BOEING

MAGAZINE

NOVEMBER 1963

Volume XXXIII—Number 11 November, 1963

Published monthly in Seattle, Washington by the Public Relations Office.

Editor: CHESTER CHATFIELD
Associate Editor: DARRELL BARTEE (Wichita)
Art and Production Mgr.: KEITH KINSMAN
Staff Artists: ALDEN METCALF, BILL HARCUS, PHIL VON PHUL

In This Issue

ON OUR COVER—What has happened to the leather helmets and goggles of yesteryear? Captain "Pete" Knight is fitted instead with a space suit which he may wear to circle the earth at 18,000 miles an hour in X-20. More about X-20 pilots on next page.

PHOTO CREDITS—Dale Keasey (cover); Bob Koreski (3); United States Air Force (3, 4, 11); Jan Osborne (5); Aero Service Corporation (6); Vernon Rutledge (7); Thomas Cusick (10, 11); Rodney Martin (12, 13); Gil Baker (13); John Bodisch (13); Jack Barkus (14); Byron Wingett (14, 15).

THE BOEING COMPANY
HEADQUARTERS OFFICES
7755 East Marginal Way Seattle, Washington

THE BRIEFING

The U.S. Department of Defense last month announced award of a $31,035,240 Navy contract to the Boeing Vertol Division at Morton, Pennsylvania, for production of additional CH-46A Sea Knight helicopters for the Marine Corps. Several Sea Knights already have been delivered to the Marines, from previous orders totaling $33,496,937.

The Sea Knight is a military version of the Model 107. Similar models have been delivered to the Swedish Royal Air Force and Navy and ordered by the Royal Canadian Air Force and Army.

When evacuating Indians by helicopter from a flooded area in Alberta recently, the Royal Canadian Air Force discovered that it had evacuated 30 per cent more than actually lived there. The Air Force then discovered that some of the Indians were recrossing the river to get another ride.

The jet-cargo pot continues to boil. Pan American World Airways has ordered three additional Boeing 707-320Cs, which will bring its all-cargo jet fleet to 11. Pan Am introduced the first all-cargo jet service over its transatlantic and transpacific routes June 17, 1963.

Next month American Airlines will put into operation a completely new mechanized system for ground handling cargo. The equipment was designed especially to speed loading and unloading of American's new Boeing 707-320C Astrojet Freighters. The airline has ordered four of these big jet planes, the first one to be delivered this month, which will greatly increase cargo-carrying capability. American also operates 14 piston-engine all-cargo planes. Last year American earned about $45,000,000 gross revenue from air cargo. Cargo ton miles rose approximately 20 per cent in 1962 compared with 1961.

The Hurricane Hunters (53rd Weather Reconnaissance Squadron of the U.S. Air Force Military Air Tranport Service) now are using modified Boeing B-47 Stratojets to track dangerous storms over the Atlantic. The first of the planes was delivered in September. A total of nine WB-47s will be located at Hunter Air Force Base, Georgia.

X-20 pilots will have power to spare when they

SADDLE THE DRAGON

By WILLIAM JURY

AN EX-FIGHTER pilot with 142 Korean War missions under his belt sat at a restaurant table in Johnsville, Pennsylvania not long ago and looked at a waitress through eyes that resembled matched rubies.

"Who-eee! Whatever you've been doing, mister, you'd better stop it!" she admonished.

Maj. Russell L. Rogers had not fallen off the wagon—he acquired the temporarily bloodshot orbs while riding the big centrifuge at the Naval Air Development Center in Johnsville.

It actually was mild stuff to Rogers and five other test pilots who are training for the day they'll fly the Air Force's X-20 Dyna-Soar, a black-as-coal winged craft which will soar through space like a satellite and return to earth like an airplane.

The X-20 is scheduled to be rocketed into orbit in 1966 by a Titan III-C booster which is designed to use both liquid- and solid-fuel engines and develop more than two million pounds of thrust. The whirling Johnsville centrifuge gives the pilots an accurate feel for the stresses they will have to endure when they are mashed back in their seats at liftoff.

X-20 pilot Maj. Jim Wood (below) knows its instrument panel as most people know their TV consoles.

Looking forward with Rogers to this 2,000-ton kick in the pants are Maj. James W. Wood, at 39 the "pappy guy" of the group; Maj. Henry C. Gordon, 37; Capt. William J. "Pete" Knight, 34 this month; Capt. Albert H. Crews Jr., 34, and Milton O. Thompson, 37. Rogers is 35 years old. Five of them are Air Force officers. Thompson is a civilian pilot with the National Aeronautics and Space Administration.

It is doubtful that any other pilots ever spent longer getting acquainted with their vehicles. About 2,000 hours already have been spent by the pilots working in the Dyna-Soar simulator at Boeing's Plant 2

NASA pilot Milton Thompson may fly X-15 rocket research plane.

Capt. Al Crews is newest X-20 pilot, holds master's degree in engineering.

Like all X-20 pilots, Maj. Russ Rogers spot tests fast jet aircraft.

Titan III—X-20 model has special interest for Maj. Hank Gordon.

in Seattle. By the time one of them settles into the cockpit of an X-20 for the first launching, the seat should feel as familiar as his easy chair at home.

Three years ago this month, four Air Force pilots and three pilots representing NASA quietly joined the Dyna-Soar program. When word became widespread of their frequent trips between the Boeing plant and Edwards Air Force Base, California, they were identified officially as "pilot consultants" to Boeing.

The four Air Force pilots who joined the program late in 1960 still are associated with it. Capt. Al Crews joined the group in September, 1962. Thompson is the only NASA representative still an X-20 pilot consultant.

The six officially were designated Dyna-Soar pilots a year ago, and Hank Gordon insists they are the envy of "about 2,000 young second lieutenants who would like to take our places."

All five Air Force pilots are graduates of the Air Force Experimental Flight Test Pilot School. Thompson, a Navy veteran of World War II, worked for Boeing as an engineer before joining NASA in 1956. Each of the X-20 pilots holds a bachelor's degree. Al Crews also has a master's degree in aeronautical engineering from the Institute of Technology, Wright-Patterson Air Force Base, Ohio.

At least one Dyna-Soar pilot always is on standby in Seattle to assist with design problems and offer the advice of a person who someday may fly the craft.

By far the biggest consumer of their time is the Dyna-Soar simulator, an ingenious device that is wired to a huge analog computer and does everything but go into orbit.

While a pilot sits in a replica of the X-20 cockpit, designers feed him simulated flight conditions through a computer. Pieces of a flight, such as a launching or an approach, can be made life-like. Gusts of wind or rough air can be introduced during the "flight" in the simulator. Malfunctions can be fed into the instrument display in the cockpit.

"It's the most complete simulator

any of us has ever seen." Gordon says of the device which can simulate pitch, roll and yaw as well as forward, backward, lateral and up-and-down motions.

There also have been times when it has seemed like an unreasonable shrew. During the early days of the X-20, when design engineers were barely getting to know their new bird, they fed data into the simulator to see how the craft would respond to a pilot's touch. These simulated flights sometimes lasted until two o'clock in the morning. Sometimes the simulated flights went well. Sometimes they wound up in a theoretical spinout and crash. Each helped refine some phase of Dyna-Soar's design.

There is nothing on the ground or in the air that is quite like the X-20. For that reason, some airplanes have had to endure certain indignities in the interests of training the Dyna-Soar pilots and perfecting their spacecraft.

The cockpit canopy of an F-104 was masked to duplicate an early X-20 windshield design. The fighter was flown to see if the pilot's vision was hampered. It wasn't.

An F-106 was put into a power-off glide with its flaps and landing gear down to simulate Dyna-Soar's drag.

The Navy's delta-wing F5D fighter was used in tests because its approach and landing characteristics are similar to those Dyna-Soar is expected to have.

Dyna-Soar's sidearm controller and rate command system were tried out aboard an F-101 in tests at Minneapolis.

Possible in the near future are flights by some of the X-20 pilots in the X-15 rocket plane. Thompson already has flown NASA's M-2 "lifting body" craft and may fly the X-15.

Throughout, each pilot maintains his proficiency by flying high-performance aircraft. Each does spot-testing at Edwards AFB when he is not on call in Seattle.

All the pilots were at Cape Canaveral last spring to see the start of Astronaut Gordon Cooper's multi-orbit mission in a Mercury capsule. They also have visited factories in Minnesota, Colorado, Ohio, Maryland, New Jersey and New York to become more familiar with major Dyna-Soar sub-systems.

Flight simulator is "home away from home" for X-20 pilots.

With them on most of these trips (and wishing he could go along on the big one) has been Arthur "Kit" Murray, Boeing's manager for X-20 crew integrations. Murray retired from the regular Air Force as a major and joined Boeing in the spring of 1961. He had been chief of the Air Force X-15 project office at Wright Air Development Division from 1957 until his retirement. A former rocket-plane test pilot himself, Murray contributes by assuring close cooperation between engineers designing the X-20 and the pilots who someday will fly it.

Like most flyers, the X-20 pilots have felt a yearning to fly something with unlimited power. No matter how "hot" their previous aircraft, they always reached a point where they could go no higher and no faster.

"It's natural to want to keep going up," says Gordon. "We all were impressed with the F-104, but even it had a ceiling. We always wanted to keep going."

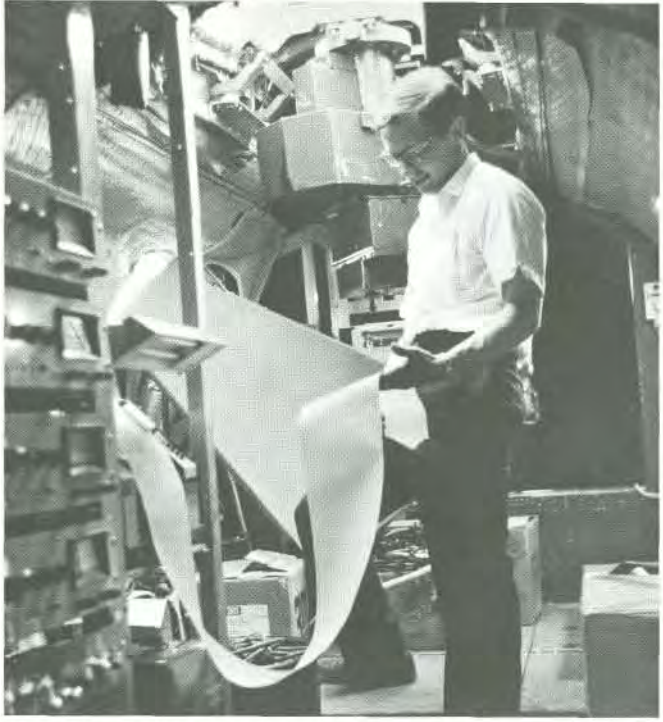
Then, with a grin and a wave toward a model of Dyna-Soar sitting on top of a Titan III booster, he added: "Now we've got the thing that'll let us do it!"

How will it feel to fly a craft with a powerplant capable of developing two million pounds of thrust? The Johnsville centrifuge gave them an idea of what to expect. Programmed for a complete boost simulation, the centrifuge was outfitted with controls, an X-20 sidearm controller, rudder pedals and the like. Then, with each pilot taking his turn at flying the booster during the simulated launch, the centrifuge started.

When a pilot overcontrolled, the centrifuge responded by vibrating and rattling just as the actual booster can be expected to do. The pilots agreed the simulated ride atop the Titan taught them to respect the booster's awesome power.

The next major phase of the pilots' training program will begin after finished X-20 spacecraft roll out of Boeing's missile production center. The pilots have been assigned an active role in system integration tests and, later, air launches from a B-52 mother ship (see *Boeing Magazine,* October, 1963).

In the meantime, Russ Rogers is looking to the day he can give that waitress a red-eyed look and a snappy comeback about just returning from a 90-minute trip around the world.



Charles Deehr checks recording equipment in B-17.

THE 100 SECONDS OF 27 CHARLIE

By CHESTER CHATFIELD

IT'S HARD to be a hero when you're middle aged, but a Boeing B-17 built to fight in World War II won its glory 18 years after that conflict ended.

At 1:35 p.m. Mountain Standard Time, on July 20, 1963, the former bomber, its fuselage stuffed with two tons of scientific instruments, droned steadily over Great Slave Lake in Canada's Northwest Territories. Quentin Allen, the plane's captain, noted that navigational lights and rotating beacons were as brilliant as in the middle of the night.

A moment later he said, "Three and one-half minutes to go and we wonder how much darker it can get. The under sides of the clouds around us are an eerie silver color."

At 1:39 his voice over the radio reported, "It is beginning to get lighter now. We have just passed the full total eclipse. The sky is beginning to take on a more normal shade of blue and the clouds have the color that clouds should have."

In 100 critical seconds flight 27 Charlie had made substantial additions to man's knowledge. Most important, information had been obtained regarding dayglow, or day airglow, a phenomenon produced at high altitude by the action of sunlight on gases of the ionosphere. The intensity of the day airglow was measured in five colors during total eclipse of the sun, providing a significant basis for the expansion of the day-airglow theory.

Confirmed also was the fact that the aurora borealis sends its colored streamers across the sky in daytime as well as night.

Both dayglow and the aurora can give much information on the condition and makeup of the ionosphere. Knowledge of this region is important to radio communications, both on the earth and between the earth and outer space.

Auroras, which long have been known to exist at night in zones surrounding the geomagnetic poles in the Arctic and Antarctic, are caused by electrically charged particles from space traveling down geomagnetic field lines and striking gases in the upper atmosphere. The gases become electrical conductors and glow in varied colors like gases in neon sign tubes.

Only at a certain place and only for 100 seconds when day was turned to night could the observations be made. At other times the brightness of sunlight blotted out the dayglow and the aurora.

The National Science Foundation sponsored the expedition with a $50,000 grant. Scientists of the Geophysical Institute of the University of Alaska, headed by Charles S. Deehr, directed the work.

More than a year of preparation preceded the final 100 seconds. The Aero Service Corporation of Philadelphia, a division of Litton Industries, which engages in a worldwide business of aerial surveying, mapping and exploration, was hired to provide a high-flying, stable and reliable platform from which to take photos and observations.

From its long experience the firm chose the B-17. As it was unpressurized, windows could be cut in the fuselage to provide the best viewing angles. In addition to photos taken skyward, more than 100 pictures were snapped of the moon's shadow as it raced over the earth at 2,000 miles an hour.

During the 100 seconds of complete eclipse the plane flew at 31,500 feet elevation. Outside temperature was 45 degrees below zero. The eight men on the flight wore oxygen masks.

WHICH ALLOY IS BEST?

By DONALD BRANNON

BOEING HAD a running start when it entered design competition for America's first supersonic jet transport this fall. The company already had devoted five years and more than $17,000,000 to supersonic research.

Among the most important facets of this research has been selection of the best structural material.

The Federal Aviation Agency, developing the supersonic transport program for the United States, has laid down four basic requirements: an aircraft which will fly about 1,500 miles per hour, carry up to 160 passengers and their baggage plus 5,000 pounds of cargo, operate from existing international airports and travel nearly 4,000 miles without refueling.

These specifications demand a lightweight, tough material which will retain its strength and shape when heated by air friction at supersonic speeds. Being considered for the job are stainless steel alloys and various types of titanium.

Before engineers make a final selection, they want results from thousands of hours of comprehensive tests—a job still under way by the Airplane Division's structures laboratories in Seattle and Renton, Washington.

In a fracture test, to determine a metal's resistance to tearing, structures engineers bolt the ends of a metal sheet into a massive test machine. A typical test sheet is 72 inches long, 24 inches wide and .2 inches thick, containing a previously prepared crack. Electrohydraulic control enables the machine to exert a pull on the test specimen at rates up to 1,000,000 pounds per square inch per second.

The test is quick. An engineer presses a control button, and a rifle-like report cracks through the laboratory. The test sheet rips in two and its fracture strength and tear-resistance are recorded.

Creep tests are longer. Engineers can estimate a material's useability after several years of service through knowledge of intergranular distortion, or creep. A typical test, conducted in a Boeing-designed furnace, continues automatically 24 hours a day for many months. It simulates actual supersonic flights.

A creep test cycle begins as a specimen is stressed and furnace heat begins its rise to flight temperature. These simulated flight conditions are then maintained for the duration of an average supersonic journey. Heat is next decreased for a simulated landing approach, and stress is removed as the imaginary aircraft touches ground. Fifteen minutes later the cycle resumes as the airplane takes off again.

These are among several tests during which metal is pushed, pulled, bent, beaten and heated. Boeing has developed one of the nation's most complete facilities for studying the types of stress encountered by supersonic aircraft.

Much of the equipment was designed and built by the company. Some, like the 27 multiple creep test machines, is unobtainable elsewhere. One device provides stress coupled with periodic corrosion environment to simulate salt spray, corrosive fumes and smoke or cleaning fluids.

Materials men are learning much about supersonic metals. Some alloys are stronger than anticipated, others weaker. The mass of information already obtained and still being gathered will be invaluable to SST design.

Test machine exerts up to million-pound pull.

By KENNETH CALKINS

ON SEPTEMBER 5, 1963, the Aero-Space Division of the Boeing Company was awarded a research and development contract for Hibex — "another step in the overall program for providing an active defense against the ballistic missile threat."

By "active defense," the United States Department of Defense means a way to stop ballistic missiles before they do any damage. Passive defense, on the other hand, includes bomb shelters, dispersal of likely targets, hardened missile silos and the like.

Hibex—high g boost experiment —is a step toward deflecting the blow.

Under its Project Defender, of which Hibex is a part, the Advanced Research Projects Agency has been studying means of ballistic missile detection and interception for a number of years.

The "g" in "high g" stands for gravity and the reference is to the quick acceleration of the proposed Hibex booster—so quick that the g loadings on structures, electronics and propellant would be tremendous. Acceleration pressure in a Hibex vehicle would be so abrupt and so great that no human passenger could withstand it.

Hibex is not a weapon system; it's an idea. The Advanced Research Projects Agency, an arm of the Department of Defense, wants the idea explored, developed and tested. An initial funding of $6,000,000 has been released to get the work under way. ARPA has asked the Army Missile Command to act as its contracting agent for the program.

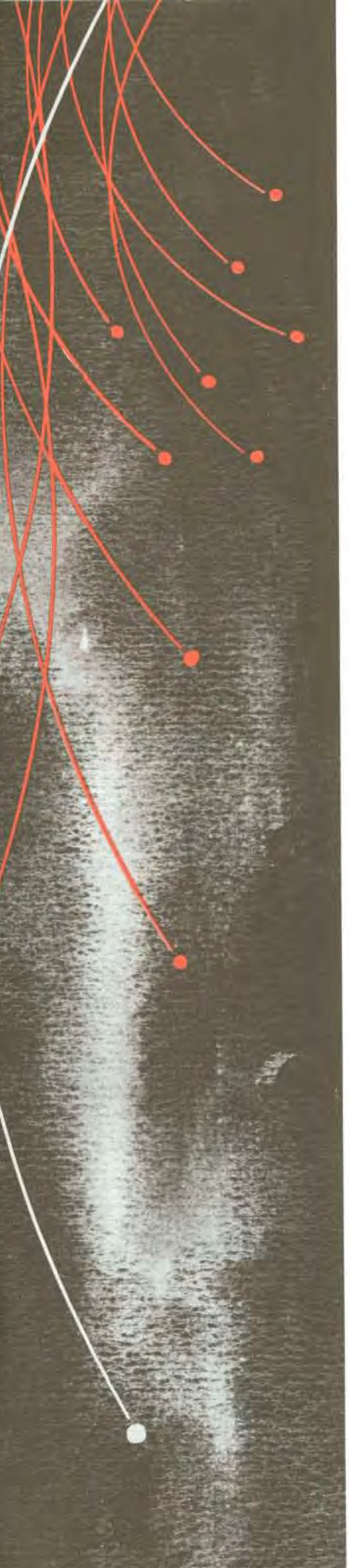
Boeing will build an undisclosed number of test boosters in Seattle and fire them at the Army's White Sands, New Mexico, missile range. The program will run an estimated two years and will involve about 300 Boeing employees, half of them engineers. Hercules Powder Company of Wilmington, Delaware, has been proposed by Boeing to develop the solid rocket motor.

Elliot Mock, Boeing Hibex program manager, compares this new research and development effort with the Gapa program of the late forties. Gapa, standing for ground to air pilotless aircraft, was a development and flight test program for a defense missile. It gave Boeing background which led to development and production of the Bomarc, a defense missile now in the Air Force inventory.

Bomarc is an efficient defense against air-breathing weapons such as aircraft and non-ballistic missiles, but no nation has an operational defense against ballistic missiles. This has allowed the ICBM to hang on to the disputed label "ultimate" weapon longer than did either the crossbow or the Gatling gun.

One of the first publicized ultimate weapons was invented about 2,000 years before the airplane.

Plutarch, a fair sort of writer, told a story about the use of missiles in the siege of the Sicilian city of Syracuse in 214 B.C.: "Archimedes soon began to play his engines upon the Romans and their ships, and shot stones of such an enormous size (about 100 pounds)



and with so incredible a noise and velocity that nothing could stand in their way, and spread terrible disorder through the Roman ranks. At length the Romans were so terrified that if they saw a rope or a beam projecting over the walls they cried out that Archimedes was leveling some missile engine at them, and turned their backs and fled."

Americans first ran into self-propelled missiles in the War of 1812. When Francis Scott Key wrote the verse "rockets' red glare, bombs bursting in air" he wasn't using poetic license. He was an accurate observer of warfare.

The rifled cannon of the mid-1800s was supposed to have sounded the death knell of rockets as effective weapons. The cannon, with fused shells replacing cannon balls, had more range and accuracy. A good rocket range then was 3,000 yards, its accuracy doubtful.

Use of rockets in war was revived by German scientists in World War II, leading to the development of present ballistic missiles. Most of them now are controlled on part of their trip by some automatic device directed by radar, inertial guidance or celestial navigation.

During this controlled phase of flight, the vehicle is properly called a guided missile—guided to a predetermined spot in the sky from which it falls toward its target. During the portion of the trip in which the missile arcs downward in response to earth's gravity pull, it is a ballistic missile. On the arc toward earth, its path can be calculated. It is vulnerable to interception.

Then why don't we have an operational defense?

Fired 1,500 or even 6,000 miles from the target, ballistic missiles attain speeds of 15,000 miles an hour and altitudes of hundreds of miles. The missile's speed and the difficulty of detection in time to react make interception a formidable task.

In addition, the ICBM can carry a number of phony warheads—decoys to draw defense fire away from the real warhead.

Professor Edward Teller of the University of California put the problem in these words: "During a massive ICBM attack we could expect unfriendly enemy vehicles over North America numbered in the hundreds or even thousands. This mass of genuine unfriendly targets would be complicated by decoys in the same or greater numbers . . . a multitude of junk we'd have to sort out . . ."

One way to sort them out requires split-second timing. As the ICBM warhead and its decoy warheads reenter the earth's denser atmosphere over the target area, the lighter decoys tend to fall away, slow down or burn up. The real warhead is then detectable.

But by now the warhead is getting thousands of feet closer by the second. The intercept must be immediate.

That's why Hibex research is so important. If a booster can be developed that can accelerate several times quicker than present boosters —from zero to thousands of feet per second — warhead interception in time to prevent devastation of the target may become a reality.

INNER TEST FOR OUTER SPACE

By DARRELL BARTEE

ELECTRONIC PROBES, gliding back and forth in their own swimming pool, are helping Boeing inspectors at the Wichita plant to get a good look at the internal quality of spacecraft metals.

Aluminum and steel for the first-stage booster of the Saturn V space vehicle are being tested by Wichita's out-sized ultrasonic inspection device. Using 6,400 gallons of water and a multi-probe system, the unit is one of the largest of the radar-type non-destructive test machines in the aerospace industry.

Tiny flaws anywhere within raw blocks of metal can be located and evaluated, and the size of the device allows it to test four different blocks of varied shapes at the same time.

The equipment is used for both the B-52 bomber program and the spacecraft programs, as a money-saving way to help ensure the soundness of metal before it reaches the expensive process of machine milling. The Wichita plant also has smaller ultrasonic units which are used to check smaller components and for research work.

Electronic search techniques have been refined to the point at which defects of minute size in the interior of an 1,800-pound Saturn component can be located quickly and accurately. Thickness of the metal tested so far varies from one-quarter inch to about two feet.

Inspection activity on Saturn components is a part of Wichita's assistance program for the company's Saturn Booster Branch of the Aero-Space Division. That division holds the contract with the National Aeronautics and Space Administration for the develpoment, construction and test of the S-1C first-stage booster for the Saturn V spacecraft. The Wichita plant manufactures a number of the tools and components.

Saturn elements already tested include actuator fittings, thrust-post ties and channel supports. Some are probed from the top, then turned over and inspected from the bottom. The time required for one piece ranges from ten minutes to four hours.

The action centers around a tank 85 feet long, 4 feet wide, 3 feet deep, filled with about 30 inches of water. Search probes move restlessly over the test articles immersed in the water, seeking flaws.

The metal to be inspected rests on crossbars under the water. Each search unit is mounted on one of seven available bridges over the water, installed on rollers at the tank edges. Three of the bridges are electrically powered, and four are moved by hand. This gives the sys-

Massive Saturn part emerges from water after test.

tem flexibility for handling any type of job.

When a probe is in action, it is linked to one of four ultrasonic instruments placed beside the tank. These units are designed to transmit and receive high-frequency signals (in the million-cycle range) and to display them in blips on cathode-ray tubes.

Search units are equipped with transducers, immersed in the water to within about 1½ inch to 6 inches of the metal being inspected. These emit high-frequency sound signals (beyond the audible range) and the water carries them.

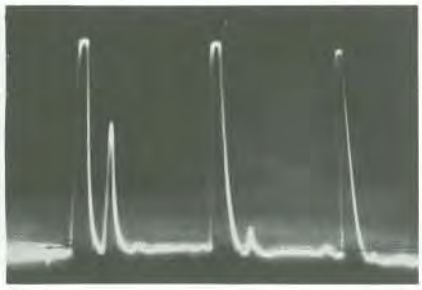
Operating on the familiar pulse-echo principle, the signals bounce back from any defect inside the metal and produce tell-tale wave patterns on the cathode ray displays.

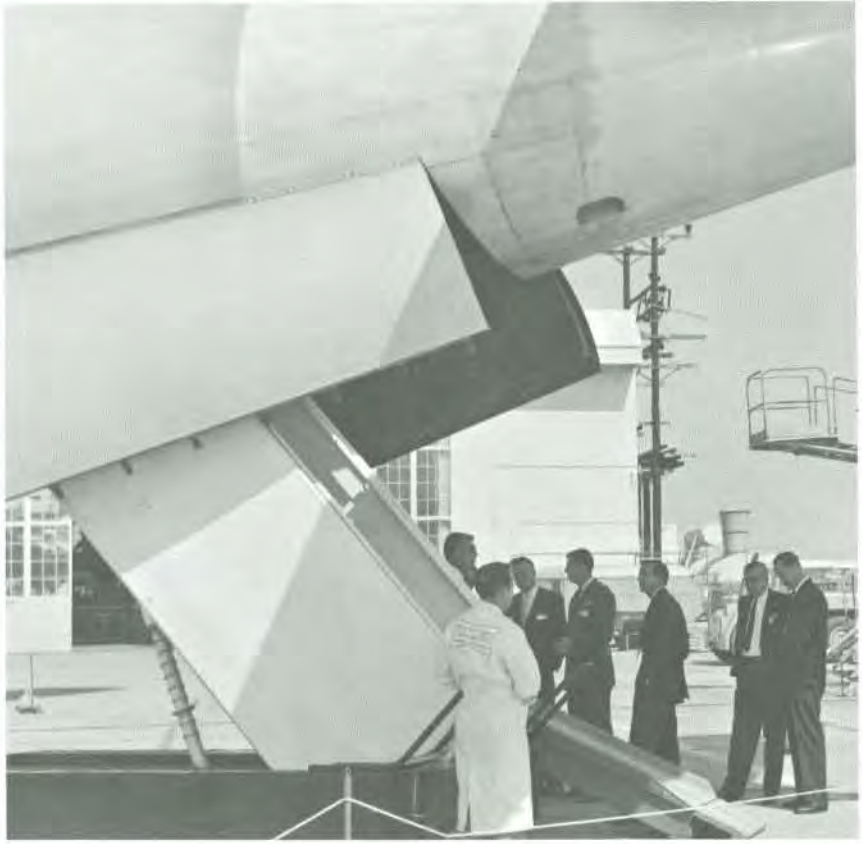
The size of the flaws can be determined by comparing wave patterns with those of reference blocks for which the flaw sizes are known. When a defect larger than a predetermined size is found, the operator halts his bridge, reaches into the water and marks the area in question. Otherwise, the powered probes proceed automatically, shifting their positions on the bridge to cover new areas.

Two sizes of transducers are used, depending upon dimensions of the metal under test. Both are designed to react to the smallest flaws. Defects are, for the most part, either voids or inclusions of foreign matter.

The search for possible flaws is carried on with the same intensity as a human x-ray examination—and rightly so, for men's lives depend on it.

A flaw would be indicated by low peaks in the graph.





Rear loading ramp replaces Flying Boom on KC-97.

AIR GUARDS GET MORE 97S

By WILLIAM R. BERKELEY
Assistant for Reserve Affairs
Military Air Transport Service

THE FIRST consignment of our C-97s was given to six Air National Guard squadrons beginning in January 1960. These forces changed from single engine jets to the C-97As.

These six squadrons, under two wings, were called to active duty for the Berlin Wall crisis and during the 11 months of active duty flew to some 26 countries and amassed some 70,000 flying hours. Since then three more wings have been formed so we now have a total of five wings with 16 flying squadrons well equipped with various models of the C-97.

Some of the more recent aircraft coming to us were KC-97Fs and Gs which, by dropping the boom and removing the plumbing, can be made into fine transport aircraft. There is a current conversion program financed by the National Guard Bureau and being accomplished by the Air Reserve Aviation Services Company located on the Los Angeles International Airport. In main, this converts KC-97s by the addition of rear loading doors to a pure transport mission.

We now have 154 C-97s which the Air Guard units, in their training, fly to all parts of the world on some 350 missions per year. Each carries a full eight-ton load. I personally think the most remarkable part of this important airlift resource we have in MATS is that these part-time citizen soldiers have, since the first flight in January 1960, flown these birds with the superb accident rate of zero.

We think the 97 in the hands of our dedicated Air Guardsmen has done a magnificent job and is making a real contribution to the airlift capability of MATS and hence the nation.

NEW BEAUTY SALON FOR JETS

By ROBERT NEPRUD

NEWEST addition to the Airplane Division pre-flight skyline is the paint hangar located near the southeast corner of busy Renton Field.

Completed in October, 1963, the high-arched, steel-and-aluminum structure is serving as a beauty salon for fresh-from-the-factory Boeing 727, 720 and 707 jet airliners.

The $1,250,000 hangar, designed specifically for the painting of aircraft, is thought to be the most advanced facility of its kind anywhere in the world. The hangar was tailored from scratch for its specialized mission and most of its equipment is built in.

Even the shape is different. It was designed to fit the swept-back contours of the current crop of Boeing jetliners and—with some alterations—to accommodate aircraft of the predictable future. The functional shape has increased efficiency in a smaller area than comparable hangars.

"We don't have five cubic feet of unused space," says Bill Hall of the facilities department, who has ridden herd on the building since long before actual construction began Thanksgiving week end of 1962.

The new hangar is 208 feet across the front, 195 feet deep and has a high-bay area which reaches a maximum height of 70 feet.

Working methods have been revolutionized. Biggest change is the use of four mobile metal platforms —or cages—each suspended from overhead monorails at three points, which enable workmen to move about an airplane at will. Two of the yellow cages positioned for operations around the nose and fuselage sections are suspended from a common overhead bridge and work in tandem. The other two platforms, designed to maneuver around the fin and stabilizer area, are operated independently.

The cages, operated from within by push-button controls, can move in any direction. According to general supervisor Jim Day, his skilled operators could guide their mobile mounts in a perfect circle if called upon to do so. The cages eliminate stair-climbing, equipment-shifting and piecemeal movement of materials, speeding the painting.

An unique heating and ventilating system assists paint-curing and eliminates buildup of hazardous fumes. Four giant fans, each capable of pumping 63,000 cubic feet of air into the building every minute, keep the interior atmosphere eternally fresh.

The air flows down over the airplane, then is exhausted through grills in the floor and is cleaned by a recirculating-water system of 12 air-washers which wash out paint and other impurities. Only a small part of the water—an estimated one or two per cent — is wasted per circuit.

Heat is provided by two 600-horsepower, low-pressure steam generators which dominate a utility room at the southeast corner of the building. The steam generators are powered by natural gas and provided with a heating-oil backup system. The boiler room is described as a non-supervised plant, which means that the controls require at-

tention only periodically. The building can be heated to a maximum of 158 degrees F to hasten paint curing, after workmen have left the area.

An eye-catching innovation is the hangar door, which operates on a sliding-leaf arrangement. Eight 20-foot sections (or leaves), each weighing six tons, may be retracted or pushed into position by means of a motor-driven cable system. When the door slides open, the leaves fold back into two corner pockets, all moving at variable speeds and arriving at their destinations simultaneously.

Interior lighting ensures excellent working visibility around the aircraft. In some sectors, brilliance runs as high as 100 foot-candles.

Protection from fire, a prime necessity in any large-scale painting operation, is provided by an overhead water-sprinkler deluge system which can flood the hangar with up to 9,200 gallons of water in 60 seconds—enough to cover the floor about half an inch deep in a minute's time.

Normal heating is provided by unit heaters throughout the hangar and by hot-water radiation in offices, a locker-lunch room, rest rooms, the paint-mixing room and other satellite areas. Except for the paint-mixing room, all of the outlying offices and support areas are equipped with air-locks, enabling employees to continue normal operations when spray-painting is in progress.

Prior to painting, an airplane receives a solvent cleaner bath. This is followed by two coats of primer paint and usually a final coat of white paint. Then comes the painting of speed lines and miscellaneous airline identification, a high-skill operation using both paint and Scotchcals.

At present one jetliner is being painted every three days. As airplane production schedules are increased, the paint cycle will move to two days by late January and to one and one-half days by the end of 1964.

Without the new paint hangar and its advanced facilities, the accelerated beauty-treatment schedule could not be achieved.

BUILDER BLUE

WHEN his wife's relatives came to visit, Gene Blue was in the midst of one of his massive home-remodeling projects. The walls of the bathroom had been reduced to a skeleton of laths. This was during a period when Blue yanked out partitions, added rooms, plastered and plumbed until he emerged with a rebuilt house. Then he moved.

The home presently occupied by the Blues looks perfect, but the family fearsomely expects to hear, any day, the sound of saw and hammer, as hard-to-stop carpenter Blue gets another uncontrollable urge to remodel.

Restless Wendel Eugene Blue, director of quality control at the Wichita plant, likes to work with his hands; this may account for some of his blistering impatience with unnecessary paper work. He is only 42, a native Oklahoman, now one of the company's youngest executives with a service record of nearly 25 years.

Blue was in high school when he first worked for Boeing as a part-time riveter's helper in 1937, but there was nothing very tender about his age. He rammed his way up to chief inspector for fabrication, tooling and sub-assembly, was named assistant quality control manager in 1954 and five years later became director.

Overall responsibility for the quality aspects of the B-52 fleet seems to ignite, rather than harass, his talents. The job involves travel all over the nation, to Strategic Air Command bases, subcontractor plants and military centers, but

A FEEL FOR THE WIND

FOR GULLS, girl-watchers, skeet shooters and people who live near pickle works, each wind has its special meaning.

But for Holden W. (Bob) Withington, assistant director of aircraft systems development for the Airplane Division, wind—filling a temperamental balloon spinnaker or howling at supersonic speeds around the wings of an airplane—represents a life-long preoccupation. Interest in it has brought him such distinctions as invitations to the debatable pleasures of standing four-on and four-off watches on a racing sailboat from the west coast of the U. S. to Hawaii.

Professionally, Withington today is concerned with the complicated aerodynamics and basic design of airplanes Boeing plans or hopes to construct—wind, if you please, nearly at its ultimate usefulness.

Personally, he began to use the same natural phenomenon as a boy, sailing near Westport, Connecticutt. That led, more or less logically, to an interest in wind tunnels at Massachusetts Institute of Technology. There, he helped to build one of the first big tunnels.

That, in turn led him to Boeing in 1941. "Bob came here," says one acquaintance, "with the understanding that we would try to sell management on the idea of building a tunnel. And together we designed one—Bob did the air circuit and I did the fan."

That design led to actual construction—and Withington's appointment as chief of wind tunnels. The one tunnel eventually became a complex of such facilities, the largest privately owned in the world. Withington went on to aerodynamic and general airplane de-

even when away he likes to maintain full command of detail at home.

Blue's notion of red-hot conversation is this: "Last Thursday, the boys in the skin shop were up to 258 days." Translated, this means that the B-52 wing fabrication shop is aiming at 365 days without a rejected wing, and has reached 258. He does all this with a robust and triumphant relish which assumes that quality is the most important thing on earth.

Blue currently heads a five-man committee for the National Security Industrial Association, assigned to study the quality assurance programs of the Army Materiel Command. A 200-page report has been completed ahead of time. That's Blue for you.

sign assignments on most of the major Boeing projects.

Withington hates to talk about himself, but is enthusiastic about the people around him. "I believe," he says, "there is no place in the world where there is a concentration of airplane talent like this. I don't believe anyone else can focus the technical power on a problem or a program that we can."

That is, when the big stickers aren't racing somewhere. Then the team may lack at least one talent —Withington is likely to be sailing a yacht, riding the wind with every inch of canvas stretched.

"When you've practically grown up with something, as I have with air flow," he says, "you get a feeling for setting a sail."

Or the precise geometry of an airplane wing.

INSTANT MONEY

EVERY MONTH the Boeing Aero-Space Division mails thousands of signed, good-as-gold blank checks to its suppliers—*and invites each of them to write in whatever amount of money he wants and cash the check.*

This free-wheeling arrangement not only has suppliers whistling Happy Days Are Here Again, but it saves them and Boeing a barrel of money.

Based on faith in business honesty, the system works like this: The Boeing purchasing office calls for bids on widgets, awards contract to Joe Vendor at $2 per widget, and sends him an order. With it goes a blank check.

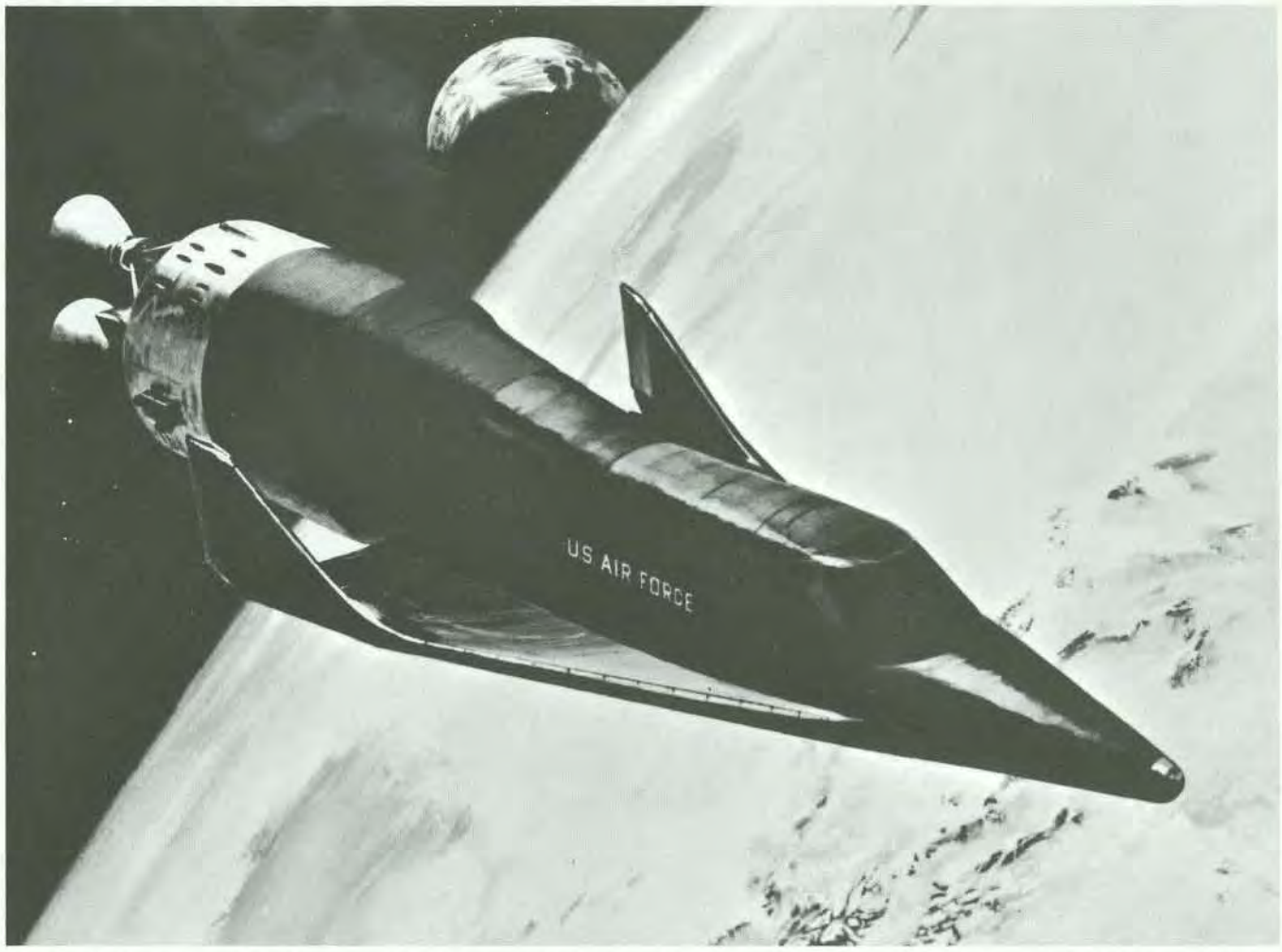
As soon as Joe ships the order, he fills in the check—total charge for the parts, plus sales tax, less discounts, plus shipping costs—and cashes it.

The returned check is Boeing's receipt.

Introduced a few months ago, the instant-money system is expected to save more than $600,000 a year in cash discounts and bookkeeping costs.

There are a few reservations—checks are limited to $1,000 or less, and must be cashed within 90 days; an order must be filled with one shipment.

The nicest thing about the new system is that if a supplier wants to complain about a slow payment, he has to talk to himself.



X-20 DYNA-SOAR. U.S. Air Force's X-20 spacecraft shown in drawing above as it will look in orbit before pilot begins controlled re-entry into atmosphere for landing at airfield of his choice. Designed to explore problems of re-entry from orbit and to develop technology of manned maneuverable re-entry from space, Dyna-Soar will combine speed of ballistic missile in space with controlled and accurate flight of an airplane in the atmosphere. From this and other studies, new space-mission concepts may evolve. Boeing, as X-20 system contractor, will build the spacecraft and integrate the vehicle with its booster.

Capability has many faces at Boeing

BOEING 727, America's first short-range jetliner, is pictured above with Boeing-Vertol 107 helicopter. Airlines have ordered 137 Boeing 727s. They enter service soon.

NATION'S LARGEST hydrofoil, U.S. Navy's anti-submarine vessel, High Point, is shown "flying" on underwater "wings". Length is 115 feet, speed over 40 knots. Built by Boeing, High Point is undergoing operational tests by U.S. Navy.

ORBITING LABORATORY. Designer's concept of orbiting space laboratory, based on Boeing studies. Boeing holds NASA contracts for research on manned orbital laboratory and space vehicle to ferry men and supplies between earth and orbiting space station.

BOEING

Space Technology • Missiles • Military Aircraft Systems • 707, 720 and 727 Jetliners • Systems Management • Helicopters • Marine Vehicles • Gas Turbine Engines • Also, Boeing Scientific Research Laboratories