
Southwest Cooler Service, 4201 Maple Ave., Dallas, Tex. AC, Cert. No. 4447
TexAirmen, Inc., Kickapoo Airport, Wichita Falls, Tex. R, Cert. No. 2040
Tradewind Airport Corp., Tradewind Airport, Amarillo, Tex. A; P; PR; R; I; AC, Cert. No. 2394
Trans-Texas Airways, International Airport, Houston, Tex. A; R; AC; SS, Cert. No. 4229
Trio Aviation Co., Inc., 10950 Dennis Road, Dallas, Tex. AC, Cert. No. 4457
Tyler Aircraft Radio Co., Pounds Field, Tyler, Tex. R; I, Cert. No. 4339
United Airmotive Services, Inc., Meacham Field, Fort Worth, Tex. A, Cert. No. 2041
United Electric Motor Co., 1727 Broadway, San Antonio, Tex. AC; SS, Cert. No. 2054
Van Der Horst Corp. of America, Grove and Delphine Sts., Terrell, Tex. SS, Cert. No. 4453
Vecto Instrument Corp., Houston International Airport, Houston, Tex. I, Cert. No. 4452
L. L. Walker Co., 609 South 80th St., Houston, Tex. PR; AC, Cert. No. 1359
Western Industrial X-Ray Corp., 3200 Clovis Road, Lubbock, Tex. SS, Cert. No. 4368
West Texas Flying Service, Inc., Midland Air-Terminal, Midland, Tex. A; P; R; I; AC, Cert. No. 4334
Wichita Falls Air Transport Co., Wichita Falls Air Terminal, Wichita Falls, Tex. R, Cert. No. 1210

Southern Region

Assistant Administrator, Southern Region, 52 Fairlie Street, N.W., Atlanta 3, Georgia

Alabama

Glenn E. Messer Co., 6 North 55th Place, Birmingham, Ala. L-I; I-1, 2, Cert. No. 3657
Gulf Coast Airmotive, Mobile Municipal Airport, Mobile, Ala. L-A; PR-1; AC-2; L-P; L-AC, Cert. No. 3619
Hayes Aircraft Corp., Napier Field, Dothan, Ala. L-SS; AC-2; L-A; L-AC, Cert. No. 2015

Florida

A. R. M. Service Corp., 5363 N. W. 36th St., Miami Springs, Fla. R-1, 2; L-R, Cert. No. 3653
Aaxico-Seminole, Inc., Building 1007, International Airport, Miami, Fla. AC-1, 2; L-AC; L-SS, Cert. No. 3629
Accessories Service Co., Inc., 3914 N. W. 25th St., Miami, Fla. AC-1, 2, Cert. No. 3648
Aerodex, Inc., International Airport, Miami, Fla. AC-1, 2; P-1, 2, Cert. No. 3644
Aero-Kool Corp., Broward International Airport, Ft. Lauderdale, Fla. L-AC, Cert. No. 2028
Aerolectra, Inc., 899 S. E. 9th Court, Hialeah, Fla. AC-1, 2, Cert. No. 3694
Aero Maintenance Radio, Inc., 82 Fairway Drive, Miami Springs, Fla. L-R, Cert. No. 3659
Aeronautical Development of Florida, Inc., Imeson Airport, Jacksonville, Fla. L-A, Cert. No. 2050
Aerosonic Corp., 1212 Hercules (North), Clearwater, Fla. L-I, Cert. No. 5311
Air Carrier Engine Service, Building 145, MIAD, International Airport, Miami, Fla. P-2; AC-1, 2, Cert. No. 3604
Aircraft Armature, Inc., 679 West 26th St., Hialeah, Fla. L-SS, Cert. No. 5002
Aircraft Service Division of Fairchild Stratos Corp., St. Augustine Municipal Airport, St. Augustine, Fla. L-A, Cert. No. 4346
Aircraft Instrument Service, Municipal Airport, Orlando, Fla. L-I, Cert. No. 4374
Airtech Service, Inc., International Airport, Miami, Fla. A-4; L-A, Cert. No. 4241
Airwork Corp., 1740 N. W. 69th Ave., Miami, Fla. L-AC; AC-2, Cert. No. 4237
American Airmotive Corp., Building 146, International Airport, Miami, Fla. A-1, 3, 4; AC-1, 2; P-1; R-1, 2; L-AC; L-R; L-I; P-2, Cert. No. 3606
Aviation Investments, Inc., d/b/a/ Air International, International Airport, Miami, Fla. A-3, 4; L-A; L-SS, Cert. No. 3692
Aviation Services, Inc., Craig Airport, Jacksonville, Fla. A-1, 2, Cert. No. 4369
Barfield Instruments, Corp., 4101 N. W. 29th St., Miami, Fla. I-1, 2, 3, 4; L-R, Cert. No. 2745
L. D. Bragg, d/b/a Aviation Electronics, Imeson Airport, Jacksonville, Fla. L-R, Cert. No. 2027
Broward Aviation Co., Inc., 1400 N. W. 19th St., Ft. Lauderdale, Fla. L-A; L-P; L-AC; L-SS, Cert. No. 2035
Continental Aviation Corp., Opa-Locka Airport, Opa Locka, Fla. L-A, Cert. No. 5003
C-Wings Inc., Municipal Airport, Leesburg, Fla. L-A; L-P, Cert. No. 4455
Dean's Inspection Service, 4812 South Dixie Highway, Miami, Fla. L-SS, Cert. No. 2065
Den Air of Miami, 4725 East 10th Court, Hialeah, Fla. L-SS, Cert. No. 2030
Dixie Air Parts, Inc., 954 S. E. 9th Terrace, Hialeah, Fla. A-2; L-AC, Cert. No. 4236
Eastern Aero Marine, 3850 N. W. 25th St., Miami, Fla. L-SS, Cert. No. 4341
Eighth Air Depot, Inc., Sebring Air Terminal, Sebring, Fla. L-AC; P-1, 2, Cert No. 3610
Embry Riddle Co., 3240 N. W. 27th Ave., Miami, Fla. A-1, 3; L-P; L-AC, Cert. No. 3608
Engine Air, Inc., 3151 N. W. 54th St., Miami, Fla. L-P, Cert. No. 4446
E. Farnell and Co., Inc., Hangar #475, Duncan Ave., International Airport, West Palm Beach, Fla. A-1, 3; L-A; L-P; L-R; L-I; L-AC, Cert. No. 4326
Florida International Engine Service, P. O. Box 48-165, Miami, Fla. L-P, Cert. No. 3649
General Hydraulics Corp., 2440 N. W. 38th Court, Miami, Fla. L-AC; A-1, 2, Cert. No. 3652
General Tire of Miami, Inc., 5600 Biscayne Blvd., Miami, Fla. L-SS, Cert. No. 5001
International X-Ray Inspectors, Inc., 558 West 18th Hialeah, Fla. L-SS, Cert. No. 4336
J & J Aircraft, Inc., 821 General Arnold Blvd., Sarasota, Fla. L-P, Cert. No. 5310
Jordan Aviation, Imeson Airport, Jacksonville, Fla. L-A, Cert. No. 2044
Karnish Instrument, Inc., Municipal Airport, Vero Beach, Fla. L-I, Cert. No. 2074
Madden & Smith Aircraft Corp., International Airport, Miami, Fla. A-1, 3, 4; AC-1, 2; L-AC, Cert. No. 3642
Materials Testing Laboratories, 4696 East 10th Court, Hialeah, Fla. L-SS, Cert. No. 5004
Maxwell Instrument, Inc., Municipal Airport, Deland, Fla. L-A; L-P, Cert. No. 4456
Nasco Service Corp., International Airport, Miami, Fla. L-AC; AC-1, 2; I-1, 2, 3, 4, Cert. No. 3752
Pan American Airways, 3801 N. W. 25th St., Miami, Fla. A-4; P-2; PR-2; I-1, 2, 3, 4; AC-1, 2, 3; R-1, 2, 3, Cert. No. 167
Pan Avion, 7291 N. W. 43rd St., Miami, Fla. L-SS, Cert. No. 3646
Paul's Aircraft Service, Inc., Vero Beach Municipal Airport, Vero Beach, Fla. L-A, Cert. No. 2005
Peninsular Aircraft Radio, Inc., 5415 N. W. 36th St., Miami, Fla. R1, 2; L-R; L-I, Cert. No. 4345
Peninsular Armature Works, P. O. Box 447, Allopettah Station, Miami, Fla. AC-2; L-SS, Cert. No. 3663
Pinellas Aircraft, Inc., International Airport, St. Petersburg, Fla. L-A, Cert. No. 4344
Precision Air, Inc., 3610 N. W. 41st St., Miami, Fla. L-AC, Cert. No. 2029
Propeller Service of Miami, 3100 N. W. 57th Ave., Miami, Fla. L-PR; PR-1, 2; L-SS; L-AC, Cert. No. 3614
Quipco Associates, Inc., 1083 East 31st St., Hialeah, Fla. AC-2; L-AC, Cert. No. 5000
Red Aircraft Service, Inc., Broward International Airport, Ft. Lauderdale, Fla. L-PR; L-A; L-P, Cert. No. 4231
Rennert-Werner of Florida, Inc., Pompano Beach Airport, Pompano Beach, Fla. L-A, Cert. No. 4439
Sentinel Magneto Service Corp., P. O. Box 48-851, Miami, Fla. AC-2; L-AC, Cert. No. 3647
Showalter Flying Service, Inc., Municipal Airport, Orlando, Fla. L-A, Cert. No. 4444
Southern Airways of Florida, Municipal Airport, Orlando, Fla. L-R, Cert. No. 2058
Space Science Services, Inc., 1080 Sligh Blvd., Orlando, Fla. L-SS, Cert. No. 2066
Sunny South Aircraft Services, Inc., Broward County International Airport, Ft. Lauderdale, Fla. A-1, 2; P-1; PR-1; L-PR; L-R; L-I; L-SS, Cert. No. 3673
Thompson Aircraft Tire Corp., International Airport, Miami 48, Fla. AC-1; L-SS; L-A, Cert. No. 3651
Tursair Executive Aircraft, Inc., P. O. Box 1553, Coral Gables, Fla. L-A, Cert. No. 2064
Williams Communications, Inc., 1213 West Thorpe St., Tallahassee, Fla. L-R, Cert. No. 5321

Georgia

Aero Corp., Aero Hangar #1, Atlanta, Ga. A-3; PR-2; L-P; L-A; L-AC; L-SS, Cert. No. 3650
Airwork Corp., 3449 Lang, Hapeville, Ga. L-I; I-1, 2; L-AC, Cert. No. 3691
Associated Airmotive, Inc., Macon Municipal Airport, Macon, Ga. A-3; R-1, 2; L-A; L-AC, Cert. No. 3679
Barfield Instrument Corp., P. O. Box 615, Municipal Airport, Atlanta, Ga. I-1, 2; L-I, Cert. No. 3636
Barfield Instrument Corp., (Miami Satellite), Municipal Airport, Atlanta, Ga. L-SS, Cert. No. 2745A
Big Brother Aircraft, Inc., Fulton County Airport, Atlanta, Ga. L-A; L-R; L-I, Cert. No. 2014
Den Air of Atlanta, 34 Elliott St., Atlanta, Ga. L-SS; L-A, Cert. No. 2037
Executive Aviation, Inc., Peachtree-DeKalb Airport, Atlanta, Ga. L-A; L-PR; L-R; L-AC, Cert. No. 2006
Federal Aviation Agency, Fulton County Airport, Atlanta, Ga. L-R, Cert. No. 4331
Golden Isles Aviation, McKinnon Airport, St. Simons Island, Ga. L-A; L-R, Cert. No. 5320
Gordy Aircraft Tire Co., 151 14th St., N. W., Atlanta, Ga. L-SS, Cert. No. 2062
Gunn Airfield Radio Service, 2112 Panola Road, Lithonia, Ga. L-R, Cert. No. 5200
Southern Airways Co., Atlanta Airport, Atlanta, Ga. A-3; L-PR; L-I; L-AC; L-SS; R-1; L-R, Cert. No. 287

North Carolina

Barfield Instrument Corp., Smith Reynolds Airport, Winston-Salem, N. C. L-I, Cert. No. 2045
Cannon Aircraft Sales & Service, Municipal Airport, Charlotte, N. C. L-A; L-P; R-1, 2; L-R; L-I, Cert. No. 377
Charlotte Aircraft Engineering, Inc., Delta Air Base, Charlotte, N. C. AC-2; L-A; L-PR, Cert. No. 3678
Greensboro-Highpoint Air Service, Greensboro-Highpoint Airport, Greensboro, N. C. L-A; L-P; L-R; R-1, Cert. No. 4243
High-Point Trinity Air Service, Darr Field, Trinity, N. C. L-A, Cert. No. 2070
Piedmont Aviation, Inc., Smith Reynolds Airport, Winston-Salem, N. C. A-1, 3; P-1; R-1, 2; AC-1, 2; L-A; L-P; L-R; L-PR; L-I, Cert. No. 1340
Shelby Aero, Municipal Airport, Shelby, N. C. L-A, Cert. No. 5360
Southeast Airmotive Corp., Douglas Municipal Airport, Charlotte, N. C. A-1, 3; L-A; P-1; L-PR; AC-2; L-AC, Cert. No. 4329

South Carolina

Atlantic X-Ray Corp., Stark Industrial Park, Charleston, S. C. L-AC; L-SS, Cert. No. 4440
Brannon's Aero Service, Greenville Municipal Airport, Greenville, S. C. L-A, Cert. No. 2004
Hawthorne Aviation, Charleston Municipal Airport, Charleston, S. C. L-I; L-P; L-PR; L-AC; A-3; L-SS; R-1, 2, Cert. No. 3666
J. P. Stevens & Co., Inc., Aviation Department, Greenville Municipal Airport, Greenville, S. C. A-3, Cert. No. 4348

Tennessee

Airborne Electronics, Inc., Memphis Municipal Airport, Memphis, Tenn. L-R; L-I, Cert. No. 2007
Appalachian Flying Service, Tri-City Airport, Johnson City, Tenn. A-3; P-1, Cert. No. 361
Dixie Air Associates, Inc., Memphis Municipal Airport, Memphis, Tenn. L-A; L-P; L-R, Cert. No. 3687
Memphis Aero Corp., Memphis Municipal Airport, Memphis, Tenn. A-3; P-1; L-PR; L-AC, Cert. No. 4370
Nashville Flying Service, Inc., Berry Field, Nashville, Tenn. A-3; P-1; PR-2; L-A; L-PR; L-AC; L-R; L-I, Cert. No. 4360
Shelby Tire Co., 690 Marshall Ave., Memphis, Tenn., L-SS, Cert. No. 2057
Southaire, Inc., Memphis Municipal Airport, Memphis, Tenn. L-A; L-P; L-PR; L-AC, Cert. No. 2078
Southeastern Aviation, Inc., Tri-City Airport, Kingsport, Tenn. L-A; L-R; L-AC, Cert. No. 4350
Tennessee Airmotive, Municipal Airport, Lovell Field, Chattanooga, Tenn. L-A, Cert. No. 2038

Puerto Rico

Caribbean Atlantic Airline, Puerto Rico International Airport, San Juan, Puerto Rico. AC-2; L-A; L-R; L-AC, Cert. No. 4249
Electronics, West Indies Hangar, Isla Grande Airport, San Juan, Puerto Rico. L-R, Cert. No. 4338

Central Region

Assistant Administrator, Central Region, 4825 Troost Avenue, Kansas City 10, Missouri

Illinois

Aircraft Propeller Sales & Service, Sky Harbor Airport, Northbrook, Ill. PR-1, 2; L-PR, Cert. No. 2377
Allen Aircraft Radio, 2500 Estes Ave., Elk Grove Village, Ill. R-1, 2; L-1, Cert. No. 4301
Anderson Propeller Co., Inc., DuPage County Airport, St. Charles, Ill. PR-1, 2; L-PR; L-AC, Cert. No. 3727
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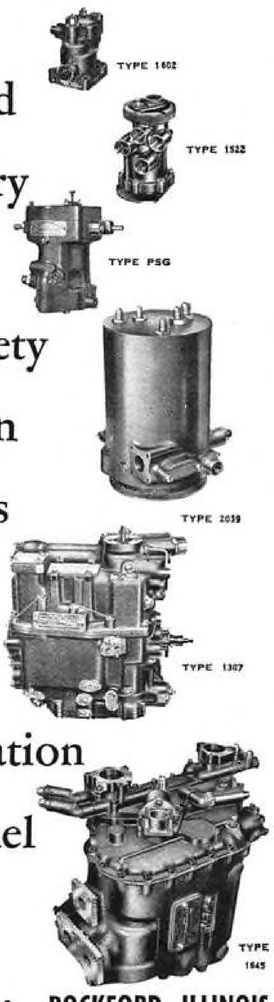

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Chicago 14, Ill. L-AC, Cert. No. 3938
B & M Aircraft Corp., Elgin Airport, Elgin, Ill. L-A; L-R; L-I, Cert. No. 3013
Bohling Aircraft Corp., 5324 West 63rd St., Chicago 38, Ill. I-1, 2, 3; R-1, 2; AC-1, 2; L-AC; L-R, Cert. No. 294
Butler Aviation, Inc., O'Hare International Airport, Chicago 66, Ill. A-1, 3; L-A; R-1, 2; L-I; L-R; L-AC, Cert. No. 3712
Capitol Aviation, Inc., Capital Airport, Springfield, Ill. A-1, 3; P-1; PR-2; AC-2; R-1, 2; L-A; L-R; L-I; L-AC; L-P; L-PR; L-SS, Cert. No. 3760
Elliott Flying Service, Inc., West Hangar, Quad City Airport, Moline, Ill. R-1, 2; L-R; L-I, Cert. No. 3786
Executive Aircraft Maintenance Corp., Crystal Lake Airport, Crystal Lake, Ill. L-A, Cert. No. 3004
Hartzog Aviation, Greater Rockford Airport, Rockford, Ill. R-1, 2; L-A, Cert. No. 3026
Helicopter Air Lift, Division Butler Aviation, Inc., 5320 West 63rd St., Chicago 38, Ill. L-PR, Cert. No. 4302
Lutz Aircraft Instrument Shop, 9602 Franklin Ave., Franklin Park, Ill. I-1, 3, Cert. No. 3750
Mainline Electronics, Inc., Joliet Municipal Airport, Joliet, Ill. L-R, Cert. No. 4322
Mid-States Aviation Corp., Sky Harbor Airport, Northbrook, Ill. R-1; L-R; L-I, Cert. No. 3769
Ozark Air Lines, Inc., Greater Rockford Airport, Rockford, Ill. R-1, 2; L-A; L-AC; L-I, Cert. No. 3039
Parks College of Aeronautical Technology, of St. Louis University, Parks Airport, East St. Louis, Ill. A-1, 3; P-1; PR-1; I-1, 2, Cert. No. 14
Petras Instrument Service, 433 Maple Ave., Elmhurst, Ill. L-I, Cert. No. 3783
Radio Division, George J. Priester Aviation Service, Pal-Waukee Airport, Wheeling, Ill. R-1; L-I; L-R, Cert. No. 4303
Radio Ranch, Route 3, Polo, Ill. R-1; L-R; L-I, Cert. No. 3763
Rusk Aviation, Inc., Greater Kankakee Airport, Kankakee, Ill. L-R, Cert. No. 4429
Schneck Engine Service & Supply, 190th and Burnham Ave., Lansing, Ill. P-1; L-P; AC-1, 2; L-I, Cert. No. 1393
Sundstrand Aviation, Division of Sundstrand Corp., 2421-11th St., Rockford, Ill. L-AC, Cert. No. 3009
University of Illinois, Institute of Aviation, 318 Civil Engineering Hall, Urbana, Ill. I-1; L-A; L-P; L-PR; L-R; L-I; L-AC; L-SS, Cert. No. 3708
Walston Aviation, Inc., Civic Memorial Airport, East Alton, Ill. A-1, 3; P-1; L-I; PR-1, 2; R-1, 2; L-AC, Cert. No. 3735
Whirlwind Propeller Service, Inc., Chicagoland Airport, Box 246-A, Prairie View, Ill. PR-1; L-PR, Cert. No. 4321
Woodward Governor Co., 5001 North Second St., Rockford, Ill. L-AC, Cert. No. 3781

Indiana

Allison Div., General Motors Corp., Allison Plant No. 5, Indianapolis, Ind. L-P; PR-2; L-I; L-AC; L-SS, Cert. No. 3776
Allison Division, GMC, Flight Test, Indianapolis Municipal Airport, Indianapolis, Ind. L-A, Cert. No. 3033
Bendix Products Division, 401 North Bendix Drive, South Bend, Ind. L-AC, Cert. No. 3020
Central States Aeronautical Service, Inc., Bob Shank Airport, Indianapolis 44, Ind. L-PR, Cert. No. 3733
Crescent City Aviation, Dress Memorial Airport, Evansville, Ind. A-3, Cert. No. 3764
Donham Aero Service, 106 E. 108th St., Indianapolis 20, Ind. L-SS, Cert. No. 3031
Executive Aircraft Corp., Weir Cook Municipal Airport, Indianapolis, Ind. L-I; L-R, Cert. No. 3030
Graubart Aviation, Inc., Porter County Airport, Valparaiso, Ind. L-R, Cert. No. 3043
Hoosier Aircraft Accessories, Inc., Turner Hangar Inc., Weir Cook Municipal Airport, Indianapolis, Ind. L-AC; L-I; L-PR; L-SS, Cert. No. 3762
Industrial Heat Treating & Metallurgical Co., Inc., 2131 Northwestern Ave., Indianapolis 2, Ind. L-SS, Cert. No. 3050
Lake Central Airlines, Inc., Weir Cook Municipal Airport, Indianapolis 44, Ind. L-A; L-AC, Cert. No. 3011
Muncie Aviation Corp., Muncie Airport, Muncie, Ind. A-3; R-1, 2; L-I; L-AC, Cert. No. 201
P & H Electronics, Purdue Airport, Hangar No. 4, West Lafayette, Ind. L-R, Cert. No. 3041
Roscoe Turner Aeronautical Corp., Weir Cook Municipal Airport, Indianapolis 44, Ind. A-3; P-1; L-P; L-I; R-1, 2; L-R, Cert. No. 764

Iowa

Ben's Aircraft Service, Municipal Airport, Waterloo, Iowa. L-A; L-R; L-I, Cert. No. 3002
Collins Radio Co., Flight Operations Department, Municipal Airport, Cedar Rapids, Iowa. L-R; L-I, Cert. No. 4311
Collins Radio Co., Factory Service Division, 321-3rd St., S.E., Cedar Rapids, Iowa. L-R, Cert. No. 3016
Collins Radio Co., Instrument Mfg. Department, 855-35th St., Cedar Rapids, Iowa. L-I, Cert. No. 3017
Des Moines Flying Service, Inc., Municipal Airport, Des Moines, Iowa. R-1; L-R; L-A; L-I, Cert. No. 3782
Elliott Flying Service, Inc., Municipal Airport, Des Moines, Iowa. R-1, 2, Cert. No. 4310
Hubinger Airmotive Sales Co., Keokuk Municipal Airport, Keokuk, Iowa. L-R, Cert. No. 3015
Wathan Flying Service, Inc., Municipal Airport, Cedar Rapids, Iowa. L-R; L-I, Cert. No. 3003

Kansas

Aviation Electronics, Inc., 1026 North Mosley, Wichita 14, Kans. R-1, 2; I-1, 2, 4, Cert. No. 3937
Beech Aircraft Corp., 9709 East Central, Wichita 1, Kans. I-1, 2, 3; L-PR; R-1, 2; L-A, Cert. No. 334
Bevan Radio Co., Inc., Municipal Airport, Wichita 15, Kans. R-1; L-R; L-I, Cert. No. 4309
Clark Manufacturing, Inc., 1936 North A St., Wellington, Kans. L-SS, Cert. No. 4320
FAA Aircraft & Avionics, 410 E. Donovan Road, Fairfax Airport, Kansas City 15, Kans. L-I; L-R, Cert. No. 3044
Garwin, Inc., 1326 South Walnut, Wichita, Kans. I-1, 2, 3; AC-1, 2, Cert. No. 3929
General Electric Co., Strother Aircraft Service Shop, P. O. Box 797, Arkansas City, Kans. L-AC; L-SS, Cert. No. 3008
Les Endres Service, 512 South Park Blvd., Independence, Kans. L-SS, Cert. No. 3789
Mahon's Boot Hill Flying Service, Municipal Airport, Dodge City, Kans. L-A; L-AC, Cert. No. 2718
Mid-States Mfg. Division, Hello Aircraft Corp., P. O. Box 604, Pittsburg, Kans. L-A, Cert. No. 4300
Pratt Air Service, Municipal Airport, Pratt, Kans. L-R, Cert. No. 3023
Rabell Electronics, Inc., 7101 Pueblo St., Wichita 9, Kans. R-1; L-R, Cert. No. 3037
Standard Products, Inc., 4105 West Pawnee, Wichita 15, Kans. I-1, 2; L-I; L-AC; AC-1, 2, Cert. No. 2783
Topeka Aircraft Sales & Service, Inc., Municipal Airport, Topeka, Kans. R-1; L-R; L-I, Cert. No. 4306
United Airplane Sales, Inc., Municipal Airport, Hangar #2, Wichita, Kans. R-1; L-R; L-I; L-A; L-P, Cert. No. 4308
Wilcox Electric Co., Inc., 3251 Fairfax Road, Fairfax Airport, Kansas City, Kans. L-R, Cert. No. 3047
Wilson-Wylie Co., Inc., 3301 Fairfax Trafficway, Kansas City 15, Kans. R-1, 2, Cert. No. 4433
Yingling Aircraft, Inc., New Municipal Airport, Wichita, Kans. L-PR, Cert. No. 3923

Michigan

Aerodynamics, Inc., Pontiac Municipal Airport, Pontiac, Mich. R-1, 2; L-A; L-R; L-I; L-AC, Cert. No. 3007
Aerodynamics, Inc., Bay 8, Detroit City Airport, Detroit, Mich. R-1, 2; L-R, Cert. No. 3051
Approved Aircraft Accessories, Inc., Building 504, Metropolitan Airport, Mich. L-AC; L-I; L-SS, Cert. No. 3772
Barber's Flying Service, Inc., 6360 Highland Road, Pontiac Municipal Airport, Pontiac, Mich. L-A, Cert. No. 4318
Beacon Instrument Service, Inc., Bay 9, Detroit City Airport, Detroit 13, Mich. I-1, 2, 3; L-AC, Cert. No. 3738
Commander Aviation, Inc., Pontiac Municipal Airport, Pontiac, Mich. R-1, 2; L-A; L-I; L-P; L-R, Cert. No. 3778
Detroit Aircraft Supply, Inc., 11033 Gratiot Ave., Detroit 13, Mich. L-I, Cert. No. 3027
Duke Harrah, Inc., 919 South 11th St., Niles, Mich. L-AC, Cert. No. 3028
Ford Motor Co., Air Transportation Department, Building 503, Metropolitan Airport, Mich. L-R, Cert. No. 3000
G. B. DuPont Co., Inc., 1194 Roods Lake Road, DuPont-Lapeer Airport, Lapeer, Mich. L-A, Cert. No. 3046
General Motors Air Transport Section, Willow Run Hangar #2, Ypsilanti, Mich. R-1, 2; L-I; L-A; L-R, Cert. No. 3757
Great Lakes Airmotive, Inc., Willow Run Airport, Ypsilanti, Mich. R-1; L-A; L-R; L-I, Cert. No. 235
H & S Propeller Shop, Inc., 25210 Ryan Road, Warren, Mich. PR-2; L-PR; L-AC; L-SS, Cert. No. 3734
Hamlin Testing Laboratories, Inc., 29435 Gratiot Ave., Roseville, Mich. L-SS, Cert. No. 3038
Helicopter Airways Service, Inc., Executive Hangar #504, Metropolitan Airport, Mich. L-AC; L-A; L-PR, Cert. No. 3034
Holley Carburetor Co., Aircraft Division, West Fifth St., Clare, Mich. L-AC, Cert. No. 3022
Materials Testing Laboratories, Division of Magnaflux Corp., 2777 East Grand Boulevard, Detroit 11, Mich. L-SS, Cert. No. 3949
Michigan Aviation Co., 6150 Highland Road, Pontiac Municipal Airport, Pontiac, Mich. L-A; L-P, Cert. No. 3042
Michigan Department of Aeronautics, Capital City Airport, Lansing 6, Mich. L-R, Cert. No. 3010
Moore Brothers Electric Co., Inc., 2602 Leith St., Flint 6, Mich. L-AC, Cert. No. 3032
Northern Air Service, Inc., Kent County Airport, Grand Rapids 8, Mich. R-1, 2; L-I, Cert. No. 4317
Parsons Corp., Aircraft Division, Three Mile Road, Traverse City, Mich. L-SS, Cert. No. 3006
Paul Automotive, Inc., 207-223 North Larch, Lansing 29, Mich. L-SS, Cert. No. 3052
Prentice Aircraft, Inc., Adrian City Airport, Adrian, Mich. R-1; L-R; L-A, Cert. No. 3771
Servair, Inc., Bay 13 & 14, Detroit City Airport, Detroit 13, Mich. I-1, 2, 3; L-AC; L-R, Cert. No. 318
Sparta Aviation Service, Sparta Airport, Sparta, Mich. L-A; L-R, Cert. No. 3048
Superior Instrument Service, 1525 Airport Road, Pontiac, Mich. I-1, 2, 3, Cert. No. 3754
The Dow Chemical Co., Aircraft Electronics Shop, Tri-City Airports, Freeland, Mich. L-R; Cert. No. 3036
Ward Aero, Inc., Haines Airport, Three Rivers, Mich. A-1, 3; L-AC; L-SS, Cert. No. 3779
Zantop Air Transport, Inc., North Hangar #27B, Detroit-Metropolitan Airport, Inkster, Mich. R-1, 2; L-A; L-I, Cert. No. 3765

Minnesota

Aero Precision Engineering Co., Fleming Field, South St. Paul, Minn. L-A; L-R, Cert. No. 4323
Aircraft Instrument Corp., St. Paul Downtown Airport, St. Paul, Minn. I-1, 2; L-I, Cert. No. 3784
Gopher Aviation, Inc., Olmstead County Road #16, Adjacent Municipal Airport, Rochester, Minn. L-P; L-AC, Cert. No. 3012
Gopher Aviation, Inc., Rochester Municipal Airport, Rochester, Minn. R-1; I-1, 2; L-A; L-PR; L-R; L-I, Cert. No. 3721
Gopher Aviation, Inc., Fleming Field, South St. Paul, Minn. L-A; L-R; L-I, Cert. No. 3024
Maxwell Aircraft Service, Inc., Crystal Airport, Robbinsdale 22, Minn. PR-1, 2; L-AC,, Cert. No. 3725
Mercury Aviation, Inc., St. Paul Downtown Airport, St. Paul, Minn. L-SS, Cert. No. 3014
Mercury Aviation, Inc., 6801-34th Ave., South, Wold-Chamberlain Field, Minneapolis 50, Minn. L-A; L-AC, Cert. No. 3005
Minneapolis-Honeywell Regulator Co., Aeronautical Division, Repair Dept., Como Ave. at Eustis, Minneapolis 1, Minn. L-I, Cert. No. 3035
Minnesota Airmotive Flying Cloud, Division of F. H. Peavey & Co., Flying Cloud Field, Hopkins, Minn. L-R, Cert. No. 4304
Minnesota Airmotive, Division of F. H. Peavey & Co., Wold-Chamberlain Field, Minneapolis 50, Minn. A-3; I-1, 2; R-1, 2; L-A; L-R; L-I; L-AC, Cert. No. 3936
Minnesota Mining & Mfg. Co., Aviation Department, South Riverside Hangar, Downtown Airport (Holman Field), St. Paul 7, Minn. L-A, Cert. No. 3049
Northwest Instruments, 4805-4th Ave. South, Minneapolis 9, Minn. L-I, Cert. No. 3025
Wey Aircraft Service, 9325 Bryant Ave. South, Minneapolis 20, Minn. PR-1, 2; AC-1; L-AC; L-SS, Cert. No. 3019
Williams Instrument Service, 8001 Lea Road, Minneapolis 20, Minn. I-1, 2; L-I, Cert. No. 3758

Missouri

Beldex Corp., Chester-Perryville Airport, Perryville, Mo. L-R; L-A; L-P; L-AC; L-SS, Cert. No. 3001
Executive Aircraft Co., 701 Perimeter Road, Kansas City 16, Mo. R-1; L-R, Cert. No. 4314
Interstate Airmotive, Inc., Lambert Field, St. Louis 21, Mo. A-1, 3; R-1; L-A; L-R, Cert. No. 3909
Kansas City Flying Service & Air College, Inc., 601 Perimeter Road, Kansas City 6, Mo. A-1, 3; PR-1; L-PR; L-A, Cert. No. 1376
Murphy Electric Co., 1707-11 W. 45th St., Kansas City 11, Mo. L-SS, Cert. No. 3787
Ozark Air Lines, Inc., Lambert Field, St. Louis 34, Mo. L-R; L-I, Cert. No. 3021
Remmert-Werner, Inc., Lambert Field, St. Louis 34, Mo. A-1, 3; R-1, 2; I-2; L-A; L-PR; L-AC; L-I; L-SS, Cert. No. 3919
St. Louis Flying Service, Inc., Lambert Field, St. Louis 34, Mo. R-1, 2; A-1, 3; L-I, Cert. No. 1360
Young Aviation Corp., Young East Hangar, Lambert Field, St. Louis 34, Mo. A-3; R-1, 2; L-A; L-AC; L-SS, Cert. No. 4307

Nebraska

Robert Graf, Inc., Eppley Airfield, Omaha, Nebr. L-R; L-I, Cert. No. 3029
Sky Harbor Air Service, Eppley Airfield, Omaha, Nebr. L-R; L-I, Cert. No. 3018

South Dakota

Graham Flying Service, Inc., Box 368, North Sioux City, S. Dak. L-R, Cert. No. 3034

Wisconsin

Aerial Blight Control, Inc., Aircraft Engine Overhaul Division, Highway 45, South of City Limits, West Bend, Wis. L-P, Cert. No. 3040
Aircraft Electronic Specialists, Inc., P. O. Box 824, Winnebago County Airport, Oshkosh, Wis. R-1, 2, Cert. No. 3775
Aviation Radio Co., Timmerman Field, 9305 West Appleton Ave., Milwaukee 18, Wis. R-1, 2; L-R; L-I, Cert. No. 3761
DEC Aviation, Inc., Truax Field, Box 1071, Madison, Wis. L-A; L-P; L-PR; L-AC; L-R; L-I, Cert. No. 2702
Gran-Aire, Inc., Timmerman Field, 9305 West Appleton Ave., Milwaukee 18, Wis. A-1, 3; L-P, Cert. No. 3749

Western Region

Federal Aviation Agency, Assistant Administrator, 5651 West Manchester Avenue, Los Angeles 45, California

Arizona

Aero American Corp., Box 21 Y, Ryan Field, Tucson, Ariz. L-A, Cert. No. 4371
Aero Mechanics, Inc., Municipal Airport, Prescott, Ariz. A-1, 3, Cert. No. 4416
Anderson Aviation Co., Inc., 2745 East Airline, Phoenix 34, Ariz. P-1; L-AC, Cert. No. 3847
Bonanza Airlines, Inc., 2700 Airline Way, Phoenix, Ariz. I-1, 2, 3; R-1; L-R, Cert. No. 4172
Carma Aircraft Co., Inc., P. O. Box 11312, Tucson, Ariz. A-1, 3, Cert. No. 4420
Dan Decker Airmotive, 2418 E. Harrison St., Phoenix, Ariz. P-1; L-P; AC-1, 2; L-AC, Cert. No. 4417
Hamilton Aircraft Co., Inc., 6501 S. Park Ave., Tucson, Ariz. A-1, 3, 4, Cert. No. 4187
Hargraves Electronics Corp., P. O. Box 1103, Sierra Vista, Ariz. I-1, 2, 3, 4; AC-3, Cert. No. 4263
Hawkes Aviation, Inc., 2402 Airline Way, Phoenix, Ariz. R-1; L-R; L-I, Cert. No. 3849
Mercury Aviation Corp., P. O. Box 11275, Tucson, Ariz. A-1, 3, Cert. No. 4039

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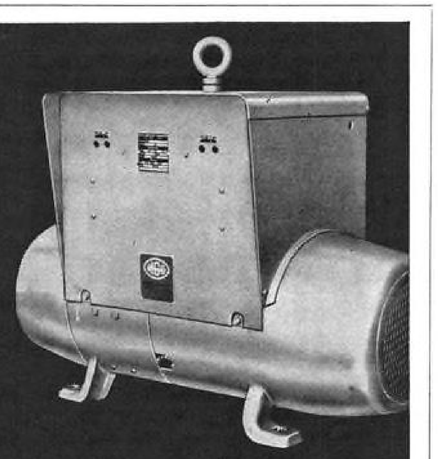

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Ottosen Propeller Service, Inc., 2536 E. Harrison St., Phoenix, Ariz. PR-1, 2; L-PR; L-AC; L-SS, Cert. No. 4013
Phoenix Aviation Co., 2413 Airline Way, Phoenix 34, Ariz. A-1, 3, Cert. No. 4268
Sun Valley Air Service, Inc., 2400 Airline Way, Phoenix, Ariz. R-1; L-R; L-I, Cert. No. 2715
Thompson Aircraft Sales, Inc., Coolidge Division, P. O. Box 1407, Coolidge, Ariz. A-1, 3; L-A, Cert. No. 4009
Tucson Propeller Service, Inc., P. O. Box 11457, Tucson, Ariz. PR-2; L-PR, Cert. No. 4121

California

A.I.R. Corp., Oakland Municipal Airport, Oakland, Calif. I-1, 2, 3, 4; L-SS, Cert. No. 4004
Aero-Engines, Inc., 3030 Coolidge Ave., Los Angeles 39, Calif. P-1; L-P; AC-1, 2, Cert. No. 3865
Aero Equipment Co., 16222 Lindberg St., Van Nuys, Calif. R-1, 2, Cert. No. 4166
Aero Propeller Co., 3103 Pacific Coast Highway, Torrance, Calif. PR-1, 2; L-PR, Cert. No. 3885
Aero Technical Services, 5001 W. Rosecrans Ave., Hawthorne, Calif. L-AC, Cert. No. 4210
Aerojet-General Corp., Ontario International Airport, Ontario, Calif. R-1; L-R; L-A, Cert. No. 4401
Aeronautical Electronics Sales Corp., 3101 Pico Boulevard, Santa Monica, Calif. R-1; L-R, Cert. No. 4222
Aetna Helicopters, Inc., P. O. Box 426, Etna, Calif. L-A, Cert. No. 4092
Air Electronics Co., 7250 Hinds Ave., North Hollywood, Calif. R-1; L-R, Cert. No. 4167
Air-Oasis Co., 3353 Lakewood Boulevard, Long Beach, Calif. A-1, 3, 4; P-1; R-1, 2; L-I, Cert. No. 4082
Air-Oasis Co., 2361 Airlane, Lindbergh Field, San Diego 1, Calif. A-1, 3; L-A; R-1; L-R, Cert. No. 3880
Air Overhaul Inc., 22597 So. Western Ave., Torrance, Calif. L-SS, Cert. No. 4028
Airadio Co., 2611 E. Spring St., Long Beach, Calif. R-1, 2; L-I, Cert. No. 4478
Aircraft Associates, 2611 E. Spring St., Long Beach 6, Calif. A-1, 3; P-1, L-P, Cert. No. 4094
Aircraft Carburetor Co., 2801 Empire Ave., Burbank, Calif. AC-1, Cert. No. 4059
Aircraft Cylinder & Parts, 7934 Clybourn Ave., Sun Valley, Calif. L-SS, Cert. No. 4316
Aircraft Electronics, 2735 E. Spring St., Long Beach 6, Calif. R-1, 2, Cert. No. 3977
Aircraft Governor & Accessory Repair, 7680 San Fernando Road, Sun Valley, Calif. AC-1, 2; L-AC, Cert. No. 4475
Aircraft Sales & Brokerage Co., 2701 E. Wardlow Road, Long Beach 7, Calif. A-1, 3; P-1, Cert. No. 3884
Aircraft Tank Service, Inc., 10201 Cohassett St., Burbank, Calif. L-SS, Cert. No. 4481
AiResearch Aviation Service Co., Div. of Garrett Corp., 6201 W. Imperial Highway, Los Angeles 45, Calif. A-1, 3, 4; R-1, 2, 3; L-SS, Cert. No. 4022
AiResearch Indl. Div. of Garrett Corp., 9225 Aviation Boulevard, Los Angeles 45, Calif. L-AC, Cert. No. 4113
Airframe Manufacturing & Supply Co., P. O. Box 1116, Burbank, Calif. AC-1, 2, 3, Cert. No. 3987
Airmotive Carburetor Co., 479 Riverside Drive, Burbank, Calif. AC-1, Cert. No. 4060
Airotary Supply Co., Inc., 11655 Vanowen St., North Hollywood, Calif. AC-2, Cert. No. 3875
Airpower Overhaul, Inc., 150 Doolittle Drive, San Leandro, Calif. P-1, 2; PR-2; L-PR; AC-1, 2; L-AC, Cert. No. 4065
Airtronics, 1855 West Fifth St., Oxnard, Calif. R-1; L-R; L-I, Cert. No. 4471
Airway Instrument Corp., 5556 W. Washington Boulevard, Los Angeles 16, Calif. I-1, 2, 3, Cert. No. 4170
Alta Aircraft Instrument & Ser. Co., 10413 Burbank Boulevard, North Hollywood, Calif. I-1, 2, 3, Cert. No. 4351
American Electronics, Bldg. 200, Municipal Airport, Hayward, Calif. R-1; L-R, Cert. No. 4042
American Turbine Engine Co., 3218 Cherry Ave., Long Beach, Calif. A-3; L-A, Cert. No. 4192
Astro-Aire Enterprises, Bldg. 731, Oakland Municipal Airport, Oakland 14, Calif. I-1, 2, 3; L-I; L-AC, Cert. No. 4217
Atlas Aircraft Service Corp., Hangar #6, Santa Barbara Municipal Airport, Goleta, Calif. L-A, Cert. No. 4468
Atwood Aviation, Inc., 236 Geil St., Salinas, Calif. P-1; L-P, Cert. No. 3878
Aviation Power Supply, Inc., 3111 Kenwood St., Burbank, Calif. P-2; L-AC, Cert. No. 4076
Avion Instrument & Repair Corp., 2518 W. Burbank Boulevard, Burbank, Calif. I-1, 2, Cert. No. 4021
Avinx Inc., P. O. Box 4098, Sylmar, Calif. AC-1, 2, 3; L-I, Cert. No. 4211
B-G Detection Service, 1024 W. Burbank Blvd., P. O. Box 65, Burbank, Calif. L-SS, Cert. No. 4086
Bacon Aircraft Co., P. O. Box 222, Thermal, Calif. A-1, 3, Cert. No. 4226
Baker Aircraft Sales, 3425 Lakewood Blvd., P. O. Box 8066, Long Beach, Calif. R-1; L-R, Cert. No. 4029
Bakersfield Air Radio, Div. of Pemberton Flying Service, 2199 Airport Drive, Bakersfield, Calif. R-1; L-R, Cert. No. 4191
Bates Aviation, Inc., 1026 East 120th St., Hawthorne, Calif. A-1, 3; P-1; R-1; L-R; L-I, Cert. No. 4128
Bay Aero Radio Service, 3103 Pacific Coast Highway, Torrance, Calif. R-1, Cert. No. 4091
Bayaire Avionics, Inc., Box 2301, Oakland International Airport, Oakland, Calif. R-1, 2, 3; L-I, Cert. No. 3863
Bearing Inspection, Inc., 3311 E. Gage Ave., Huntington Park, Calif. L-SS, Cert. No. 4403
Bell Airborne Electronics, Gillespie Field, Santee, Calif. R-1; L-R, Cert. No. 4197
Belmont Aviation Corp., 2700 East Wardlow Road, Long Beach 7, Calif. A-1, 3, Cert. No. 4052
Bendix West Coast Div., Bendix Aviation Corp., 117 E. Providencia Ave., Burbank, Calif. L-I; L-AC, Cert. No. 4193
Bendix West Coast Div. (Palmdale), The Bendix Corp., 117 E. Providencia, Burbank, Calif. L-AC, Cert. No. 4193A
A. Biederman, Inc., 1045 Air Way, Glendale 1, Calif. I-1, 2, 3, 4; L-AC; L-SS, Cert. No. 197
N. C. Boardman, Jr., 7518 Clybourn Ave., Sun Valley, Calif. AC-2, 3, Cert. No. 3882
Bomar Magneto Service, Inc., 2546 Cherry Ave., Long Beach 6, Calif. L-AC, Cert. No. 4063
Bragg Service Inc., d/b/a Aero Sales and Service, Chandler Field, Fresno, Calif. A-1, 3, Cert. No. 4259
R. A. Bridgeford, Inc., d/b/a/ Bridgeford Flying Service, 1465 Lindbergh St., Stockton, Calif. L-A; L-AC, Cert. No. 3857
Butler Aviation-San Francisco, Inc., San Francisco Intl. Airport, Airport Station, San Francisco 28, Calif. A-1, 3; L-A; R-1, 2; L-R; L-I, Cert. No. 4155
Cal-Western Aero Service, P. O. Box 6002, Bakersfield, Calif. L-A, Cert. No. 4482
Calac-Certified O&R Station, P. O. Box 551, Burbank, Calif. AC-1, 2; L-A, Cert. No. 4101
California Airmotive Corp., 7139 Vineland Ave., North Hollywood, Calif. P-2, Cert. No. 3890
California Fritzen Propeller Co., 20820 S. Main St., Torrance, Calif. PR-1, 2; L-PR, Cert. No. 285
Captive-Air, Inc., 2909 Thornton Ave., Burbank, Calif. AC-1, 2; L-AC; L-SS, Cert. No. 4070
Centimeg Electronics, 312 E. Imperial Highway, El Segundo, Calif. R-1, Cert. No. 3877
Central Air Repair, Inc., 3333 Burton Ave., Burbank, Calif. AC-1, 2; L-AC, Cert. No. 4223
Certified Inspection Service, 6326 Dale Ave., Buena Park, Calif. L-SS, Cert. No. 4479
Chrisbarry Aircraft, 10902 Vanowen St., North Hollywood, Calif. AC-1, 2; L-AC; L-SS, Cert. No. 4088
Chandler Aircraft Service, 151 West Lambert Ave., El Monte, Calif. L-A; L-AC, Cert. No. 4234
Clover Field Radio Supply Co., 3231 Airport Ave., Santa Monica, Calif. R-1, 2; L-I, Cert. No. 4220
Coastal Accessory Service, Div. of Ken-Air, Inc., P. O. Box 728, Sun Valley, Calif. AC-1, 2; L-AC, Cert. No. 4151
Collins Radio Co., c/o Service Div., Modification & Repair Center, 3132 West Central Ave., Santa Ana, Calif. L-R, Cert. No. 4418
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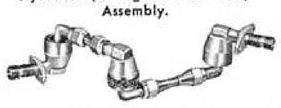

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N. L. Curtis Company, 10702 Vanowen St., North Hollywood, Calif. L-SS, Cert. No. 4280
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Debs Aircraft & Engine Service, 1065 Arroyo, San Fernando, Calif. P-1; L-AC, Cert. No. 4412
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Executive Air Service, 4th Flr. Terminal Building, Lindbergh Field, San Diego 1, Calif. R-1; L-R, Cert. No. 4001
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Fallin Air Service, 4119 W. Commonwealth, Fullerton Municipal Airport, Fullerton, Calif. R-1; L-R, Cert. No. 4163
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The Flying Tiger Line, Inc., Lockheed Air Terminal, Burbank, Calif. A-1, 3, 4; AC-1, 2, 3; I-1, 2, 3, 4; L-AC; R-1, 2; L-R; L-SS, Cert. No. 4038
Fortner Accessory Service Corp., 1809 Victory Boulevard, Glendale 1, Calif. L-AC, Cert. No. 4252
Galaxy Electronics, 1075 Seymore Place, Hayward, Calif. R-1; L-R, Cert. No. 4077
Genaire Co., 15922 Strathern St., Unit 14, Van Nuys, Calif. AC-2; L-AC, Cert. No. 4116
General Electric Aircraft Apparatus Service Shop, Ontario International Airport, Ontario, Calif. I-2; L-I; AC-2; L-AC; L-P; L-PR; L-SS, Cert. No. 4159
Giannini Controls Corp., Systems Division, 1600 South Mountain Ave., Duarte, Calif. L-AC, Cert. No. 4023
Glendale Instrument Co., 1412 W. Glenoaks Boulevard, Glendale 1, Calif. L-I; L-R, Cert. No. 3879
Golden Gate Aviation, Inc., P. O. Box 2398, Oakland International Airport, Oakland, Calif. A-3; R-1, 2, Cert. No. 4189
Golden Propeller Co., 20401 Hesperian Boulevard, (Bldg. 208), Hayward, Calif. L-PR; L-AC; L-SS, Cert. No. 4195
Gorco Engineering Services, P. O. Box 551, Concord, Calif. R-1, Cert. No. 4244
Grand Central Aircraft Co., 1100 Air Way Drive (Engine Div.), Glendale 1, Calif. P-1, 2; PR-2; L-PR; AC-1, 2, 3, Cert. No. 75
Great Lakes Airlines Maint. Corp., Lockheed Air Terminal, Burbank, Calif. L-A, Cert. No. 4212
Groves Aircraft Sales, Inc., 8216 Lankershim Boulevard, North Hollywood, Calif. AC-1, 2; L-AC; L-SS, Cert. No. 3976
Gunnell Aviation, Inc., 3000 Airport Ave., Santa Monica, Calif. A-1, 3; P-1; L-R, Cert. No. 4406
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The Gyro House, Box 3162, Riverside, Calif. L-I, Cert. No. 4079
Hagelin Aircraft Motors Co., 933 Air Way Drive, Glendale 1, Calif. P-1; L-AC, Cert. No. 322
Hangar Four Corp., P. O. Box 1169—Airport Station, Oakland International Airport, Oakland, Calif. R-1, 2; L-R; AC-2; L-AC; L-A; L-I; L-SS, Cert. No. 4016
Helicopter Welders, 7943 Haskell Ave., Van Nuys, Calif. L-A, Cert. No. 4476
Huff Airsupply Corp., d/b/a Cal Pacific Airsupply, 7560 San Fernando Road, Sun Valley, Calif. AC-2; L-AC, Cert. No. 4242
Hughes Aircraft Co., Florence & Teale Sts., Culver City, Calif. A-3, 4; I-1, 2; R-1, 2; L-I, Cert. No. 2770
Hughes Tool Co., Aircraft Div., Florence & Teale Sts., (Hughes Airport), Culver City, Calif. L-A; L-PR; L-R, Cert. No. 4010
Hunt Aviation Co., d/b/a Air-Oasis Co., Chandler Field, Fresno, Calif. R-1; L-R; L-A; L-I, Cert. No. 3864
INESCO, 7339 Varna Ave., North Hollywood, Calif. I-1, 2, Cert. No. 4067
Inland Aircraft Co., Engine Overhaul Division, Box 712, Los Banos, Calif. L-P; L-AC, Cert. No. 4483
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International Aircraft Services, Inc., AEMCO Division, P. O. Box 6188, Oakland 3, Calif. A-1, 3, 4; I-1, 2, 4; L-I; R-1, 2; L-R; AC-1, 2, 3; L-AC, Cert. No. 4127
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Lane Electronics Co., 7254 Atoll Ave., North Hollywood, Calif. R-1, 2; L-R, Cert. No. 3876
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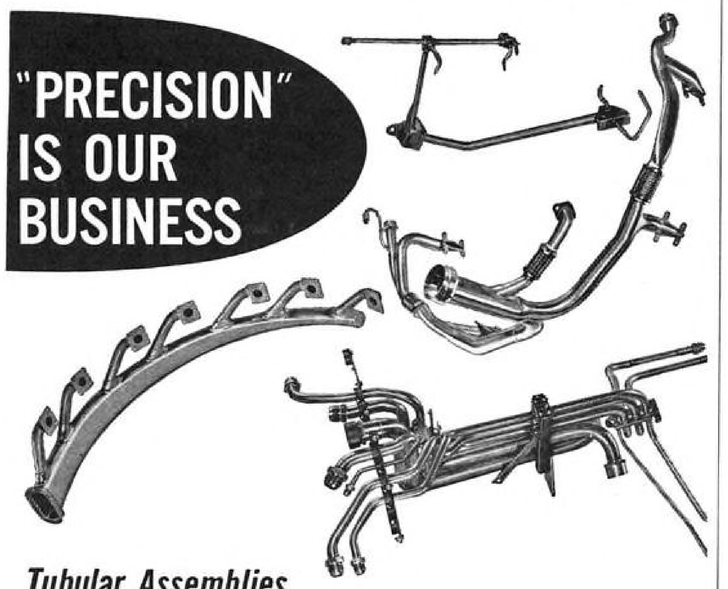

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H. J. Olney Co., Building 735, P. O. Box 2361, Oakland International Airport, Oakland, Calif. AC-1, 2, Cert. No. 4129
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PacAero Engineering Corp., 3000 Clybourn Ave., Burbank, Calif. A-1, 3, 4; AC-1; L-SS, Cert. No. 4215
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Pacific Airmotive Corp., P. O. Box 2338—Airport Station, Oakland 14, Calif. I-1, 2, 3, 4; L-AC, Cert. No. 3870
Pacific Avionics, Inc., P. O. Box 63, San Carlos, Calif. R-1; L-R, Cert. No. 4421
Pacific Electronic Enterprises, 1416 W. Glenoaks Boulevard, Glendale 1, Calif. R-1; L-R, Cert. No. 4171
Pacific Industrial X-Ray Corp., 2327 Union St., Oakland 7, Calif. L-SS, Cert. No. 4161
Pacific Scientific Co., 6280 Chalet Drive, Bell Gardens, Calif. I-3; L-I, Cert. No. 2366
Pacific Southwest Airlines, 3100 Goddard Way, San Diego 1, Calif. R-1; L-R; L-A, Cert. No. 4174
F. M. Pardo Enterprises, 19532 Acacia St., Santa Ana, Calif. R-1; L-R, Cert. No. 4002
Parsons Corp. of California, 902-908 East Scotts, Stockton, Calif. L-PR; L-SS, Cert. No. 3891
Patterson Aircraft Co., Hangar #1, Municipal Airport, Sacramento 22, Calif. L-A; L-AC, Cert. No. 4043
Pierce Flying Service, Inc., 4100 Jacobs Ave., Eureka, Calif. R-1; L-R, Cert. No. 4470
Pioneer Aero Service, P. O. Box 227, Burbank, Calif. L-AC, Cert. No. 3980
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R.W.S. Electrical Accessory Service, 3210 N. San Fernando Boulevard, Burbank, Calif. AC-1, 2, 3; L-AC, Cert. No. 4090
Radio Electronic Service Co., Building 604, Oakland International Airport, Oakland, Calif. R-1, 2; L-R; L-I; L-AC, Cert. No. 4097
REP-AIR, Inc., P. O. Box 2353, Oakland International Airport, Oakland, Calif. L-A, Cert. No. 4186
Riverside Flight Academy, Inc., 6873 Airport Road, Riverside, Calif. R-1; L-R, Cert. No. 4061
Rotor-Aids Maintenance Corp., P. O. Box 1850—Ventura Airpark, Ventura, Calif. L-A, Cert. No. 3978
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Ryan Aerospace Division Standards Laboratory, 2701 Harbor Drive, San Diego 12, Calif. I-1, 2, 3, Cert. No. 4036
S&S Accessory Overhaul Co., Building 643, Oakland International Airport, Oakland, Calif. AC-1, 2; L-AC, Cert. No. 4120
Sacramento Sky Ranch, Inc., 6900 Stockton Boulevard, Sacramento, Calif. A-1, 3; P-1; L-AC; L-SS, Cert. No. 3850
San Jose Avionics Co., Municipal Airport, San Jose, Calif. R-1, 2; L-I, Cert. No. 3851
Santa Barbara Aviation, Inc., P. O. Box 296, Goleta, Calif. A-1, 3; L-A; P-1; L-P, Cert. No. 4019
Savage Magneto Service, Building 629, Oakland International Airport, Oakland, Calif. AC-2, Cert. No. 3881
Scott Aero Service, Inc., 2901 East Spring St., Long Beach 6, Calif. A-1, 3; L-A, Cert. No. 4020
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Sea Air, Inc., d/b/a Western Navion, 3205 Lakewood Boulevard, Long Beach, Calif. A-1, 3, Cert. No. 4188
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Skycrafters, Inc., 1365 Gladys Ave., Long Beach 4, Calif. R-1, Cert. No. 3896
Skytronics, Inc., P. O. Box 90910—Airport Station, Los Angeles 9, Calif. AC-2; L-AC, Cert. No. 4018
Southwestern Avionics, Inc., Box 10, Torrance Municipal Airport, Torrance, Calif. L-I; L-R, Cert. No. 4124
Spec Tool Co., 9626 East Beverly Road, Pico Rivera, Calif. L-I, Cert. No. 4062
State Radiator Co., 1594 East Hill St., Long Beach, Calif. L-AC, Cert. No. 4008
Stellar Hydraulics Co., 11034 Sutter Ave., Pacoima, Calif. L-AC, Cert. No. 4275
Steward-Davis, Inc., 3200 Cherry Ave., Long Beach 8, Calif. P-1, 2; L-AC, Cert. No. 4044
Perry D. Stilley Communication & Electronic Service, 505 East Boone, Santa Maria, Calif. R-1, Cert. No. 4190
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Transient Aircraft Maint. Service, P. O. Box 2332, Airport Station, Oakland 14, Calif. A-1, 3, 4, Cert. No. 3868
United Air Lines, Inc., San Francisco International Airport, San Francisco, Calif. A-1, 3, 4; I-1, 2, 3, 4; R-1, 2, 3; P-1, 2; L-P; PR-1, 2; AC-1, 2, 3, Cert. No. 11
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Vroom Aircraft Supply, 3321 Burton Ave., Burbank, Calif. L-SS, Cert. No. 4117
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West Coast Instrument Service, 711 Cherry Ave., Long Beach 13, Calif. I-1, 2, 3; L-I, Cert. No. 4119
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Western Gear Corp., P. O. Box 192, Lynwood, Calif. L-AC, Cert. No. 4087
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Wright Brothers, Inc., 401 Newhall St., San Jose 10, Calif. I-1, 2; L-I; R-1, 2, Cert. No. 3895
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Colorado

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Aircraft Communications, 1755 No. 18th St., Grand Junction, Colo. L-R, Cert. No. 4071
Aircraft Mechanic's, Inc., 3200 No. Nevada Ave., Colorado Springs, Colo. L-SS, Cert. No. 4064
Aircraft Radio & Accessory Co., Inc., Hangar 4, Stapleton Airfield, Denver 7, Colo. R-1, 2; L-R; L-I, Cert. No. 3932
BEMM Aircraft Instrument Service, Stapleton Airfield, Denver, Colo. L-I, Cert. No. 3903
Combs Aircraft, Inc., Hangar No. 7, Stapleton Airfield, Denver 7, Colo. L-PR, Cert. No. 4152
Continental Airlines, Stapleton Airfield, Denver 5, Colo. I-1, 2, 3; L-I; PR-2; AC-1, 2; L-AC; L-A; L-P; L-R, Cert. No. 3869
Denver Airplane Supply, Div. of Clinton Aviation Co., Stapleton Airfield, Denver, Colo. L-R; L-AC; L-PR, Cert. No. 3931
Empire Aviation, Inc., Municipal Airport, LaJunta, Colo. P-1, Cert. No. 4414
Frontier Airlines, Inc., Stapleton Airfield, Denver 7, Colo. I-1, 2, 3; L-I; L-SS; AC-1, 2; L-AC; L-R; L-A; L-P; L-PR, Cert. No. 4050
Grand Valley Aircraft, Inc., P. O. Box 158, Grand Junction, Colo. A-1, 3, Cert. No. 4014
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Precision Airmotive Balancing, 2000 So. Osage St., Denver 23, Colo. L-SS, Cert. No. 4080
Sundstrand Aviation-Denver, 2480 West 70th Ave., Denver 21, Colo. L-AC, Cert. No. 4179
Universal Aircraft Industries, Inc., P. O. Box 5306, Denver, Colo. A-1, 3; P-1; L-P; I-1, 2, 3; L-I; AC-1, 2; PR-1, 2; L-PR, Cert. No. 3846
Woodward Governor Co., P. O. Box 532, Ft. Collins, Colo. L-AC, Cert. No. 4030

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Morrison-Knudsen Co., Inc., P. O. Box 450, Boise, Idaho. A-1, 3, 4; P-1; R-1; L-R; AC-1, 2; L-AC, Cert. No. 3894
Oakley-Moody Service, Inc., P. O. Box 1701, Boise, Idaho. L-I; L-AC, Cert. No. 4089
Welch Aircraft Electronics, P. O. Box 4131, Boise, Idaho. R-1; L-R, Cert. No. 4405

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ELCON, (Electronic Consultants Services), P. O. Box 698, Billings, Mont. R-1, 2; L-I, Cert. No. 4173
Johnson Flying Service, Inc., Box 1366, Missouli, Mont. A-1, 3; L-A; P-1; L-P; L-AC, Cert. No. 1331
Lynch Flying Service, Inc., P. O. Box 1575—Logan Field, Billings, Mont. A-1, 3; L-AC; P-1; L-I, Cert. No. 4198

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Bonanza Air Lines, Inc., P. O. Box 391, Las Vegas, Nev. R-1; L-R; L-A, Cert. No. 4085

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Flightcraft, Inc., 7505 N. E. Airport Way, Portland 18, Oreg. A-1, 3; L-A; P-1; R-1, 2; PR-1, 2; L-I; L-AC, Cert. No. 4126
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Aero Boeing, 8013 Perimeter Road South, Seattle 8, Wash. L-A; L-P, Cert. No. 4026
Aero Nav-Comm., Co., 6549 Airport Way, Boeing Field, Seattle 8, Wash. R-1, 2, Cert. No. 4474
Alaska Airlines, Inc., Paine Field, P. O. Box 1014, Everett, Wash. A-1, 3, 4; P-1; L-P; PR-2; R-1, 2; L-R; I-1, 2, 3, 4; AC-1, 2, Cert. No. 4114
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Bendix West Coast Division—Seattle Facility, 8425 First Ave. South, Seattle 8, Wash. L-I, Cert. No. 4084
Boeing Co., Transport Div. (Renton Airport), P. O. Box 707, Renton, Wash. I-1, 2, 3; R-1, 2, 3, Cert. No. 4047
Boeing Co., Transport Div. (Boeing Field), P. O. Box 707, Renton, Wash. AC-1, 2, 3; L-A; L-I, Cert. No. 4100
Clover Park Vocational-Tech. School, Clover Park Aviation Dept., 5214 Steilacoom Boulevard, S.W., Tacoma 99, Wash. A-1, 3; P-1; PR-1, 2; L-PR; R-1; L-R, Cert. No. 4466
Collins Radio Co., Seattle Repair Facility, 2826 Empire Way South, Seattle 44, Wash. L-R, Cert. No. 4245
Dascomp Aircraft Supplies, Room 130, FAA Building, Boeing Field, Seattle, Wash. AC-1, 2; L-AC, Cert. No. 4109
Del-Tech Instrument, Inc., 6740 Perimeter Road, Seattle 8, Wash. I-1, 2, 3, 4, Cert. No. 4164
Eastern Instrument Co., 5907 East Rutter Ave., Spokane 6, Wash. I-3; L-I, Cert. No. 4219
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Northwest Propeller, Inc., FAA Building, Boeing Field, Seattle 8, Wash. PR-1, 2; L-PR; L-AC, Cert. No. 4102
Pacific Airmotive Corp., Seattle Branch, 7097 Perimeter Road, Seattle 8, Wash. AC-1, 2; L-SS, Cert. No. 4096
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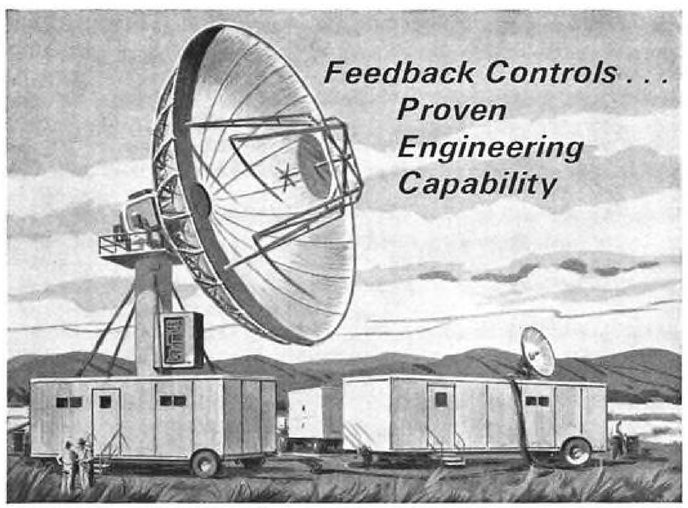
Lynn Quackenbush-Powerplants, 1451 S.W. 150th, Seattle 66, Wash. P-1, Cert. No. 4055
Renton Aviation, Inc., P. O. Box 487, Renton, Wash. A-1, 3, Cert. No. 4419
Sky Van Airways, 7999 Perimeter Road South, Seattle 8, Wash. L-SS, Cert. No. 4112
Sutherland's Inc., Box 25, Boeing Field, Seattle 8, Wash. I-1, 2, 3, 4; AC-1, 2; L-AC, Cert. No. 2751
Switzer Communications Co., East 5907 Rutter Ave., Felts Field, Spokane 6, Wash. R-1, 2, Cert. No. 4125
Thun Field Inspection Service, Route 2, Box 595, Puyallup, Wash. L-SS, Cert. No. 4423
United Control Corp., P. O. Box 3104, Seattle 14, Wash. L-I; L-AC, Cert. No. 4054
Walace Airmotive, P. O. Box 276—Parkwater Station,



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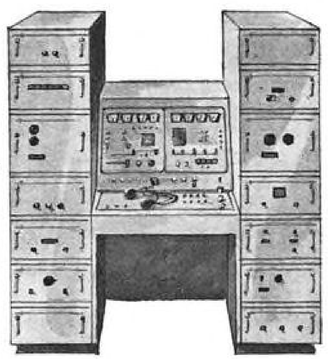

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Wien Alaska Airlines, Inc., P. O. Box 690, Fairbangs, Alaska. I-1; L-1, Cert. No. 4204

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Aluminum Welding & Mfg. Co., Building #239, Honolulu International Airport, Honolulu, Hawaii. L-SS, Cert. No. 956
Carbonic Products Corp., 91-153 Hanua St., Campbell Industrial Park, Oahu, Hawaii. L-SS, Cert. No. 958
Electronic Laboratories, Inc., 2779 Mokumoa St., Honolulu 17, Hawaii. R-1, Cert. No. 953
GasproO, Ltd., 500 Kuwili St., Honolulu, Hawaii. L-SS, Cert. No. 955
Hawaiian Airlines, Inc., Yorktown Ave., Honolulu International Airport, Honolulu, Hawaii. I-1, 2, 3; AC-1; L-A; L-P; L-PR; L-I; L-AC; L-SS, Cert. No. 950
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Murrayair, Ltd., Yorktown Ave., Honolulu International Airport, Honolulu, Hawaii. A-1, 3; P-1; RR-1, 2; AC-1, 2; L-P; L-PR; L-SS, Cert. No. 4253
Welding & Industrial Products, Ltd., 1370 Makaloa St., Honolulu 12, Hawaii. L-SS, Cert. No. 959

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International Division, FS-700, Washington 25, D. C.

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Sabena-Belgian World Airlines, 35 Rue Cardinal Mercier, Brussels, Belgium. A-2, 3, 4; P-1, 2; PR-2; R-1, 2, 3; I-1, 2, 3; AC-1, 2, 3, 4; L-SS, Cert. No. 111-F

Brazil

Panair do Brasil, Galeao Airport, Rio de Janeiro, Brazil, A-4; P-2, 3; PR-2; R-1, 2, 3; I-1, 2, 3, 4; AC-1, 2, 3, Cert. No. 108-F

Colombia

Aerovias Nacionales de Colombia, S. A., Soledad Airport, Barranquilla, Atlantico, Colombia, A-3, 4; PR-2; P-1, 2; I-1, 2, 3, 4; R-1, 2; AC-1, 2, 3, Cert. No. 129-F

Costa Rica

Servicios Aerotecnicos Latino Americanos, S.A. (SALA), El Coco Airport, San Jose, Costa Rica. A-1, 2, 3, 4; P-1, 2; PR-1, 2; I-1, 2, 3, 4; AC-1, 2, 3; R-1, 2, Cert. No. 116-F

Denmark

Scandinavian Airlines System, Region Denmark, Copenhagen Airport, Kastrup, Denmark. A-4; P-2; PR-2; R-1, 2; I-1, 2, 3, 4; AC-1, 2, Cert. No. 110-F

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Field Aircraft Services, Ltd., Instrument Division, Bovingdon Airport, Nr. Hemel Hempstead, Herts, England. I-1, 2, 3; AC-2, Cert. No. 140-F
Field Aircraft Services, Ltd., Croydon Airport, Surrey, England. P-2; AC-1, 2, Cert. No. 133-F
Marshalls' Flying School, Ltd., Cambridge Airport, Spokane, Wash. A-1, 3; P-1, 2; PR-1, 2; L-PR; AC-1, 2; L-AC, Cert. No. 299
Washington Aircraft & Transport Corp., Box 9, Boeing Field, Seattle 8, Wash. A-1, 3; R-1; L-R; P-1; L-SS, Cert. No. 4402
WenAirCo., Aircraft Service, Box 1160, Wenatchee, Wash. A-1, 3, Cert. No. 4312
X-Ray, Inc., 7500 Perimeter Road South, Boeing Field, Seattle 8, Wash. L-SS, Cert. No. 4175

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Land-Air, Inc., P. O. Box 2327—Airport Station, Cheyenne, Wyo. A-1, 3, 4; R-1; 2; L-SS, Cert. No. 3973
Sky Harbor Air Service, Box 138, Cheyenne, Wyo. R-1; L-R, Cert. No. 4183
Western Aerotronics, 3801 Evans Ave., Cheyenne, Wyo. R-1; L-R, Cert. No. 4156
England. A-4; P-3; PR-2, Cert. No. 146-F

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Air Asia, Ltd., Tainan Airfield, Tainon, Taiwan and Kaohsiung Harbor, Kaohsiung, Taiwan. A-1, 3, 4; P-1, 2; PR-1, 2; R-1, 2, 3; I-1, 2, 3, 4; AC-1, 2, 3, Cert. No. 122-F

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Air France, Centre de Revision de Courbevoie, 112 Boulevard de Verdun, Courbevoie, France. P-2; AC-1, Cert. No. 109-F
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Societe Nationale d'Etude et de Construction de Moteurs d' Aviation (SNECMA), 167 Rue De Silly-Billancourt, Seine, France. P-3, Cert. No. 144-F
Transports Aeriens Intercontinentaux, Orly Airfield—B.P. 118, Seine, France. A-4; P-2; PR-2; R-1, 2, 3; I-1, 2, 3, 4; AC-1, 2, 3, Cert. No. 126-F
Union Aeromaritime de Transport, Le Bourget Airport, Seine, France. A-4; I-1, 2, 3, 4; AC-1, 2, 3; R-1, 2, 3, Cert. No. 147-F

Hong Kong B.C.C.

Hong Kong Aircraft Engineering Co., Kai Tak Airport, Hong Kong, B.C.C. A-3, 4; P-2; PR-2; R-1, 2; I-1, 2, 3; AC-1, 2, Cert. No. 136-F

India

Air India International, Bombay Airport, Santa Cruz (East), Bombay 29, India. A-4; P-2; PR-2; R-1, 2, 3; I-1, 2, 3, 4; AC-1, 2, Cert. No. 143-F
Hindustan Aircraft, Ltd., Dumlur Road, Bangalore, India. A-3, 4; P-2; PR-2; R-1, 2; I-1, 2, 3, 4; AC-1, 2, 3, Cert. No. 119-F

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Israel Aircraft Industries, Ltd., Lod Airport, Israel. A-1, 3, 4; P-1, 2, 3; PR-1, 2; I-1, 2, 3, 4; AC-1, 2, 3; R-1, 2, 3, Cert. No. 125-F

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Alfa Romeo, Sezione Avio, Pomligiano D'Arco, Naples, Italy. P-2, 3; AC-1, 2, Cert. No. 138-F
Fiat, Sezione Motori Avio, Via Niza 312, Torino, Italy. P-2, 3; PR-2; AC-1, 2, Cert. No. 139-F

Japan

Japan Aircraft Maintenance Co., Tokyo International Airport, Edomi-cho, Ohta-ku, Tokyo, Japan. A-4; P-2, 3; PR-2; R-1, 2, 3; I-1, 2, 3, 4; AC-1, 2, 3, Cert. No. 123-F

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Compania Mexicana de Aviacion (CMA), Balderas No. 36, Mexico City, Mexico. A-4; P-2; PR-2; R-1, 2, 3; AC-1, 2, 3; I-1, 2, 3, 4, Cert. No. 101-F

Netherlands

KLM Royal Dutch Airlines, Schiphol Airport, Amsterdam, Netherlands. A-4; P-2; PR-2; R-1, 2, 3; I-1, 2, 3, 4; AC-1, 2, 3, Cert. No. 102-F

Pakistan

Pakistan International Airlines Corp., Karachi Airport, Karachi, Pakistan. A-1, 3, 4; P-1, 2; PR-2; R-1, 2, 3; I-1, 2, 3, 4; AC-1, 2, 3, Cert. No. 141-F

Philippine Islands

Philippine Air Lines, Manila Int'l. Airport, Pasay City, Philippines. A-1, 3, 4; P-1, 2; PR-1, 2; R-1, 2; I-1, 2, 3; AC-1, 2, 3, Cert. No. 130-F

Sweden

Scandinavian Airlines System, Region Sweden, Bromma Airport, Stockholm 40, Sweden. A-4; P-2; PR-2; R-1, 2, 3; AC-1, 2, 3; I-1, 2, 3, 4, Cert. No. 114-F

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Swissair, Technical Department, Zurich Airport, Kloten, Switzerland. A-4; P-2; PR-2; R-1, 2, 3; I-1, 2, 3, 4; AC-1, 2, 3, Cert. No. 106F
Swissair, Geneva Airport, Geneva, Switzerland. A-3, 4; P-2; PR-2, Cert. No. 142-F
Transair, S. A., Aeroport de Neuchatel, Colombier, Neuchatel, Switzerland. A-1, 3; P-1; PR-1, 2; AC-1, 2; L-SS, Cert. No. 132-F

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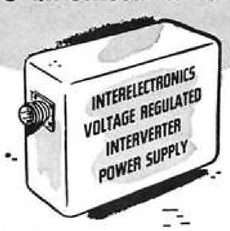

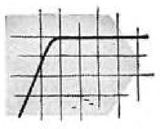

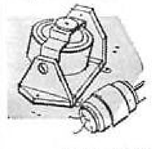

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Complies with MIL specs. for shock (100G 11 mlsc.), acceleration (100G 15 min.), vibration (100G 5 to 5,000 cps.), temperature (to 150 degrees C), RF noise (I-26600).

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.

NEW FROM BUCKEYE!
#13460 UNDERWING REFUELING NOZZLE

LIGHTWEIGHT. Aluminum. Weighs 10 lbs. Interior metal parts are of non-corrosive stainless steel or aluminum bronze.

FOOLPROOF. New interlock mechanism prevents fuel flow 'til nozzle is locked to aircraft adapter. Must be closed before nozzle can be removed.

FAST. Twist to engage. Push lever just 90° to lock on. Deliver 600 gpm. with pressure drop of less than 8 psi.

SELF-ADJUSTING. Prevents leakage without manual adjustments.

SIMPLIFIED. Minimum of moving parts and seals. All critical parts are accessible without complete disassembly of valve. Available with "free-swiveling" inlet adapter or plain threaded inlet.

Standard Accessories include: dust cap, grounding cable, 60 or 100-mesh strainer. Choice of 6-inch or 12-inch bicycle-type handles.

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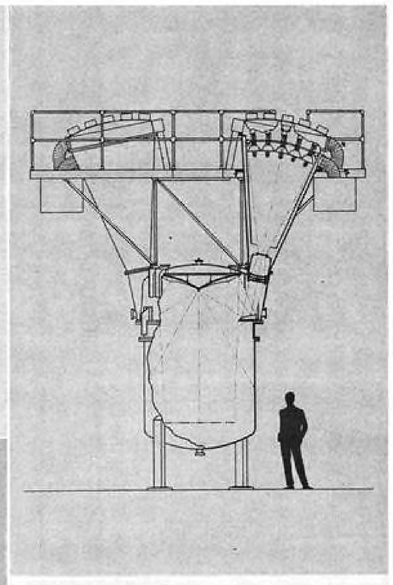

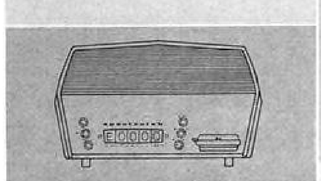

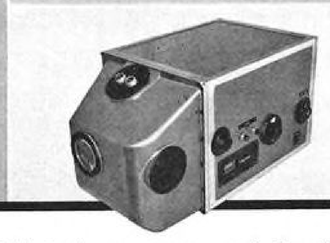

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AIRCRAFT NEEDLE ROLLER BEARINGS
Track Roller Bearings — NAS 502 and NAS 503 Series
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With self-contained, two piece outer ring which maintains positive position during installation and when under load.
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Turn to page 267 for a consolidated listing of FAA CERTIFICATED REPAIR STATIONS coded to show type of work performed.

A Complete Line of Fasteners

For Metal Castings, Machined Parts and Assemblies

Heli-Coil Standard Screw-Thread Insert	*Heli-Coil* Screw-Lock Insert	Gripco Toplock Nut	Gripco Centerlock Nut
Winds easily into tapped holes. Anchors itself in the receiving threads with expanding pressure. Won't loosen. Needs no oversize bosses, flanges, or wall thicknesses.	Locks screws into tapped holes. Holds tight against impact and vibration without lock nuts, lock wiring, lock washers.	Eliminates need for lock washers and other external locking devices. Nut spins onto the bolt to the lock section and then is torqued onto the bolt.	Double chamfered, with locking feature in center. Can be applied from either end. Locks wherever it is turned on bolt.

For Sheet Metal

Gripco Countersunk Weld Nut	Gripco Pilot Weld Nut	Gripco Clinch Nut	Tab Weld Nut
Threads can't be fouled by molten metal during welding. Three weld projections for firm electrical connection.	Circular locating collar for quick, easy positioning. Three weld projections for firm electrical connections.	Hex collar fits into hex hole, prevents nut from turning when installing or removing bolt. Ideal for blind applications.	Illustrated in projection weld type... also available in spot weld type. Only weld nut of this type with locking feature.

For Plastics

Standard Dodge Expansion Insert	Dodge Clinch Insert	Dodge Flange Insert
Placed by hand or machine into molded-in or drilled holes. Eliminates tapping costs, reduces open press time. Provides torque and pull strength greater than mating screw.	All features of Standard Dodge Insert... plus an eyelet for strong and highly conductive electrical connections.	Same features as Standard Dodge Insert... plus flange to hold down insulators, contacts, springs, other electrical and mechanical components.

Dodge Cone-Spread Insert	*Heli-Coil* Push Insert	Dodge Wedge Insert
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For Woods and Particle Board

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Self-tapping. Provides reusable threads.	Self-tapping. Increase thread strength. Permit use of shorter thread engagements.	Stronger than straight knurled bushing. Fibers flow around fin as installed. Axial knurl provides additional strength against rotation.	Simplified assemblies. Provides strong, re-usable threads.

All of these fasteners are stock items, available for immediate delivery in a wide range of sizes. ***Heli-Coil's*** experienced engineering staff will be glad to assist you in solving your fastening problems at the design level. Write today for detailed literature.

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283

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Latest Developments in Electronic Wire & Cable

ITT Surprenant—recognized for over 25 years for originating new electronic wire and cable specifications—now lists these late developments. Send coupon for details.

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APPLICATION I HAVE IN MIND IS:

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☐ SUROK* coated abrasion resistant Teflon** wire and cable.

☐ Special thin wall, extra abrasion resistant, high temperature wire and cable.

☐ Weight and bulk reducing wiring system programs.

☐ Alloy 63* wire and cable—the most important development in conductor alloys—maintains 90% conductivity and the elongation of annealed copper; has three (3) times the flex life, very high tensile and breaking strength. Rust-proof—non-magnetic.

☐ Cable assemblies for ground support systems and umbilical cables.

☐ Special moisture-proof connectors for cable assemblies.

*ITT Surprenant Mfg. Co. trademark
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284

AC POWER SUPPLIES

A complete line of single phase, two phase and three phase electronic power supplies with output power ranging from 3 watts to 9 KVA.

Featuring:

- Precision 400 C.P.S. output (other fixed or variable frequency ranges available).
- Regulated output voltage.
- Low distortion.
- Many standard optional features to suit your requirements.

WRITE FOR OUR NEW POWERTRON SPECIFICATION CATALOG

INDUSTRIAL TEST EQUIPMENT CO.
55 EAST 11th STREET • NEW YORK 3, N. Y.

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Turn to page 241

for

an alphabetical listing

of

MANUFACTURERS'

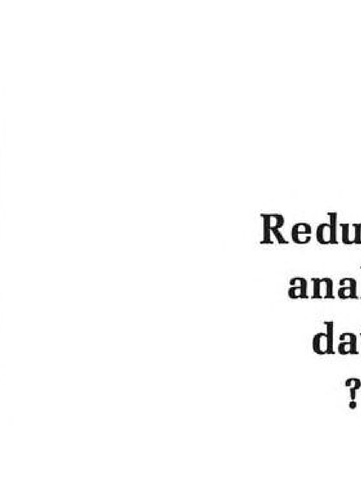
NAMES & ADDRESSES

For more information about products and services advertised in the 1963 **BUYERS' GUIDE ISSUE** fill-out the handy READER SERVICE CARDS **on pages 257-260**

Reducing analog data ?

SEARCH ANY TIME CODE

with EECO search and control system using any tape transport



EECO search and control systems control tape transports to search time-code-referenced tape with modulated time codes, at speeds up to 100 times the recording speed or 1/20 the recording speed in either direction. Start & stop times programmed with rotary thumbwheel EECoSWITCHES. Highly reliable Nixie-tube decimal display of days, hours, minutes, seconds. Readily adaptable to fully automatic punched paper tape programming. Output time code signals to computer available. Standard 19-inch width panel-chassis. *Model 831* reads IRIG Formats A, B, C, NASA, or any 1, 2, 4, 8 BCD code; 12¼" high. *Model 835* reads any of the modulated carrier codes now in use by means of easily changed plug-in modules; 26¼" high. Send for complete descriptions.

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CLASSIFIED SECTION

1963 AVIATION WEEK and Space Technology BUYERS' GUIDE

CLASSIFIED ADVERTISERS INDEX

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2—Aids, Training
3—Aircraft, Executive, Personal
4—Antennas & Radiating Equipment
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7—Brushes, Carbon
8—Cables, Assemblies, Swaging, Terminals
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10—Carburetors
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12—Components, Jet
13—Condensers, Mica, etc.
14—Connectors, AN, Coaxial
15—Engines, Parts
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17—Fasteners, AN, MS, NAS
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20—Generators
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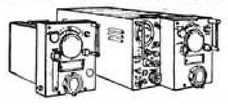
RADAR and MICROWAVE
TEST EQUIPMENT
NEW and AS NEW



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for your Laboratory and Radar needs

PIB 1	Pulse Impedance Bridge, Cleeo Labs.	400.00
480 A	Hewlett Packard VTVM	125.00
400 C	Hewlett Packard VTVM	135.00
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402 A	Sylvania Synchroscope	100.00
TS10	Calibrator	15.00
TS12	Standing Wave Amplifier	100.00
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TS16	Calibrator	45.00
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TS33	WE X Band Frequency Meter	95.00
TS34	WE Synchroscope	100.00
TS34A	WE Synchroscope	150.00
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TS35A	WE X Band Signal Generator	150.00
TS36	WE X Band Power Meter	90.00
TS45	X Band Signal Source	95.00
TS46	S Band Frequency Meter	45.00
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TS59	L Band Delay	35.00
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TS102A	Calibrator	125.00
TS108	Lead X Band	95.00
TS110	Echo Box	45.00
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TS125	S Band Power Meter	195.00
TS126	Oscilloscope	45.00
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TS147B	Wide Band X-Band Signal Generator	795.00
TS147D	Wide Band X-Band Signal Generator	1,695.00
TS148	X-Band Spectrum Analyzer	1,595.00
TS155	S Band Signal Generator	125.00
TS155C	S Band Signal Generator	595.00
TS173	Frequency Meter	125.00
TS174	Frequency Meter	225.00
TS175	Frequency Meter	195.00
TS175C	Frequency Meter	275.00
TS192	VHF Oscillator & Power Meter	45.00
TS193	Battery Tester	35.00
TS226	Frequency Meter	45.00
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TS270A	Echo Box	175.00
TS270B	Echo Box	225.00
TS403	S Band Signal Generator	1,250.00
TS419	L Band Signal Generator	495.00
TS419A	Echo Box X Band—New	495.00
TS545	L Band Echo Box	95.00
TS577	Telephone Test Set	295.00
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EPUT554	Berkley Instruments Frequency Meter	395.00
RCAMI-7519E	Distortion & Noise Analyzer	150.00
UPM 4, 6, 7, 8, 10, 11, 11A, 30, 33, 42, 44, URM 12, 23, 25, 43, 64, others		

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Tektronix Oscilloscope Model 511A..... 450.00
Boonton Signal Generator Model 84..... 750.00
General Radio Signal Generator 605B..... 295.00
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Radar Pulsers to test Magnetrons.....695.00 up

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2K22	25.00	2K50	24.00
2K23	25.00	2K54	35.00
2K25	12.00	2K55	50.00
2K26	35.00	2K56	60.00
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2K33A	200.00	V23	450.00
2K39	170.00	V45	225.00
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Furst Power Supplies
Inverters
Thermistors 167332

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APR4 (w/5 tuning units)	295.00	APT9	180.00
APR5	180.00	APS4	225.00
APR5A	180.00	APS10	695.00
APR9	P.U.R.	APS23 (trans)	195.00
APR10	160.00	APS32 K band radar	875.00
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APS44 & others	P.U.R.		

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OA2	.80	4-125A	20.00	100TH	12.00	816	2.00	5836	50.00
OA2WA	1.50	4-250A	35.00	100TL	12.00	826	3.50	5837	50.00
OA3	.85	4-400A	35.00	FG-105	25.00	828	12.50	5840	2.50
OA5	5.75	4-1000A	95.00	FG-172	25.00	829B	10.00	5842	7.50
OB2	.60	4AP10	10.00	HF-200	15.00	832A	7.50	5845	6.00
OB2WA	1.50	4B31	15.00	212E	50.00	833A	37.50	5847	7.50
OB3	.75	4C35	12.50	242C	10.00	836	2.50	5852	5.00
OC3	.50	4CX250B	30.00	244A	3.50	837	1.25	5876	9.50
OD3	.50	4CX1000A	125.00	249B	8.50	842	7.50	5879	1.15
C1A	7.50	4D32	15.00	249C	6.50	845	12.50	5881	2.50
1AD4	1.75	4E27	10.00	250R	10.00	849	75.00	5886	3.50
1B24	7.50	4J32	100.00	250TH	25.00	851	50.00	5893	10.00
1B24A	17.50	4J34	100.00	251A	75.00	866A	2.00	5894	19.85
1B35A	3.50	4J50	100.00	259A	5.00	869B	75.00	5899A	2.00
1B59/R1130B	10.00	4J52	35.00	262B	4.00	872A	5.00	5915	1.00
1B63A	10.00	4J62	150.00	267B	5.00	884	1.25	5933	3.50
1C/3B22	5.00	4J63	150.00	271A	10.00	885	1.00	5948	150.00
1D21/SN4	5.00	4J64	150.00	274A	3.50	889RA	150.00	5949	100.00
C1K	7.50	4PR60A	50.00	279A	200.00	891R	200.00	5963	1.00
1P21	30.00	4X150A	12.50	283A	3.50	913	12.50	5964	.85
1P22	8.00	4X150D	12.50	287A	3.50	927	2.00	5965	.85
1P25	10.00	4X150F	20.00	QK-288	200.00	931A	5.00	5976	50.00
1P28	15.00	4X150G	25.00	HF-300	35.00	1000T	100.00	5993	5.00
1Z2	2.50	4X250B	25.00	300B	5.00	1237	5.00	5998	5.00
2-01C	12.50	4X250F	30.00	304TH	35.00	VC-1257	975.00	6005	1.50
2AP1A	8.50	5ABP1	20.00	304TL	35.00	VC-1258	15.00	6012	4.00
2B23	20.00	5AHP7A	25.00	310A	3.50	K-1303	35.00	6021A	2.00
2BP1	10.00	5BP1A	9.50	311A	3.50	1500T	200.00	6028	2.75
2C36	22.50	5C22	17.50	313C	1.50	1603	3.50	6032	50.00
2C39	5.00	5CP1A	9.50	323A	6.00	1614	2.25	6045	1.15
2C39A	10.00	5CP7A	9.50	328A	4.50	1620	4.00	6072	1.25
2C39B	15.00	5J26	75.00	329A	4.50	1624	1.00	6073	1.50
2C40	7.50	5LP1A	20.00	336A	2.50	1625	.50	6074	1.50
2C42	4.00	5R4GY	1.25	337A	3.50	1629	.50	6080	3.35
2C43	7.50	5R4WGA	4.00	348A	4.50	1645A	4.00	6080WA	5.00
2C50	4.00	5R4WGB	6.00	349A	3.50	1846	50.00	6080WB	10.00
2C51	1.50	5R4WGY	2.00	350A	3.50	1850A	300.00	6081	25.00
2C53	7.50	5RP1A	9.50	350B	2.50	2000T	350.00	6082	3.35
2D21	.65	5UP1	12.50	352A	8.50	2050	1.25	6087	2.50
2D21W	1.25	5Y3WGT	1.25	354A	12.50	ZB-3200	150.00	6101	1.50
2P22	3.00	6AC7W	1.00	355A	12.50	5516	7.50	6115A	65.00
2E24	3.50	6AG5WA	1.50	393A	5.00	5528/C6L	3.50	6130	6.50
2E26	2.50	6AG7Y	1.00	394A	3.00	5545	25.00	6136	1.50
2J42	75.00	6AK5W	1.25	403B	3.00	5550	35.00	6146	3.00
2J51	50.00	6AL5W	.60	404A	7.50	5551/FG271	50.00	6159	3.50
2J55	100.00	6AN5	1.75	407A	3.75	5552/FG235	60.00	6161	35.00
2J66	200.00	6AN5WA	3.50	408A	2.75	5553/FG258	125.00	6163	15.00
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2K25	8.50	6AS7G	2.50	GL-414	80.00	5557/FG17	5.00	6186	1.60
2K26	35.00	6AU6WA	1.25	416B	20.00	5558/FG32	10.00	6189	1.60
2K28	25.00	6B4G	3.35	417A	7.50	5559/FG57	10.00	6197	1.75
2K29	25.00	6BA6W	.75	418A	7.50	5560/FG95	10.00	6199	35.00
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3B4	2.50	6SL7WGT	1.25	701A	5.00	5684	9.50	6363	90.00
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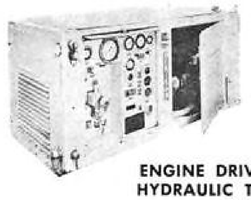

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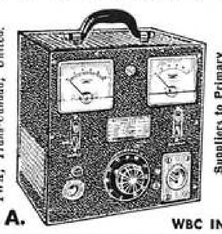

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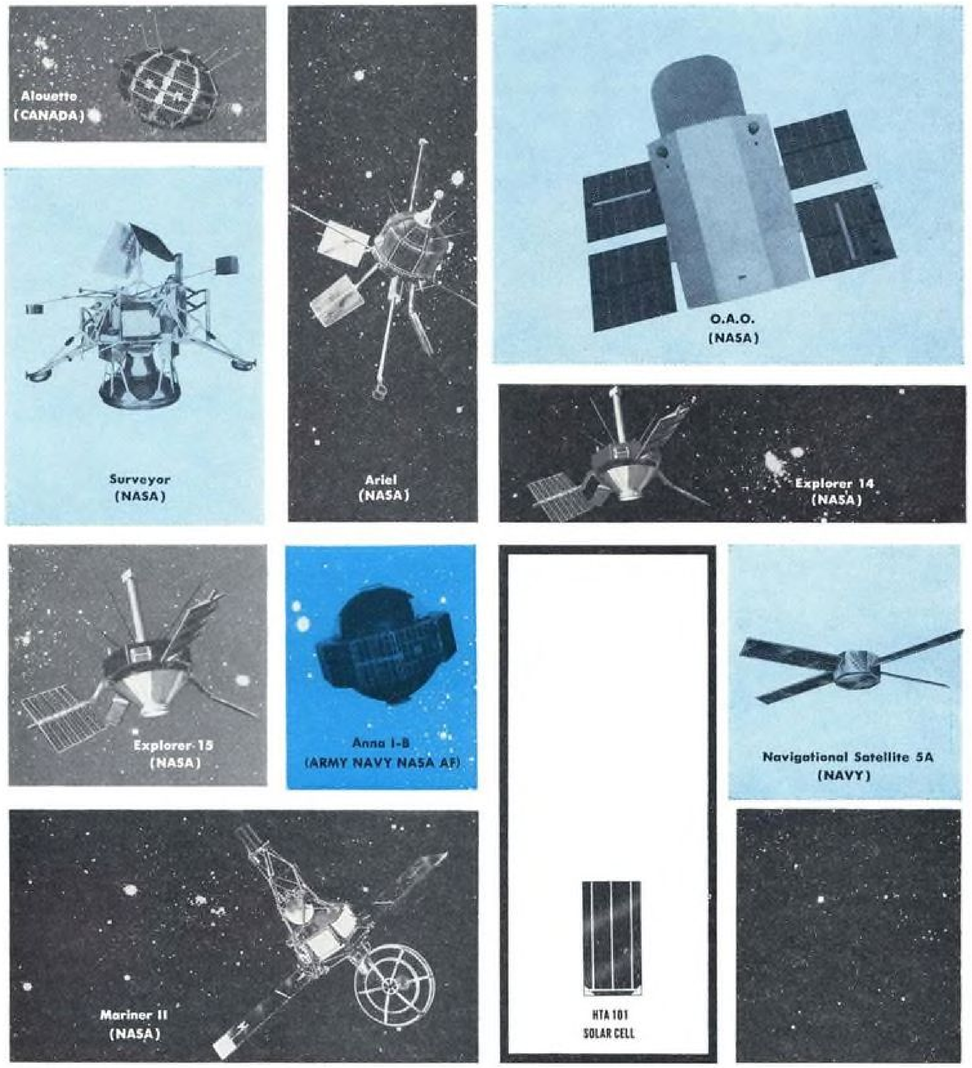

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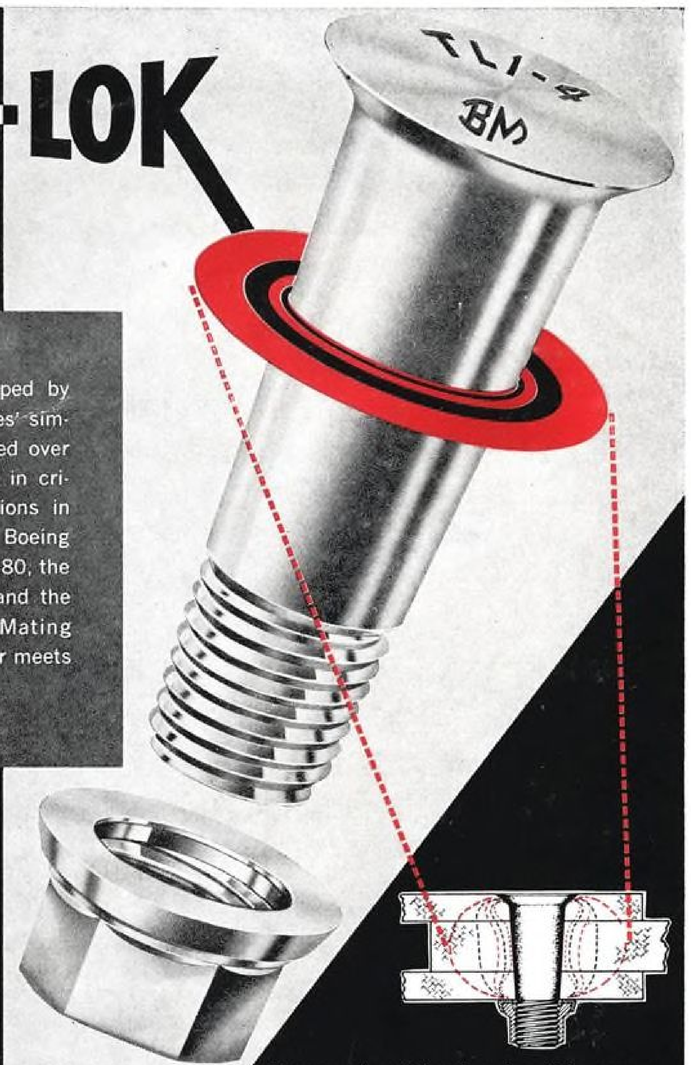

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