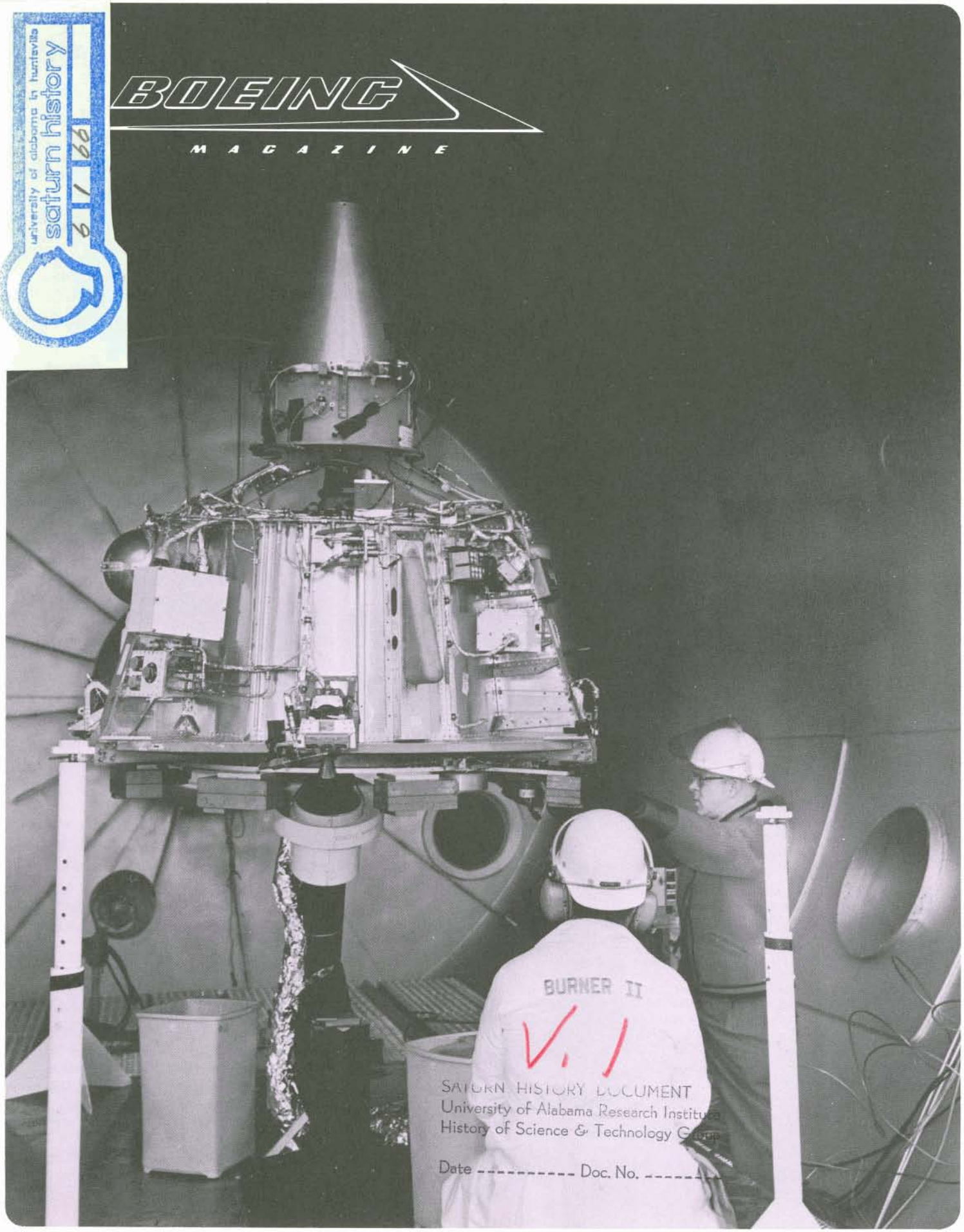
BOEING MAGAZINE



JUNE 1966

Volume XXXVI—Number 6 June, 1966

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

PHOTO CREDITS — Vernon Rutledge (cover, 6, 7, 9, 11); United States Air Force (3); National Aeronautics and Space Administration (4, 5); Paul Wagner (7, 8, 14); Richard Stefanich (9); Vernon Manion (10); Caledonian Airways (12,13).

ON OUR COVER — Technicians check Burner II upper stage, mounted on an air bearing, prior to flight simulation at Boeing's Tulalip Test Site near Seattle. The large vacuum chamber simulates altitudes up to 150,000 feet. For details see pages 8-9.

THE BOEING COMPANY
HEADQUARTERS OFFICES
7755 East Marginal Way, Seattle, Washington 98124

BRIEFING

A Model 747 jetliner program team, under direction of Malcolm T. Stamper, a Boeing vice-president, is taking all actions necessary for planning and developing the 747 program during the time preceding final go-ahead decision. Stamper, formerly general manager of the Turbine Division, reports to J. E. Steiner, vice-president, Product Development. Robert E. Bateman now is general manager of the Turbine Division. He previously was assistant general manager of the Turbine Division.

Cargo potential of the giant new Boeing 747 was displayed full size last month at the third International Air Cargo Forum in Chicago. Two side-by-side rows of eight-by-eight-foot simulated cargo containers were positioned as they would be in an airplane, with a short section of 747 fuselage arching over the forward part.

Airlines recently placing orders for Boeing jetliners include Continental Air Lines, four 707-320Cs; TAP Portuguese Airline, three 727s; Lufthansa German Airlines, two 707-320Bs, one 707-320C and five 727QCs; Pan American World Airways, twenty-five 747s; Air France, three 707-320Cs and one 707-320B; Braniff Airways, four 727s and one 707-320C; Western Air Lines, four 720Bs and four 737-200s; World Airways, two 707-320Cs; Lake Central Airlines, three 737-200QCs, and Trans World Airlines, one 707-120B and one 707-320C.

An intensive two-week course dealing with recent developments in fluid power control will be offered at the Massachusetts Institute of Technology July 5 to 15, 1966. Details and applications are available from the Director of the Summer Session, Room E19-356, M. I. T., Cambridge, Massachusetts 02139.

The 1966 edition of *United States Aircraft, Missiles and Spacecraft* is off the press. This authoritative reference book contains highlights of 1965 aerospace events, facts and figures on the aerospace industry's 1965 accomplishment and photos and descriptions of aircraft, missiles, drones, launch vehicles and spacecraft. The book is published by the National Aerospace Education Council, 806 15th St. N.W., Washington, D.C. 20005, at $2 per copy.

A Minuteman II takes off from Cape Kennedy.

Boeing men and products pour into

THE SPOUT OF THE FUNNEL

By GREGG M. REYNOLDS

FOR 2,000 Boeing employees, things—enormous, curious, reassuring, intriguing—are coming from all directions.

The 2,000 are the Boeing people now manning various activities at Cape Kennedy, Florida; the things are the Apollo/Saturn V moon rocket, Lunar Orbiter spacecraft and a few Minuteman missiles thrown in for luck. When they all come at once, or nearly so, the situation can be confusing—as if, and it's almost literally true—300,000 people were pushing their hardest against the 2,000, who haven't time to push back.

Kennedy Space Center's Launch Complex 39, says A. M. Johnston, director of Boeing Atlantic Test Center, "is like the spout of a funnel. All activities of the estimated 300,000 government and industry people working on Apollo and of the thousands of large and small contractor firms located across the United States converge here. Stages and components are received at the

Saturn V facilities model is assembled in Kennedy Space Center.

525-foot-tall Vehicle Assembly Building (world's largest by volume) to be assembled into America's largest rocket. When complete, the entire 363-foot-8-inch-tall Apollo/Saturn V and its 440-foot-high Mobile Launcher will be moved approximately 3½ miles to the launch pad by a 5½-million-pound transporter.

"Then, as if this mammoth job were not enough, NASA will launch the first Americans to the moon and return them safely to earth. The technology employed here and the results of that first manned space voyage beyond earth orbit will bring great advances to this industry and to everyday life. The men who work here are helping to write history, develop new technology and set the stage for a new era of transportation and commerce."

For the Boeing people involved, the year 1966 started fast and promises to move faster as the months pass. The few hundred employees here a year ago have been joined by hundreds more. Workload and numbers of persons involved continue to rise. The acceleration comes as a result of the three programs on which the company holds contracts converging in time. Minuteman tests continue, Apollo/Saturn activity rises and Lunar Orbiter launchings are imminent. And, all at once, the products of thousands of workers in New Orleans, Wichita, Ogden and Seattle come almost nose-to-nose on the Florida sands.

The first big event of 1966 was the arrival of the 287,000-pound S-IC-F, the facilities checkout version of the Saturn V moon rocket, on January 19. It was transported to the NASA Kennedy Space Center, Merritt Island, Florida by seagoing barge from Boeing assembly lines at the space agency's Michoud plant in New Orleans, Louisiana. This booster, together with other ground test Saturn V stages, is being used to check out facilities and procedures prior to processing the first flight hardware this summer.

Boeing's role in the Apollo/Saturn V program at Kennedy Space Center reads like an aerospace engineer's dream. In addition to being charged with receiving, inspecting,

erecting and mating S-IC boosters with upper stages, the company is responsible for design and installation of certain support equipment in the Saturn V assembly and launch facilities and support of NASA during launch operations.

Since the arrival of the booster, Boeing Saturn V personnel at Launch Complex 39 on Merritt Island have run the gamut of erecting and mating the S-IC-F to the upper stages as well as installing first stage booster ground support equipment and certain Apollo/Saturn V ground support equipment common to the vehicle. Erection of the "F" was accomplished on schedule March 15 and mating to second and third stages and instrumentation unit was complete on March 30. Thereafter electrical power to the first stage was turned on and joint checkout of vehicle flying subsystems and ground support equipment begun.

A major milestone in the Saturn V project at Kennedy Space Center was reached a few days later on May 25 when the Apollo/Saturn V facilities checkout vehicle was moved from the VAB to Pad 39A. There company engineers and technicians have begun several weeks of propellent loading operations. First, they are loading propellents separately to each stage in conjunction with appropriate stage contractors. Later they will simultaneously fuel the entire rocket.

Propellent loading of flight model Saturn Vs will require only hours. However, initial operations with the 500-F vehicle will check out facilities, train personnel and polish procedures—hence the long duration. The first Apollo/Saturn V mission, an unmanned launch, is scheduled for early 1967.

Before Saturn V steals the spotlight in 1967, Lunar Orbiter will move center stage this summer when the first flight model of the unmanned, camera-carrying spacecraft is launched to the moon from Pad 13. It has arrived at Cape Kennedy and now is being readied for its launch.

Boeing is under contract with NASA to build three non-flight plus five flight versions of the Orbiter, which will circle the moon taking photographs to assist in selecting manned Apollo landing sites. Additionally, Orbiter will obtain data on the moon's shape and gravity as well as micrometeorological activity near the lunar surface.

Current Lunar Orbiter work at the Cape was made possible by the success of Spacecraft C, or the prototype as it is sometimes called. Built at the company's Missile Production Center, Seattle, Washington, it arrived at the Cape on February 8, following a series of highly successful performance demonstration tests at Goldstone, California (see *Boeing Magazine,* January and April).

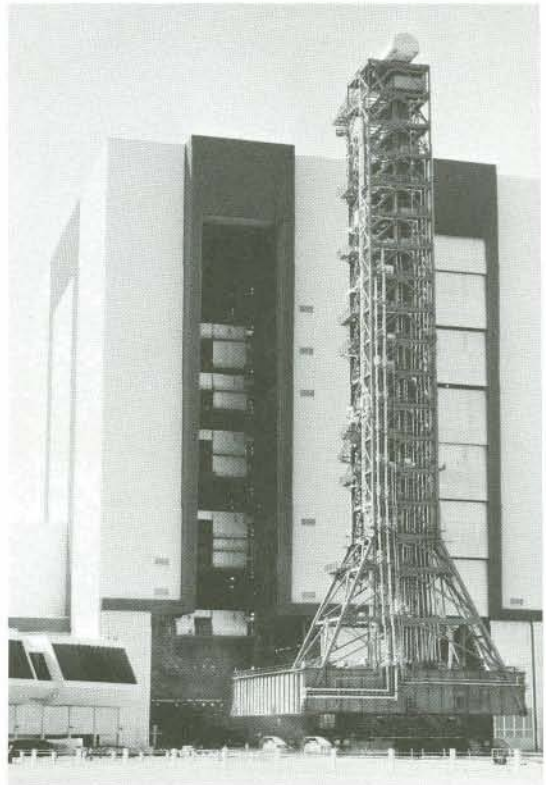
The "C" has completed two months of tests in its clean room at Hangar S, one of the most historic buildings in the space program. (All project Mercury astronauts were quartered there before their missions.) Like the S-IC-F, Spacecraft C is being used to polish handling and processing techniques as well as check out test and launch facilities. Approximately 100 engineers and technicians are assigned to this project at Cape Kennedy. In addition, each spacecraft has a team of Boeing and subcontractor representatives which accompany it from assembly to launch.

Not to be outdone by space activities at the Cape, Minuteman II personnel across the Banana River on Cape Kennedy Air Force Station started the year by launching a test missile on January 5. It was the 12th consecutive successful flight of the nation's most advanced intercontinental ballistic missile.

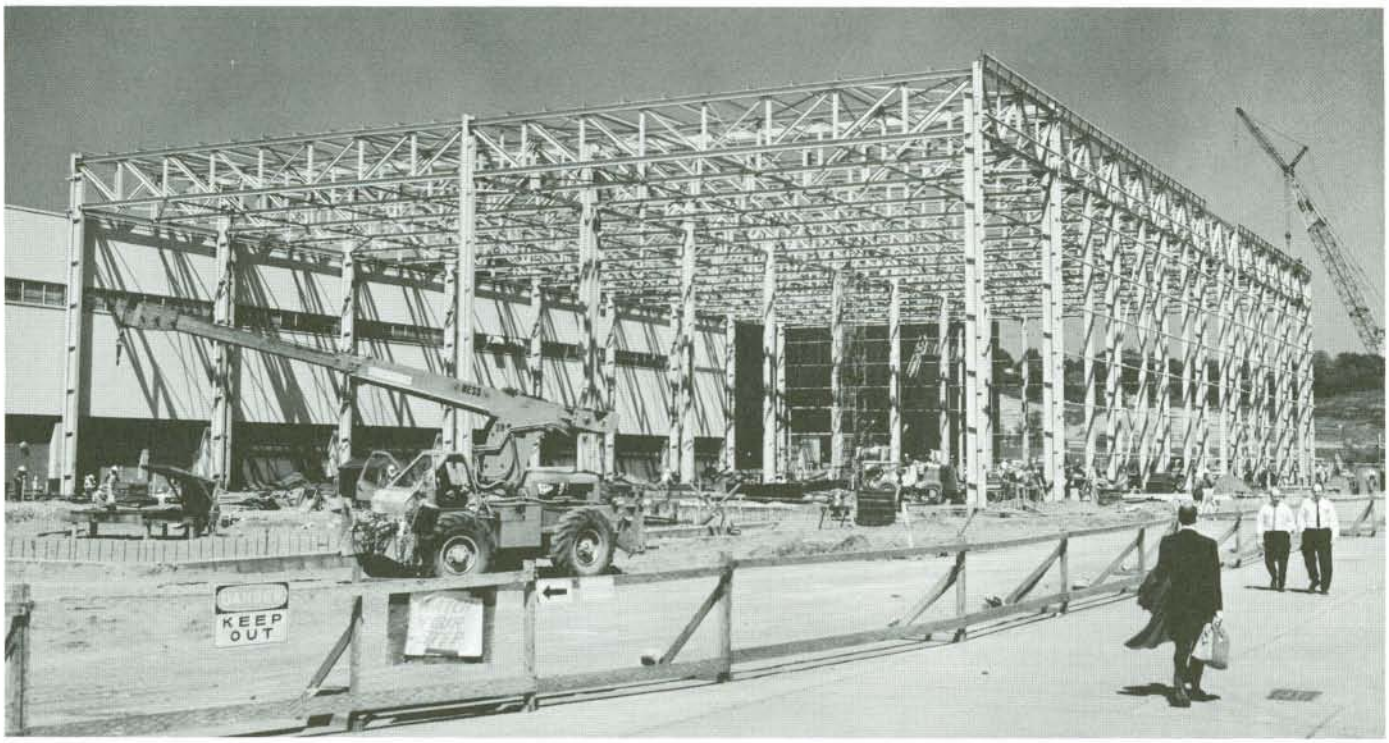
Since that flight the pace has quickened. Minuteman II has run its enviable record to a perfect 14 successes out of as many attempts down the Air Force Eastern Test Range. Company employees and Air Force personnel of the 6555th Aerospace Test Wing now are launching the three-stage solid-fuel missiles at the rate of about one a month.

In addition to assisting the Air Force during launch operations, company personnel assemble the research and development missiles on Cape Kennedy. Operational versions of Minuteman II are mass produced at the company's Ogden, Utah, assembly line.

Lunar Orbiter is inspected at Kennedy.



Apollo/Saturn V mobile launcher on transporter moves toward Vertical Assembly Building at Cape Kennedy.



Titanium processing building rises in Seattle.

New plant is designed to shape

TITANIUM FOR THE SST

By JOHN NEWLAND

AN UNUSUAL multi-million-dollar titanium-processing facility is under construction at Boeing's Developmental Center in Seattle. The facility was designed from the outset for the demanding task of hot forming and hot sizing the strong and light metal which will be used in the United States' supersonic transport.

The building which will house the presses and furnaces will be 180 feet wide — approximately the width of the arrow-wing Boeing SST design with its wings extended for efficient low-speed flight — and 480 feet long. A high-bay manufacturing area, it will be 45 feet from the floor to the hooks of the 15-ton capacity mobile cranes under the roof trusses. Each bay will be 90 feet wide.

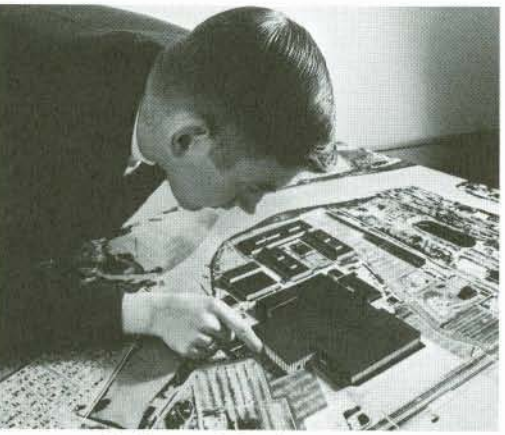
Divided roughly in thirds, the building will have an area for constructing master models from which the hot-forming and hot-sizing dies will be built, an area for the high-temperature forming and sizing operations required in working titanium, and one for chemical processing and penetrant inspection.

To form and size titanium, the dies used will be heated to three times the temperature produced on the SST's skin by the friction of its 1,800-mile-an-hour passage through the air. Titanium hot forming and hot sizing at temperatures up to 1,500 degrees F make possible tighter radii curves than in cold-formed titanium, combine forming and sizing with stress relieving and prevent springback after forming.

The new facility will include many advanced industrial features — pressurization of certain areas to prevent dispersal of chemical fumes, anti-pollution fume scrubbing to remove chemicals from exhaust air, no-clutter power supply for the hot-die area, rail storage for the heavy but fragile ceramic dies used for creep forming titanium parts as long as 70 feet and a complete penetrant inspection setup to detect surface imperfections in the titanium parts through use of black light.

But the heart of the facility will be its chemical tanks, furnaces, dies and presses.

The nine tanks in the chemical-processing line, 75 feet long, 5 feet



Scale model of new building fits against the Developmental Center.

wide and 10 feet deep, will be used for cleaning titanium parts before and after forming and sizing and will remove scale, the titanium equivalent to oxidization in iron.

Standing out along one wall in the forming and sizing area will be a giant gas-fired furnace 70 feet long, 10.5 feet wide and 10 feet high. The furnace will be used for relieving stresses in cold-formed titanium and for preheating dies. Five other, smaller furnaces also will preheat dies and spacer blocks before they go into the presses. The 10 presses will be capable of operating at 1,500 degrees F and exerting horizontal and vertical pressures on the dies.

Schedules call for the master-model area to be activated in August. Not long after, employees looking like spacemen in air-cooled asbestos suits will begin working in the hot-forming and hot-sizing area, where the temperature will be no more than 10 degrees greater than the outside at floor level but will be somewhat hotter near the presses, dies and furnaces.

Some of the asbestos-clad men at the presses may already have spent as much as two years working in a similar facility of smaller scale at another Boeing plant in Seattle where titanium hot forming has been going on since 1964.

In future, computers may be top recruiters

JOBS, ANYONE?

By RAY THOMAS

THE VOICE of the turtle, traditional harbinger of spring, already has trouble being heard on American college campuses, what with the siren tones of industrial recruiters rising day by day. Before too long, both may be out-shouted by the clack of the computer and the curious sounds of special circuit television.

It's all for the sake of easing the transfer of man from campus to industry, says William B. Evans, professional personnel manager for the Aerospace group of The Boeing Company. He predicts that equipment now being developed will make it possible some day for a job applicant to pick up a telephone, dictate his qualifications to a computer in a Boeing office, through it make an appointment to receive a long distance phonovision call a day later, and in that call to talk—face to face, in effect—with the man who may be his supervisor at Boeing.

A sophisticated computer could determine almost immediately whether the applicant's qualifications met the company's needs, and where. It will ask necessary questions when programmed properly. The phonovision, when perfected, would provide the advantages of an on-the-spot interview without the need for cross-country travel. If the man is teetering about coming to Seattle because he's not sure whether he can find anybody to listen to his bassoon playing in the evenings, he can get the answer in the interview — without ever leaving the campus.

Evans believes such a system could free a job seeker of useless applications, tiresome travel, endless letters, job-taking mistakes.

On the whole, really humanizing things, these computers and phonovisions—or they will be, when they all arrive. In the meantime, naturally, Boeing recruiters continue to visit campuses seeking by time-tested methods the talented and the technically promising.

And if recruiters view computers with alarm, who can blame them?

William B. Evans, Boeing professional personnel manager for Aerospace Group, tries TV telephone.

Versatile, reliable, inexpensive

BURNER II HEADS FOR GROWTH

By HAROLD CARR

THE FIRST Burner II, a new upper-stage space vehicle, has been delivered to the United States Air Force by a small, hand-picked Boeing team.

Like the end runner in a relay race, Burner II will provide the final "kick" for placing small- and medium-size space payloads into precise orbit.

Special qualifications of Burner II are its low cost, high reliability, versatility and early availability, based on an extremely short 12-month development timetable. As the latest addition to the Air Force's space inventory, Burner II on top of the Thor booster will fill the payload gap between the National Aeronautics and Space Administration's Scout launch vehicle and the Delta and Thor-Agena launch vehicles.

As Boeing's initial entry in the space propulsion field, Burner II is the first upper stage designed for broad applications to employ a solid rocket motor combined with full control and guidance capability. It will push its payloads into orbit at speeds of more than 25,000 feet per second and then point the payload accurately.

A complete flight-hardware prototype of Burner II is being delivered to the Air Force for crew training.

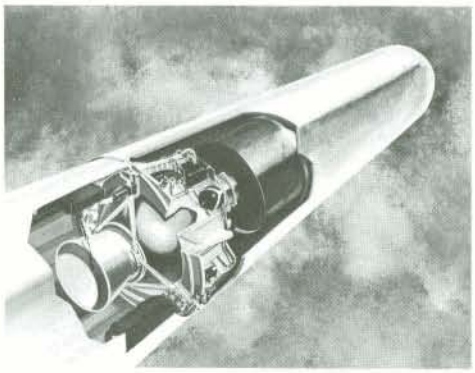
The Air Force asked for Burner II proposals from the aerospace industry in mid-1964; Boeing and Ling-Temco-Vought were selected to proceed with the competition in August, 1964, and Boeing was awarded the design and development contract in April, 1965.

Company officials signed a $6.5 million contract with the Air Force System Command's Space Systems Division in April, 1965. Chief of the Burner II program at the Air Force Space Systems Division is Col. Jean G. Goppert.

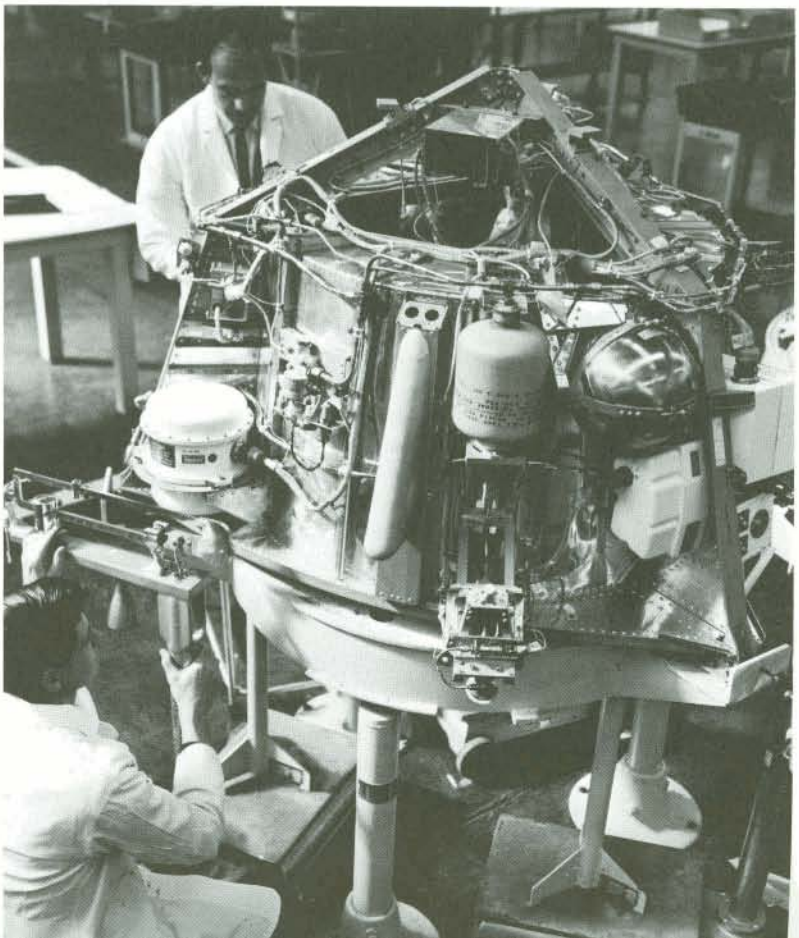
Winning Burner II was a breakthrough in several respects. Although a small program, it is significant that this was the first new military contract for the company since the Minuteman ICBM award in 1958. It was Boeing's first hardware contract with the Space Systems Division and the first contract won under the new military total package procurement process.

"The first key to winning Burner II was the design job," says Douglas Graves, program manager during the competition. "We never did change our original design proposal once we had an indication the Air Force liked it."

Burner II does not break new



Heat shroud will protect Burner II and its payload during flight.



First Burner II flight vehicle undergoes precise weight and balance test.

technological ground, but rather is a combination of already-proved space components. Its Thiokol solid-fuel engine is the same one developed for Surveyor, the soft-landing lunar vehicle; the Honeywell guidance system is essentially the one used on NASA's Scout launch vehicle, and the Walter Kidde reaction control system is from NASA's Little Joe booster and other programs.

"Once we froze the design, all our effort went into cutting Burner II cost. This was the second and biggest key to success," Graves continued.

The mere presence of Burner II at Boeing is an anomaly. Compared with the company's other airplane and space products it is minuscule, measuring 68 inches long and 65 inches in diameter. Only 180 employees were assigned to the program at its peak, far less than the staff on many company study contracts. Program manager E. Watson Smith and his engineering staff are located a few steps away from the production area.

"Burner II should enhance Boeing's reputation for ability to handle a small program economically," says Smith. "We demonstrated our willingness when we signed a firm, fixed-price contract. It's the first time the company has done this on a development program.

"Although we've had to go through all the steps on Burner II that a large program demands, we've held down the costs by short lines of communications and by having top technical people working the day-to-day problems."

This emphasis on economy is why the Air Force is counting on Burner II to operate at a small fraction of the cost of larger, more complex, liquid upper stages currently in use. By replacing these liquid stages with Burner II, launch vehicle expense can be substantially reduced.

Burner II stages are thoroughly checked by Boeing in Seattle and no further intensive testing is required following their arrival at the launch site.

Although specifically designed as the second stage on the Thor booster, Burner II has the adaptability to be used as either the second or third stage on the complete stable of standard launch vehicles from Thor through the Titan 3.

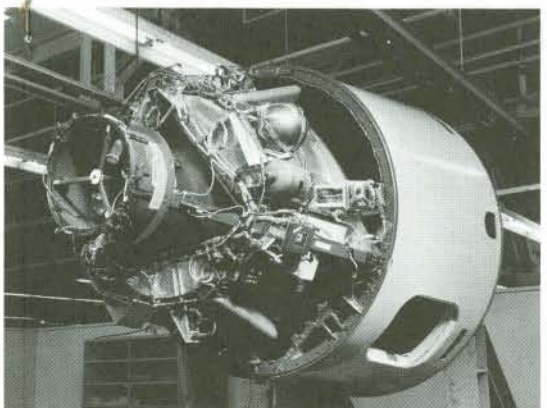
The new solid-fuel upper stage can do many jobs. These might include injecting payloads such as the Tiros weather satellite into orbits below 1,000 miles; "kicking" payloads as large as 800 pounds, such as the communications satellites, into 20,000-mile stationary orbits after they have been lobbed into space and providing power for earth-escape missions for either solar or planetary probes.

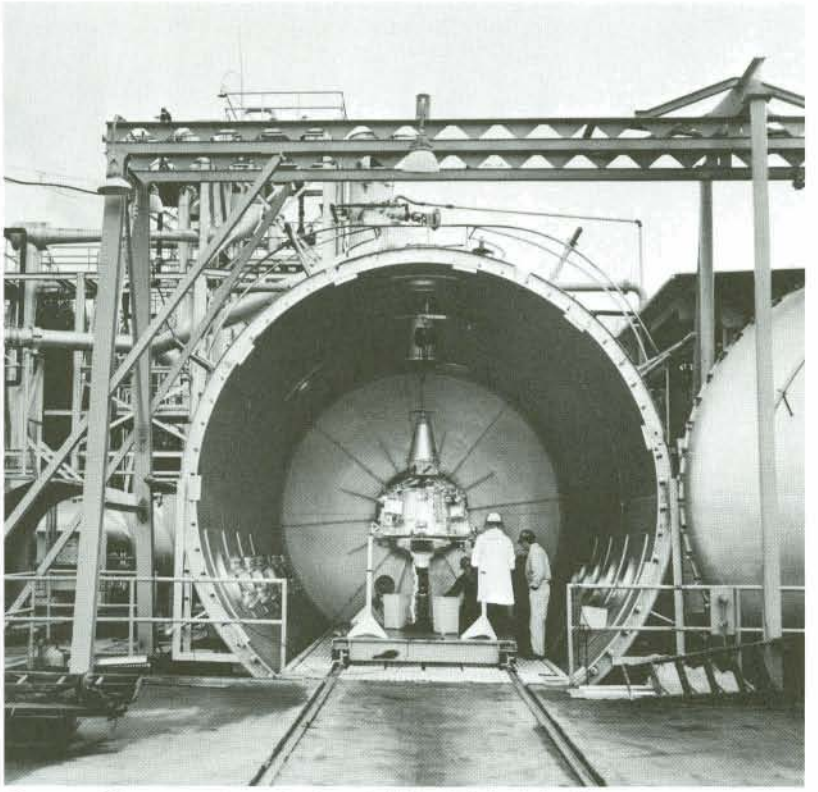
Burner II has attracted the attention of several government agencies and the aerospace industry as a money saver. For this reason, Boeing is already proposing growth versions.

Four such versions have been studied. They include strengthening the structure on which the payload attaches to Burner II so that it will carry 1,000-pound payloads; building a structure around the basic Burner II to boost the payload capability to 4,000 pounds; placing two Burner II's in tandem or using a larger solid-fuel rocket engine to provide increased performance.

Technicians check portable ground equipment.

Payload will be attached to ring at left.





Burner II upper stage is dwarfed by high-altitude chamber at Tulalip Test Site, north of Seattle.

Compensating regulator is adjusted to control temperatures of specimens in open oven at left.

New regulator provides

EXACT TEMPERATURE CONTROL

By WESLEY ROBINSON

ANY HOUSEWIFE knows she can't bake a successful cake unless she has exact control of the temperature of her oven. The cake will fail to rise properly if the oven is too cold, and will crack or burn if it gets too hot.

A similar problem faces Boeing engineers experimenting with the effects of extremely high temperatures on metal structures and alloys. Unlike the housewife's oven, however, test ovens are only partially enclosed, and heat escapes by radiation, convection to the air and by conduction to interior surfaces.

This makes the simulation of aerodynamic surface temperatures between zero and 3,000 degrees F extremely difficult to control. Even the best temperature controls on the market tend to be either unstable at low test temperatures or inaccurate at high temperatures.

Engineers found they could improve the effectiveness of their hot tests by resorting to dial-twiddling —adjusting gain, rate and reset controls for each temperature change. This proved awkward and cumbersome. Boeing now has developed a first in thermal control: its own precision non-linear compensating temperature regulator.

The new regulator automatically adjusts dials for the engineer during a heat test. As a result, dial settings need to be made only once. The temperature regulator's compensating circuit will maintain the desired temperature across the test surface regardless of convection, conduction and radiation losses.

"We started at the equation for heat transfer and worked backward from desired performance to determine how much power would be needed to make up specimen thermal losses at any given temperature," said Eugene Ihlenfeldt, the Boeing engineer who developed the regulator. "We now have a versatile, general-purpose temperature regulator."

The regulator uses two separate control systems. One is made up of a differentiating circuit and a regenerative feedback circuit which calculates and applies the correct amount of power to offset thermal losses of the specimen. The second system detects the slightest error between the desired temperature and the actual temperature, adjusting the power level to correct this error.

In a series of tests at the Commercial Airplane Division, the new temperature regulator was set up to hot-test one particular part. Immediately following this test, another part with completely different thermal characteristics was placed in the oven and hot-tested without readjusting the controls. Results on the second specimen proved to be just as good as those for the first test specimen—a feat which could not be accomplished with previous regulators.

Used in series, the new temperature regulator can hold the heat levels of two or more sections of the same piece of material at two or more different temperatures. Ten or 15 of the controls have been employed on a single test. Boeing's supersonic aircraft testing may require several hundred regulators for one test.

The new precision temperature regulator has been licensed by United Power and Control Systems, Inc. of Seattle for manufacture and distribution.

Minuteman equipment will undergo

NUCLEAR SHOCK TESTS

SHOULD AN ENEMY drop a nuclear bomb near a Minuteman missile installation, it would only raise a mushroom cloud. Cradled in its silo deep in the earth, a Minuteman can absorb almost anything short of a direct hit and still come up fighting.

Part of this rebound ability is due to a shock absorber system in the Minuteman silo. Personnel and electronic equipment waiting to send the big bird roaring out of its tunnel are protected from damage by floors that float on shock isolators much as an automobile floats on shock absorbers and springs.

Tests conducted independently by Boeing and the Air Force Special Weapons Center, Albuquerque, New Mexico, are constantly evaluating the Minuteman shock isolation system to be sure the isolators will, indeed, dampen a massive shock wave properly. These tests involve slamming a small section of shock-isolated floor, then analyzing the results by computer to give an idea of what might happen to the entire floor.

To get more positive results, Boeing's Missile and Information Systems Division is now designing a blast simulator to be built at the company's Tulalip test range. This high-energy simulator will pack a punch roughly equivalent to an earthquake with an order of magnitude of 10 on the Richter scale, yet the Tulalip countryside will feel little or nothing. The energy will go directly to the test item, and the ground shock of megaton-size nuclear weapons can be virtually duplicated for any kind of shock-isolated floor in any type of soil.

The new simulation facility will have horizontal and vertical impact devices. Timing of the impacts and control of the forces will simulate various degrees of nuclear shock, direction, multiple shocks and different burial depths of the electronics equipment. Other effects —such as acoustic environment— may be imposed simultaneously with the shock testing.

"For the first time, this new test rig will permit us to track the effect of a nuclear weapon attack on the entire floor and its electronic equipment," said Art Hitsman, project manager of the Minuteman shock isolation system. "We are developing actuators that will give us real conditions on an actual system rather than relying only on computer simulation."

The shock tests for the Minuteman silo equipment will be equivalent to flight testing missiles or aircraft, picking up where computer analysis leaves off in verifying the rebound ability of a complete system. As Bob Hager, head of Minuteman Dynamics staff, explained it: "We'll get simultaneous verification of the dynamic performance of the isolators, structural integrity of the floor, and electrical performance of the equipment just as would occur under a real nuclear blast."

Computers still will be called upon to reduce the test data to workable form and to apply the knowledge obtained from the tests in the design of more efficient isolation systems. Even in this day of high-speed calculation, a computer will need 45 minutes to boil down all the information generated by one shock test.

The new Boeing facility may be used for other types of shock testing, since nearly anything that requires a high energy shock could be studied by the facility. Airplane landing gear, currently drop-tested with weights, could be checked easier and faster on the shock platform; with the added advantage of having the landing gear moving forward as the shock is applied.

Minuteman liquid-spring shock isolater is inspected.

Caledonian carries many pilgrims to Mecca.

Highland Games are held at Braemar

Pilgrims board plane at Rabat.

Caledonian Airways provides

HOLIDAYS WITH OR WITHOUT HAGGIS

By MICHAEL HIGGINS

A CANNY Scot living in the United States or the travel-minded American with a wee bit of Scotch blood in him soon will be able to enjoy a 14-day holiday in the United Kingdom for little more than the cost of the current standard one-way air fare.

This will be the immediate result of an exclusive tour charter license granted by the U.S. to Caledonian Airways, the Scottish International Airline which has ordered a Boeing 707-320C for the company's North Atlantic operations. Fourteen charter flights will span the Atlantic between April and October of next year.

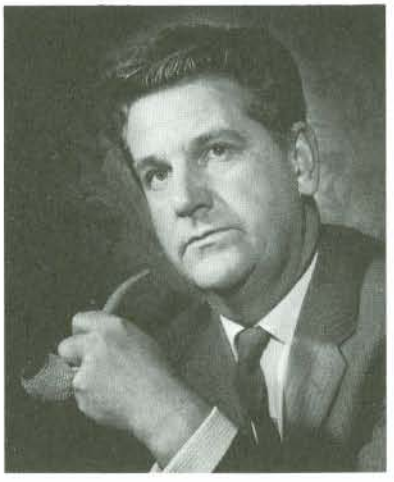
Caledonian, a young airline by any standards, was incorporated in 1961 by a group of young aviation executives including 39-year-old Adam Thomson, current chairman and managing director. Organizational meetings were held in various parts of the world whenever two executives happened to be on the spot at the same time.

Their efforts resulted in Scotland's first international airline, using one leased DC-7C with the Scottish Lion Rampant adorning the tail of the aircraft and stewardesses wearing the ancient Black Watch tartan uniform. Since the first flight in December, 1961, Caledonian has added six Britannia jet-prop aircraft to its fleet.

Caledonian specializes in long distance inclusive tour and charter work. Inclusive tours are complete package arrangements in which the tour operator not only books the

Artist's conception shows how 707 will look with Caledonian markings.

Adam Thomson,
Managing Director, Caledonian



aircraft seating, but also hotel accommodations and the other necessities for an inclusive holiday. As a result the general public can travel for considerably less money than would be necessary if holidays were planned individually.

The airline's charter work has taken some unusual turns. Recently, three Britannia 300s were engaged in the oil lift to Zambia. On this airlift Caledonian flew more than 150 sorties during the first six weeks of this year and carried upwards of 350,000 gallons of oil.

Caledonian also has carried pilgrims to Mecca. In 1964 they transported over 3,000 pilgrims from all parts of Africa on the Hadj—the name given to the sacred pilgrimage.

Such charter flights involve special problems. The weighing of passengers' luggage is one. Female passengers on these pilgrimages invariably carry much of their belongings strapped to their waists. Caledonian experience has proved the quickest method is to weigh the bundle while it is still attached to the passenger. This calls for a certain amount of tactful handling for sometimes it is difficult to avoid weighing part of the passenger as well as the luggage.

The strict observance of facing East during the five daily prayers while in flight presents its own problem, but an even greater one is the custom of washing before prayers. This places a considerable strain on the aircraft's water supply.

While the more romantic flights were taking place, some aircraft were flying troops and their families to different parts of the world while others were busy on North Atlantic passenger charter flights. The build-up of North Atlantic business has been one of the cornerstones of Caledonian's success. During 1965 about 200 such flights were operated. The number will be exceeded by a wide margin this year. In addition, an application is pending for scheduled flights to the Continent from Glasgow airport, Scotland.

The bulk of Caledonian's work has reflected the desire of its chairman to bring to the American public the opportunity of visiting England and Scotland and seeing the beauty of Highland mountains in August and the thatched cottages of the Cotswold hills in the height of summer.

Adam Thomson and his young and enthusiastic band of directors want to bring to the mass American market—particularly to Americans with Scottish blood in their veins—the opportunity of visiting their homeland without making too much inroad into their "bawbees." The 707-320C which is due for delivery in the spring of 1967 is the vehicle on which Thomson and his colleagues are placing their hopes for success.

Concerning the 707 order, Thomson commented, "In addition to the full evaluation study carried out by Caledonian, I travelled several times on this aircraft and I think from all aspects—operations, range and carrying capacity—it is a first-class airplane and the right one for us."

Gunboat Man

IN THE BOAT-CONSCIOUS Pacific Northwest, he never has owned one; in the airplane-conscious Boeing Company, he cares little about flying. But place him within hearing of the word "hydrofoil" and Gene R. Myers responds —even though hydrofoils are boats which fly on underwater wings.

Trimly built, Montana-born Myers manages the hydrofoil gunboat program which Aerospace Advanced Marine Systems is conducting in Seattle for the Navy Bureau of Ships. A 24-year man with Boeing, he personifies a credo which reflects long experience in preliminary design: patient optimism.

"Gene is a master of the reverse flap," said an associate. "He saves his most deadpan expression and most casual voice for the things that are the most difficult to do. Other times, he's merely relaxed."

Myers has been in AMS since 1959 and has spent most of this time on advanced hydrofoil designs. Under his thoughtful eye have passed such concepts as hydrofoil ferries, hydrofoil anti-submarine-warfare craft and hydrofoil gunboats. Now, with the Navy contract, he is building the gunboat and planning for the day it will fly on Puget Sound.

"Anyone who works on design concepts must truly believe that success is only a day or so away, that tomorrow may bring the goose with the golden egg," he says. "This isn't always easy, but it imparts drive to your work and spurs your desire for excellence."

Myers came to Boeing in 1942 while still a student at Seattle's Queen Anne High School. He bucked rivets full time on the swing shift, and, later, after earning a diploma in aeronautical engineering at Curtiss-Wright Technical Institute, moved into the engineering end of things. Myers has been associated with nearly every Boeing airplane since the B-17. He is remembered for his work on landing gear systems and for a habit of excelling on sticky jobs.

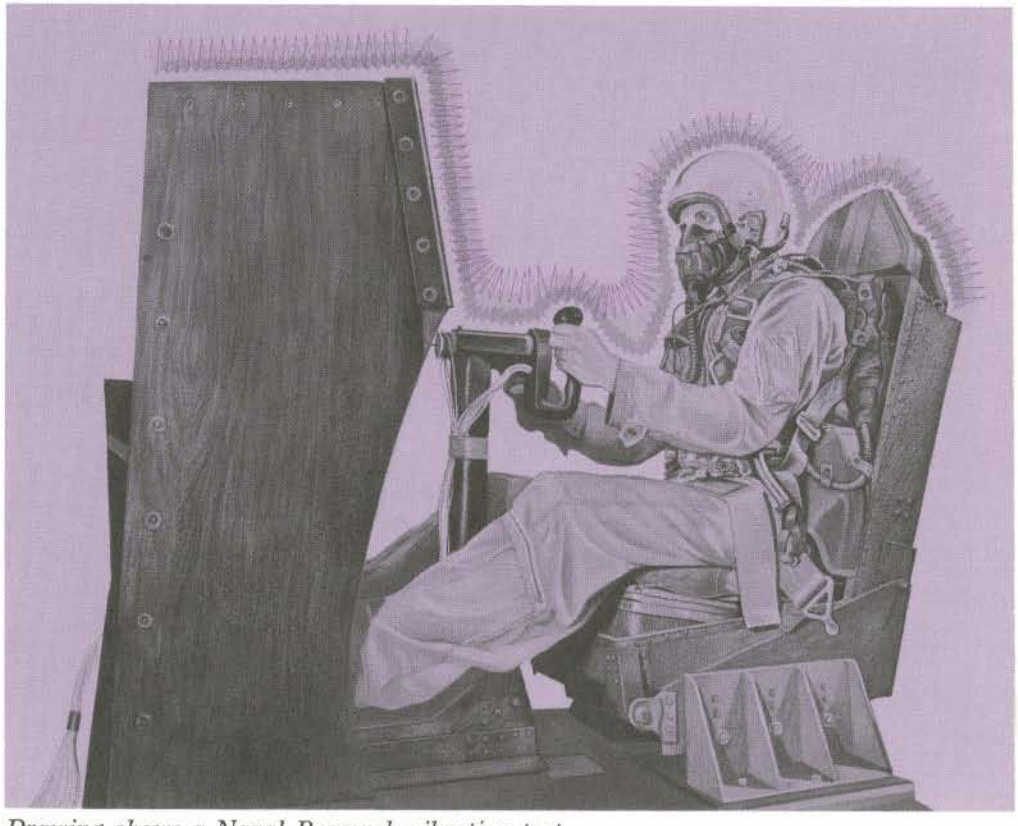
He was an assistant program manager for Dyna-Soar in the former Systems Management Office when marine systems was starting up. Myers joined the fledgling group, intrigued with the pioneering in the offing, and later was given charge of preliminary design. The contract award for the hydrofoil gunboat capped 3½ years of effort.

Myers relies not at all upon how-to manuals on management. "I manage through careful selection of people," he says. "You are totally dependent upon them, for your people determine your success. On the other side, the boss determines a person's opportunities so this makes loyalty a reciprocal thing. You earn it by giving it."

Away from the plant, Myers is finishing a home he's building (the second) and takes an occasional swim. Three youngsters, a quickening Little League schedule and family field trips take care of the rest of his time.

Wichita researchers work on a

SCIENTIFIC SHAKEUP



Drawing shows a Naval Research vibration test.

By DARRELL BARTEE

HUMAN FACTORS scientists at Boeing's Wichita Division are investigating the effects of dual-frequency vibrations as they might be experienced by operators of military or civilian vehicles.

As anyone might guess, operators of aerospace or ground vehicles are often subjected to more than one source of vibration at the same time. How can the combined effects of these shakes be identified and evaluated? One vibration may tend to mask the effect of the other and there are many complex interactions to be examined. The answers have bearing on human perception, fatigue, sensitivity and performance.

The work is being done under contract with the Office of Naval Research. This is the ninth project in a series of human vibration studies for ONR which started seven years ago at the Kansas plant.

Human subjects are placed in a special rigid seat and multiple vibrations applied. The study can establish, among other things, at what point in time a man experiencing a uniform, low-frequency vibration becomes affected by a second, higher-frequency shake.

Youthful subjects who are in good health and have test experience are used. Their physical condition is thoroughly checked to begin with and is rechecked after each shake session. An M.D. is present for all tests. He watches a stylus as it traces heart-action graphs and closely watches the subject for any signs of distress or extreme changes in his performance. Most tests last about 40 minutes. They are kept well within safety ranges established by previous research.

The subject is held in the pilot's seat by a special lap belt with a grip that cannot be loosened by vibration. The seat is mounted atop a platform and a hydraulic cylinder which supplies the up-and-down motion. A simulated cockpit eliminates outside distractions.

Airplane noise is reproduced from tape. Monitors in a control booth observe the subject through a one-way window, converse with him via microphones and provide instructions through a remotely controlled instruction panel. The subject can increase, decrease, or halt the vibrations through hand controls.

The shakes, of different frequencies, are controlled electrically from a lab beneath the control booth. Many combinations are used. Frequencies range from one to 27 cycles per second.

Results from completed tests are made known to other researchers and to equipment designers and users, by means of various technical reports, articles in journals and presentations for technical and scientific meetings.

Complexity in the propulsion and operation of military vehicles is increasing every day. ONR and the Wichita researchers are contributing basic data to help understand and solve vibration problems.

Try this time-saving approach to your next 2-week vacation.

(And loaf for 16 days.)

Fly there and back.

When you fly, you can actually crowd 16 full vacation days into a regular two-week period.

You can, for instance, board a Boeing jet the evening of your last work day, and be in any part of the country in a few hours. You can begin your vacation *there*, that same night. And you can vacation right through the last day, because a Boeing jet can whisk you back—rested and refreshed—that same evening.

By Boeing jet, two weeks is time enough to vacation anywhere in the world. Boeing jets serve 301 cities in 121 countries. And every 13 seconds a Boeing jet lands or takes off somewhere in the world.

This year, get your vacation off to a flying start—by Boeing jet.

Fly Boeing with: *Air Congo, Air France, Air-India, Air Jamaica, Air Madagascar, All Nippon, American, Ansett-ANA, Avianca, BOAC, BWIA, Braniff, Continental, Eastern, El Al, Ethiopian, Flying Tiger, Indian, Iran Air, Irish, JAL, Japan Domestic, Lufthansa, MEA, National, Northeast, Northwest, Olympic, PIA, PSA, Pacific Northern, Pan American, Qantas, Sabena, Saudi Arabian, South African, TAA, TAP, TWA, United, Varig, Wardair Canada, Western, World.* Later: *Aerolineas Argentinas, Air Asia, Alaska, American Flyers, Braathens, Caledonian, Frontier, Lake Central, Mexicana, Northern Consolidated, Pacific, Piedmont, Southern Air Transport, Wien Air Alaska.*

BOEING JETS

Worlds first family of jets: 707 · 720 · 727 · 737