AIA

# planes

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# USAF CONTRACTS SPUR COST REDUCTION


## Industry Puts the Bee on Structure Problem—Honeycomb Technique Gives Needed Strength

The honeybee and a giant bomber have little in common—in appearance, means of propulsion or required hangar space.

Yet there is a major point of similarity, and that is that they both use honeycomb. In a big bomber plant the honeycomb used is shaped like the bee-manufactured article, but it is made of metal instead of wax.

Aircraft manufacturers have been using metal honeycomb structure for sometime in building aircraft because it is exceedingly strong. When sandwiched between two sheets of metal, the resulting sandwich is just about as strong as a solid plank of metal—the same thickness, yet many times lighter. And, in the manufacture of costly U. S. aerial weapons, weight reduction means cost reduction.

Today the aircraft industry is experimenting with metal honeycomb made of stainless steel, because of the need for a metal core for flying surfaces which can withstand high temperatures.

One major West Coast aircraft manufacturer is sandwiching stainless steel honeycomb between sheets of titanium, the two metals being brazed together with a lithium-silver foil in an oven cooking at more than 1,325 degrees Fahrenheit. The resulting titanium-stainless steel honeycomb sandwich could probably resist heat up to 800 degrees, which would be generated by air-friction over the surfaces of a plane travelling at 2,100 miles per hour at 35,000 feet.

Another important use for the honeycomb sandwich in modern plane building is in "vibration dampening." For example, the airframe surfaces behind a jet engine are subject to a high degree of buffeting. Internal supports of the airframe structure behind the engine must withstand this sonic vibration. Aircraft engineers have found that metal honeycomb has excellent vibration-dampening qualities as well as good structural strength.

Use of honeycomb in jet aircraft, guided missiles and rockets is just coming into its own. With the faster "hotter" aircraft has come the need for stronger flying surfaces. But as it now stands, the honeybee would have a hard time recognizing its own invention. For when the honeybee built its honeycomb, it had a load of honey in mind. The aircraft industry has a much more important load in mind.

## Aircraft Firm Uses 10,000 Subcontractors To Build Jet Bomber

The aircraft procurement dollar, like the proverbial pebble dropped into a pond, spreads in ever-widening circles until its effect reaches nearly every part of the U.S.

One major aircraft manufacturing company with large plants of its own, has nearly 10,000 other firms doing portions of the work that goes into the heavy jet bombers, jet tankers, transports and missiles produced by the prime contractor.

Of the 9,561 subcontractors and suppliers which help fabricate the military and commercial end products, more than 3,500 of them are small businesses with less than 500 employees. These firms are scattered throughout 42 of the 48 states, producing such widely varied components as fuselage sections as large as a two-car garage and rivets so tiny that there are literally hundreds of them in a pound.

Yet despite the diversity of their products, each has at least three things in common: first, each subcontractor has the facilities needed to perform a specific job; second, each has won its contract in competition with other qualified firms; and third, each is meeting the rigid quality standards of the contractor.

## Incentive System Valuable Tool

By Lt. Gen. Clarence S. Irvine
Deputy Chief of Staff, Materiel, USAF

The character of U. S. Air Force procurement policy is dynamic. The rapidity of technological developments in the aircraft industry requires that we have a highly adaptable contractual kit of tools to satisfy the unique demands of buying these developments.

The creed governing Air Force procurement policy is simple: There is no one perfect contract; selection must be controlled by the pricing situation. While it is possible to buy a standard article, such as a seat belt, on a cost-plus-fixed-fee contract, and it is also possible to buy a manned earth satellite under a firm fixed price contract, both would be extraordinary misuse of contract judgment.

The close relationship that exists between the government and industry is fostered through the prudent use of proper contracts. The present aim of our contracting techniques is to put maximum responsibility on the contractor for cost reduction.

Air Force procurement must always remain dynamic in its technique if we are to provide the best weapons for our combat inventory. In many cases, the Air Force is in the position of contracting for weapons for which only the desired capabilities are known. Procurement of an intercontinental ballistic missile is an example. There is no means of determining with complete accuracy the cost of the first twenty missiles. But we must use the appropriate contract devices that provide a sound incentive to cut costs.

The Air Force buys more than simply the completed weapons system, delivered to our combat units. We buy the best managerial talents in the nation. The infinite complexity of a modern aircraft or weapons system precludes detailed supervision by the military. We must look to industry to provide the managerial and technical skills that, in turn, will produce a superior air

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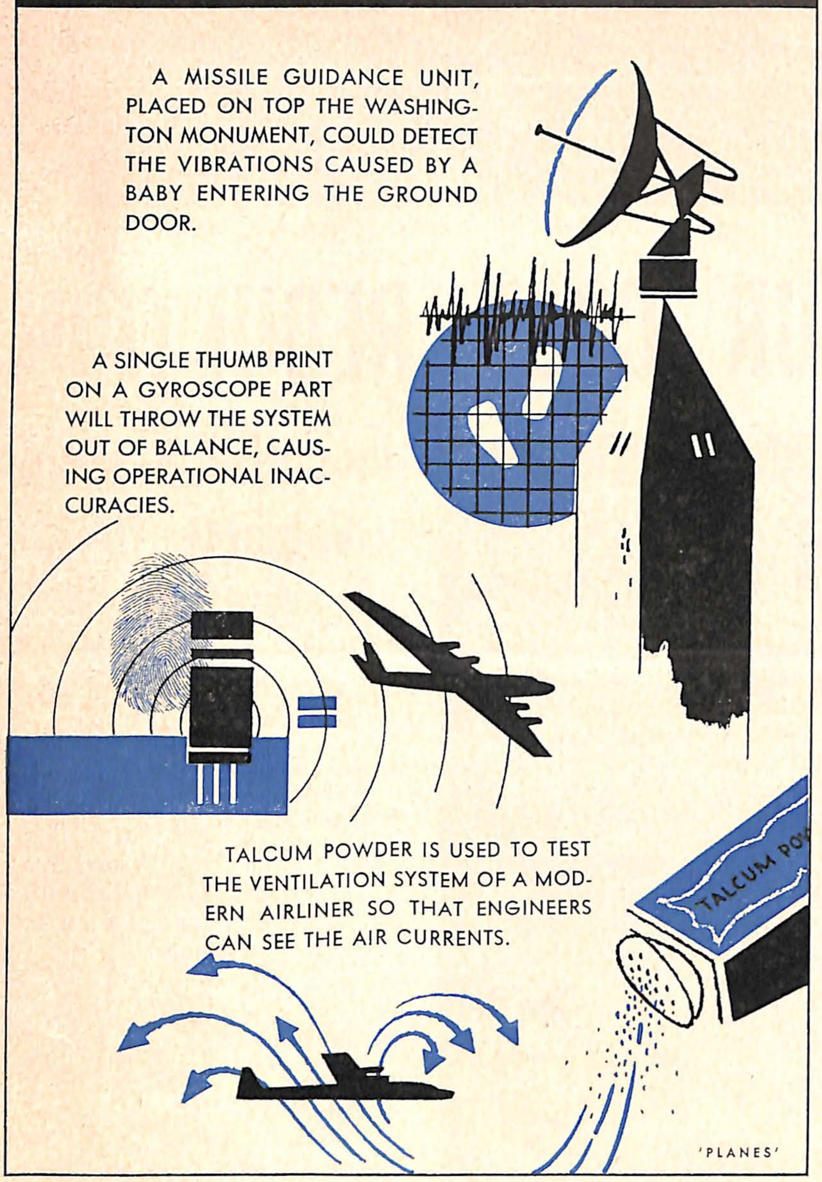
## Plane Views




## Air Freight Saves Time, Money

Shipment of products by air freight is paying dividends to companies utilizing this distribution tool.

One mail order house has concentrated their use of air distribution in Florida. It works this way: A customer places an order with the catalog sales desk at his local store. The order is immediately teletyped to a warehouse in Atlanta where the order is placed on a plane that night for delivery at the order point the following morning. Shipments to Florida from Atlanta once required seven to ten days. The mail order firm estimates that the overnight delivery service has increased sales as much as 30 per cent.

The air freight distribution system also permits better utilization of warehouse space. Items that have a rapid turnover can be stocked almost exclusively in the warehouse and products which sell less quickly can be eliminated. When there is an order for one of these products it can be rushed to the area by air freight within hours.

## PLANE FACTS

• The largest elevators in the world (big enough to carry 2,000 people) are to be installed in the Navy's new super carrier *Kitty Hawk.* The elevators are designed to feed 40-ton bombers to the flight deck at the rate of one per minute.

• **Aerial application of radiant heating will be employed for the first time in an aircraft with the installation of an 18 kilowatt system aboard a new luxurious jet airliner now in production in the U. S. Passengers will be gently "blanketed" by radiant heating panels built into cabin floors and sidewalls, even though temperatures outside the plane are bitter cold.**

• In the U. S. scheduled airlines, the nation has the largest Civil Reserve Air Fleet in the world—more than 300 four-engine aircraft, all capable of over-ocean flight. These planes are subject to call, with their crews, on 48 hours notice in the event of national emergency. CRAF, as these reserves are called, represents a $400,000,000 airlines investment and would cost the U. S. $300,000,000 per year if the nation had to maintain them in readiness.

## PLANES

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Foster a better public understanding of Air Power and the requirements essential to preservation of American leadership in the air;
Illustrate and explain the special problems of the aircraft industry and its vital role in our national security.

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# Changing Facilities

By Orval R. Cook
President, Aircraft Industries Association

Gen. Nathan F. Twining, Chief of Staff of the U. S. Air Force, recently brought into sharp focus the changing character of the aircraft industry. "Right now we are coming into the missile era," he said. "In 1954, about 90 per cent of our procurement money went for aircraft, and only 10 per cent for missiles. In the 1958 budget, about 35 per cent of our procurement money will go for missiles, and in 1961 that will be split 50-50 between aircraft and missiles."

The aircraft industry has registered an impressive series of technological gains that have hastened the adoption of guided missiles as a full-fledged member of the air power team. Intensive programs of research and development give sure promise of complete realization of the fantastic combat capabilities of missiles.

Just as the missile adds a new combat concept, it also adds new production concepts. The facilities that we used during World War II, and additional facilities built since that time, have principally been for the production of conventional manned aircraft, particularly the heavy bomber types. These structures feature high bays to accommodate the massive tail sections of bombers which reach a height of several stories.

Missiles do not require the mammoth production space but they do require rigidly controlled space. The missile is a "dense" bird. It is packed with highly complex electronic equipment which provides the "brains" for the missile, guiding it to a target in a completely automatic operation.

These electronic systems are manufactured and tested under conditions usually associated with modern surgical theaters. There is a room in one aircraft plant where guidance systems are built, in which dust is so scarce it can only be found with a microscope. Persons entering the room are vacuumed like a rug to remove dust particles. Employees are bundled in dustless nylon smocks, and women employees cannot wear face powder. The amount of dirt in the atmosphere is less than one-thirtieth of "pure mountain air." There is a bearing in one plant that spins endlessly without sign of wear, but a puff of cigarette smoke could cause it to grind to a halt because the tiny particles in the smoke would act as an abrasive. Of course, these infinitely precise instruments are hermetically sealed when they are placed in the missiles and are able to withstand the most rigorous changes in climate without loss of performance.

The missile must have the highest degree of reliability. There is no pilot present to make adjustments and corrections once it is launched. This means that each unit that goes into the missile must be thoroughly tested to guarantee this maximum reliability. The testing equipment must be located near the missile assembly line. This equipment possesses the same precision as the articles it tests and demands the same controlled atmosphere for operation.

This poses a serious problem to the aircraft industry in its conversion to missile manufacture, a conversion that is gaining momentum with each gain in research and development. A new plant recently constructed for missile manufacture is completely air conditioned. Temperature is positively controlled year-round. The entrances have double doors to cut down the entry of dust. It is possible to convert present structures producing large manned aircraft to missile production. But experience has shown that, in the long run, conversion of structures is usually more expensive than construction of a new building designed for a particular purpose.

The problem of facilities is being carefully studied by the aircraft industry today in order to have the answers for the manufacture of tomorrow's weapons.


# Engineers With Wings

By Brig. Gen. Benjamin S. Kelsey
*(USAF-Ret.)*

BRIG. GEN. BENJAMIN S. KELSEY (USAF-Ret.) was Deputy Director of Research and Development at Air Force headquarters before his retirement at the end of 1955. An outstanding test pilot with the Air Force, Gen. Kelsey completed a flying course at the age of fifteen, and was graduated from the Massachusetts Institute of Technology with a degree in mechanical engineering and later obtained a Master of Science degree in aeronautical engineering from MIT. In 1934, Gen. Kelsey participated as a project officer in various phases of blind landing and instrument flying development. He also served as deputy chief of staff of the Ninth Air Force and as chief of the all-weather operations section of the Materiel Command. Gen. Kelsey is now an aviation consultant.

THE old test pilot shook his head. Things had certainly changed in the past 30 years. Why, back in 1927, he recalled, in his heyday as a test pilot, the U.S. Navy was perfectly happy to accept an airplane after it had been thoroughly test flown for a full two and a half hours.

But, now, in 1957, the Navy, or the Air Force, or the airlines, demanded a lot more test flights before they could accept an aircraft—as much as 1,500 hours of test flying.

Standing on the apron of the aircraft manufacturer's airport, the old test pilot watched as the young test pilot walked toward the plane he would test fly. It was a sleek, up-to-date supersonic jet aircraft, carrying the equivalent of thousands of horsepower. The swept-wing craft was interlaced with miles and miles of wires, electrical and electronic systems comparable in complexity to the power system of a fair-sized city and a radio transmitting station combined.

It was armed with deadly rocket-powered guided missiles capable of bearing a nuclear warhead—a far cry indeed from its 1927 counterpart, which was armed with twin machine guns.

The young test pilot's flying gear presented still another contrast to the old test pilot. Where were the leather helmet, the goggles, the two-yard-long white silk muffler? Where were the dashing leather trenchcoat, the puttees?

The 1957 test pilot wore a new omni-environmental pressure flying suit, skin-tight and marked with strange laced welts. His headgear, equipped with oxygen controls and electronic communication devices, resembled nothing so much as a man from Mars a 1927 cartoonist might have drawn.

Today's aircraft, particularly those under test, are loaded down with a bewildering variety of electronic and telemetering equipment, which automatically relay information to ground control stations below.

The coded information, later reduced to digital form, is then fed into massive electronic "brains" which tell the engineers every conceivable fact about the aircraft's performance and flight characteristics.

IT is, indeed, a far cry from the simple testing that proved the airplanes of 30 years ago airworthy.

In those faraway days, there was no backlog of precise engineering data which would prove conclusively that a particular airplane would fly. It was up to the old derring-do test pilot to take her up and try to "fly the wings off" the test model. And, on occasion, the old ships did come unglued when put into power dives.

Engineering flight tests today are a far cry from the movie version of the 1930's, in which the airplane is put through a few violent screams and dives while the girl stands below wringing her hands, whereupon the design is declared a huge success, the manufacturer gets the contract and the pilot gets the girl.

Today's test pilots are almost all graduate engineers. And they never take a ship aloft to "fly the wings off." The greatest pains are taken by these engineers with wings to do over open water or desert areas any test flying that could conceivably be called hazardous. Most of their flights are routine "milk runs" of testing out the various inner systems in the aircraft.

Testing of a modern aircraft gets underway before the plane is really off the drawing board. From preliminary design, scale models are fashioned, which undergo many hundreds of hours of rigid wind tunnel testing for aerodynamic design.

The outer configuration of aircraft design can, of course, make all the difference between a production model which satisfactorily performs a given task, and one which doesn't measure up to specifications.

Today's high performance aircraft are thoroughly proven in wind tunnel tests. The


state-of-the-art has now reached such an advanced stage that design engineers can confidently predict final flight characteristics from wind tunnel tests alone.

Once a design model has satisfactorily passed the wind tunnel test, myriad other testing procedures begin.

EVERY part of a modern aircraft—hydraulic, electronic, fire control, braking and propulsion systems—must undergo exhaustive tests for performance data at widely differing ranges of speed, altitude, temperature, air density and other operational criteria.

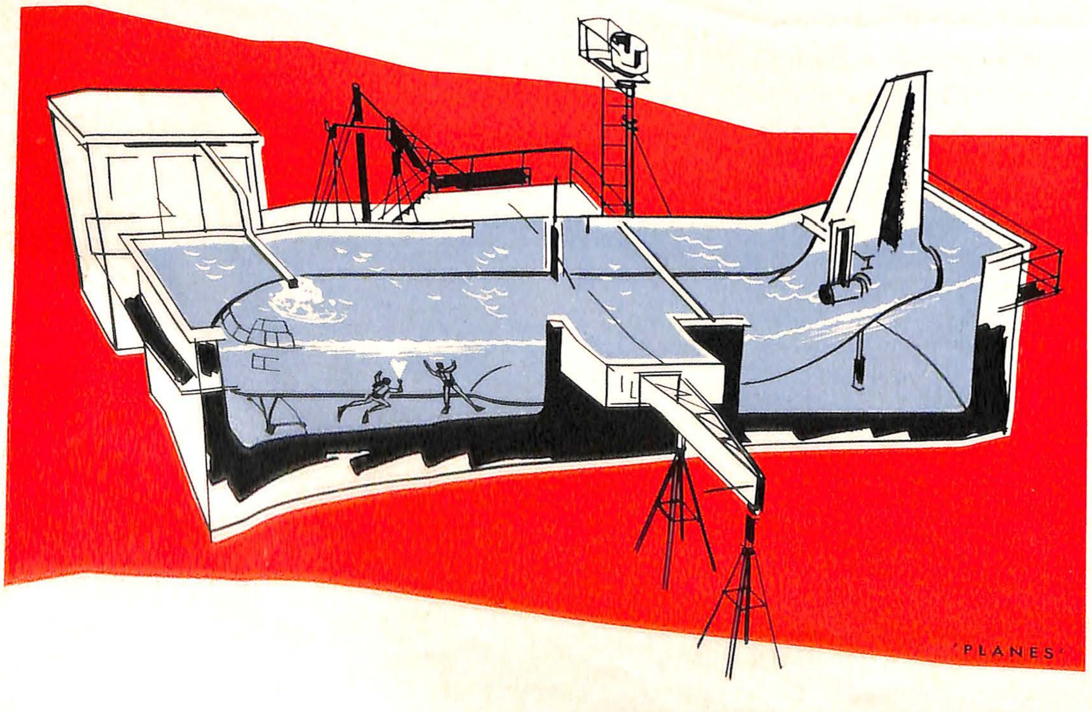
Aircraft are capable of operating in a wide temperature range. Their performance is insured whether they are based in the tropics or arctic through climatic test ranging from —65 degrees to 130 degrees above zero.

Planes designed primarily for short-haul overland domestic transport of passengers and cargo are put through severe "hydrostatic" tests to discover what happens to them when submerged in water under high pressures.

Military fighters and bombers have a shorter life expectancy than the transports, which is caused by the fact that they are constantly being made obsolete by better airplanes in a race which only the best planes can win. Yet here, too, testing programs continue even after the last production model has been delivered to the military customer.

One fighter went through eight modification models before it was "phased out" of active military service. However, since Air National Guard units are still using the aircraft for continental air defense and training purposes, its useful life is still far from over. At last report, the Air Force, the Air National Guard and the manufacturer were all still conducting tests on the now-obsolete model.

Such testing becomes particularly important in consideration of the "force in being" concept of aerial warfare today. This means, simply, that when and if an aggressor levels an attack against the United States, we must proceed with immediate retaliation with the means at our disposal at that time.




UNLIKE what happened in World Wars I and II, this time, our military leaders reason, there will be no time for America to rearm safely behind its twin ocean barriers. In this age of intercontinental atomic or hydrogen bombers, America's geographical isolation from possible aggressors means less than nothing.

Therefore, the argument goes, we must at all times keep our guard up, and be prepared to "go with what we've got" the moment an aggressor moves against us.

By logical extension, this means a continuous testing program. Every aerial weapon in our stockpile must be modified in line with every new scientific breakthrough; planes which were designed to carry conventional

World War II weapons must be modified to carry the weapons we will need if World War III occurs. By the same token, the next generation of military planes must be put through testing procedures while this rearming goes on. It is a continuous process of keeping our air strength as modern as we can to deter aggression.

Let us examine, for instance, the flight testing of a modern heavy jet bomber. Before this bomber left the manufacturer, it had already been flown to the limits of its design. It had been flown as high, as fast, as low, as slow, as its designers had predicted. Sometimes, even, this flight envelope is expanded by the aircraft firm which built it, before delivery to the military services.

Its electronic, hydraulic, flight control, fire control, landing and armament systems had been put through every test the makers could conceive. Before even the first prototype model had been flight tested, the airframe, engines and components had been subjected to severe static tests on the ground. Every piece of metal in the weapons system had undergone fatigue and heat tests. The aircraft's wings had been subjected to torsion and pressure loads tests to the point of shearing off.

Literally millions of man-hours and tens of millions of dollars were poured into the development of this particular jet-powered intercontinental bomber. All of this, of course, preceded actual delivery of flight models to the military service.

Once the Air Force had accepted the airplane, an entire new series of tests began. These were broken down into research and development testing; employment and suitability testing; and unit operational employment testing.

UNDER R. & D. testing, the Air Force establishes six phases:

1. Airworthiness and equipment functioning tests, to determine functional adequacy and insure that engineering specifications have been met.

2. Contractor compliance tests, to determine compliance with performance and handling specifications established in the contract.

3. Design refinement tests, to evaluate new design changes prior to incorporation in the production item.

4. Performance and stability tests, to obtain safety and operational instruction data on equipment committed to production.

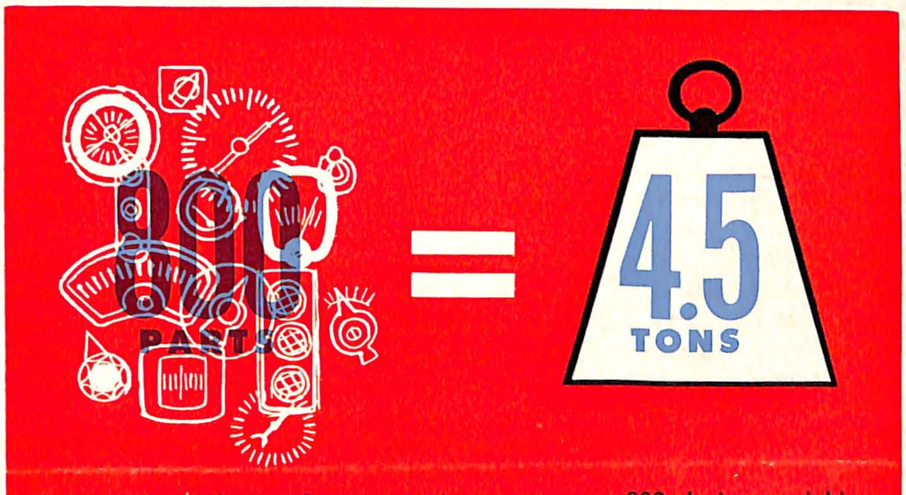
5. All-weather tests, to determine the capabilities and limitations under actual or simulated climatic conditions. This encompasses ground and flight tests under adverse weather conditions and provides adverse weather data for the handbook.

6. Functional development tests, to determine functional compatability, acceptability of maintenance qualities, and rate of parts consumption of the equipment. Also, to determine the adequacy of initial personnel skills and training requirements.

Employment and suitability testing is aimed at "evaluation of operationally configured equipment with its components, support items and personal skills under actual or simulated combat and climatic conditions," while unit operational employment testing is done "under actual field operating conditions with typical personnel and typical maintenance facilities."

THE intercontinental bomber has proved itself under all sorts of adverse weather and flying conditions. An experimental test pilot from the Wright Air Development Center who test flew the mammoth multi-jet bomber in the Arctic, made these observations:

"If the Air Force ever has to operate the big intercontinental jet out of Arctic bases, it wants to be sure the airplane will be ready and able. Let me tell you right now, the airplane will be.




An experimental aircraft may require as many as 800 devices weighing as much as four and one-half tons to record its performnce.

'PLANES'

"During the past 20 years, the Air Force and the industry have pretty well solved the problems of low temperatures at operating altitudes. But in low temperatures on the ground, each new type of airplane is likely to develop idiosyncrasies that have to be ironed out. We checked out what we could on the ground, then we took off and ran functional tests on all equipment in the air. What sort of things did we look for? Here are a few:

"Engines, gear, brakes, drag chute, control systems, air-conditioning, navigation and fire-control system: do they work after a thorough cold-soaking?

"They do—every one of them. That airplane is hot stuff, no matter how low the mercury dips."

ONE test, guaranteed to demonstrate how well the intercontinental bomber operates under icing conditions, involved sending a water-loaded flying tanker aloft at the same time the bomber was being tested. Fine spray from the flying boom doused the leading edge, and entered the engines directly. At the altitude flown, the spray turned into ice immediately. The bomber's crew reported that the aircraft can handle as much ice as will stick onto it, and keep right on flying.

Perhaps one of the most unusual tests ever devised for an aircraft is currently being conducted at a southern manufacturing facility. A mammoth transport plane has been submerged in an 18-foot deep tank of water holding 270,000 gallons.

Two skin divers make three to four 30-minute dives a day inspecting the outer fuselage of the transport while it is subjected to hydrostatic fatigue tests.

These hydrostatic fatigue tests—20,000 of them — seek to answer this question: how many high-altitude flights can a pressurized, 400-mile-per-hour turboprop transport complete before metal fatigue sets in?

Consequently, engineers are literally subjecting the ship to "more than a lifetime of flying" under water to find the answers.

Engineers now say that internal pressurization imposes a whole new series of stresses on high-altitude aircraft. This wear-and-tear factor is in addition to long-recognized in-flight "loads" of a continuous or spasmodic nature.

An easily understood example of the fatigue factor occurs when a closed tube of toothpaste is continually squeezed. Eventually, "fatigue" will cause the tube to rupture, and release the paste at the ruptured point.

Exactly the same type of fatigue affects the newest types of "sealed" aircraft after a large number of flights. The new turboprop and turbojet transports are internally pressurized for the comfort and safety of passengers who will in the near future be cruising in the stratosphere at 35,000-foot altitudes—nearly twice as high as present-day commercial transports fly.

Each time the jet craft of the future takes off and climbs quickly to high altitude, the fuselage expands slightly under internal pressurization. When the transport descends and lands, the fuselage contracts with depressurization. This happens in all pressurized aircraft, of course, but the effect is more pronounced on the newest high-altitude, high-speed planes which will soon enter service.

Consequently, the aircraft industry is conducting the underwater tests, which simulate the expansion-contraction cycle rapidly. One three-hour flight in the air requires only about one minute and 12 seconds under water for simulation.

This fatigue testing is, of course, only one of a series of major tests which must be made on any new airframe. Because of the complexity of the systems necessary to modern high-speed flight, the instrumentation required to test them is intricate to the Nth degree. This, in turn, means more time for testing to satisfy the increasingly exacting specifications for an up-to-date aircraft.

It is not at all unusual for an aircraft manufacturer to spend from 18 months to two years between production of a prototype model to production delivery to the customer. This time is needed for experimental evaluation testing of all the highly sensitive systems of an airplane under every conceivable flight condition.

During such experimental evaluation testing, as many as 800 dials, oscillographs, tape recorders, and television cameras are used to check out a new model. This instrumentation may weigh as much as four and a half tons on an experimental model.

FOUR and a half tons of instrumentation is exactly 12 times as much as the weight of the airplane that started it all—Orville and Wilbur Wright's 1903 Kitty Hawk model, which weighed 750 pounds.

Test engineers have also devised an "electrocardiograph" to check discrepancies between a pilot's report of a system malfunction in the air and static tests of the same system on the ground.

This new "in-flight recorder" not only monitors 26 systems of an aircraft, but monitors 26 elements of one of these systems as well. At the same time, it presents a graphic split-second report of each functioning system during the flight.

In effect, the in-flight recorder presents to the engineer just about what the doctor would give to his heart patient—an "electrocardiograph" or tape recording complete with undulating lines, which when interpreted, tells how each system functioned under any given set of aerodynamic load conditions.

THE manufacturer predicts that more than $500,000 in labor and flight operations will be saved annually by the in-flight recording system. Eventually, the aircraft manufacturer believes, the system will be standard equipment aboard commercial airliners. The "electrocardiograph" will provide operations at each route stop with a complete second-by-second history of the aircraft's flight, giving them ample warning to take corrective maintenance action.

Outside of the obvious answer that it must be tested to prove it will fly, there are several other not so well known answers to the question: Why are airplanes subjected to such prolonged and severe testing?

Customer satisfaction is one answer, but when the customer is America's national defense establishment, this answer is hardly enough. For the customer is, in this case, every American man, woman and child.

With aircraft which can fly 1,000 or more miles per hour now in military service, the problem of heat dispersion is getting growing attention from aeronautical engineers. The faster a pilot flies into the "thermal thicket," the higher the mercury readings become. At Mach 2, twice the speed of sound, the skin temperature of an airplane can reach 275 degrees. At Mach 3, it leaps to 650 degrees, and at Mach 5, hardened steel melts like butter in a frying pan.

Air conditioners powerful enough to cool a theater have been tested in experimental planes used for heat dispersion studies. For the pilot of any one of these latest ultra-high-speed aircraft is a mere human being, whose temperature range has definite limits. Every effort must be made to maintain the pilot inside his capsule, even though the outer skin of the aircraft is subjected to very intense heating.

Aircraft structures, if they are to stand up to the punishment encountered in this "thermal thicket," must also withstand static tests rivaling the tortures of the Inquisition. At a West Coast aircraft plant, engineers have devised a triple-torture test in which a metal ring, simulating a portion of an aircraft fuselage, is simultaneously heated, cooled and subjected to severe stress. The outside of the ring is heated to approximately 450 degrees by a battery of infrared lamps which encircle it. The inside is simultaneously cooled by cold air blown through perforated aluminum tubes, while hydraulic devices pull at the metal to simulate stresses which might be encountered in flight.

Aerial television cameras have been brought into the testing picture, too. In a recent series of flight tests on ski gear for a military cargo transport plane, a wide-angle TV camera was mounted in a clear plastic pod under the right outer wing. It relayed to the flight test engineer, riding in the cargo compartment, a continuous picture of the action of the skis on a ten-inch monitor screen.

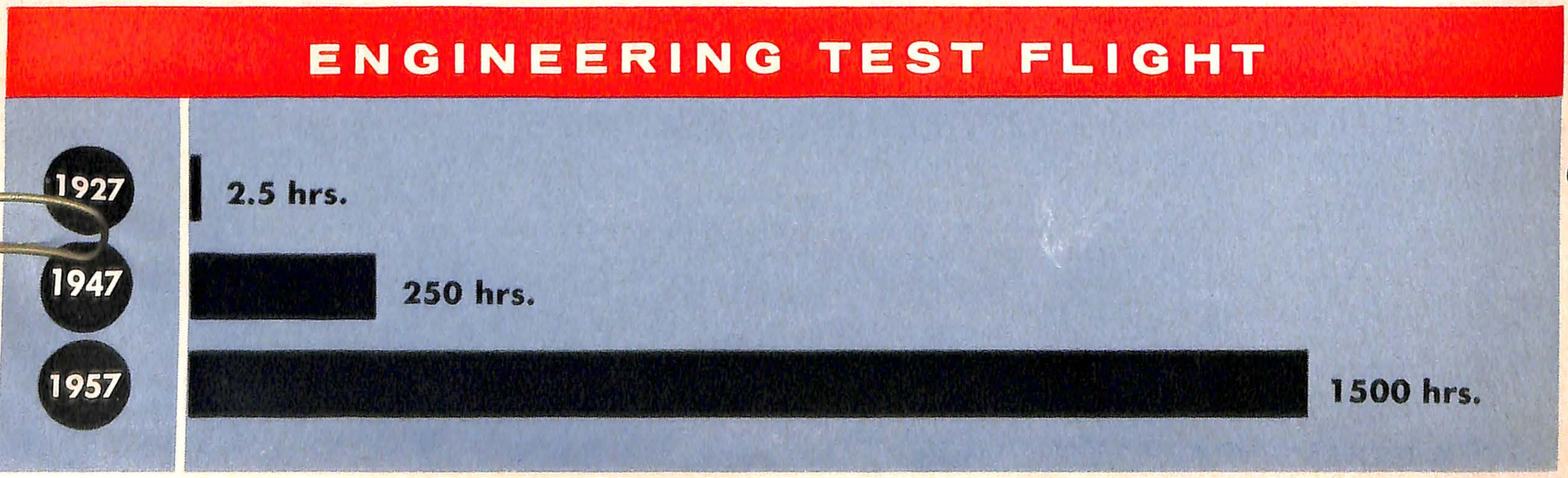
THE end result of all this testing, of course, is superiority in air power for peace or war.

An Air Force officer in the Air Materiel Command recently drew this comparison, which helps point up why today's airplanes are the best-tested product ever produced by man:

"Walk into the showroom of an automobile dealer, and pay spot cash for his most expensive car. Drive it out onto the street, and start down the road during a rainstorm. Dollars to doughnuts you'll wind up with wet socks. You've paid maybe $4,000 or $5,000 for the best automobile money can buy, and they haven't even made it waterproof. It leaks around the windshield.

"Then walk into an aircraft factory, and buy a fighter or a bomber. This baby has to go hurtling through the air at maybe twice the speed of sound while carrying enough firepower to wipe out Seattle or Detroit. And when it flies through a rainstorm, each raindrop hits the windshield like a rifle bullet. If that windshield weren't completely watertight, all our pilots would be blinded. But we haven't had a windshield failure yet, and I don't believe we will. The aircraft industry believes in testing the product before it reaches the consumer. Then we test it again. By the time it flies operationally, we know it's good."

It has to be good. In the final analysis, national survival may depend on its being good enough to do the job it was made to do.



# USAF Obtains Top Management

*(Continued from page 1)*

weapon. There is no other industry where greater demands are made on management. The military needs and demands the highest caliber of management. The day that we become content with second-class management is the day that we will start producing a second-class Air Force.

There are several different types of specific contracts used in Air Force procurement. The principal types are:

1. Firm Fixed Price
2. Fixed Price with Redetermination
3. Fixed Price with Incentive
4. Cost Plus a Fixed Fee
5. Cost Plus an Incentive Fee.

The Air Force, of course, would prefer to use the Firm Fixed Price type of contract in all its procurement. This type of contract is based on stable specifications, adequate competition with sufficient production experience to set firm prices. But these ideal factors do not always obtain. In these cases, redetermination and incentive clauses are utilized. A redetermination contract is based on a fixed price, but an option is reserved for future price changes. In many cases the final price is lower than the original estimate.

Both the fixed price and cost-plus with incentive contracts are widely used in our airframe purchasing. The incentive type contract is a particularly handy tool for rewarding superior performance. This provides a formula for computing the distribution of savings below or cost overruns above the original target costs. In the first production runs, this variance of savings or cost may be divided between the government and contractor on a 95-5 per cent ratio, the government retaining 95 per cent of the savings. As additional contracts are let, this ratio is usually increased with the division reaching as high as 70-30 per cent. However, in the later contracts, production techniques have been thoroughly developed and the contractor is hard-pressed in his search for new methods of reducing costs.

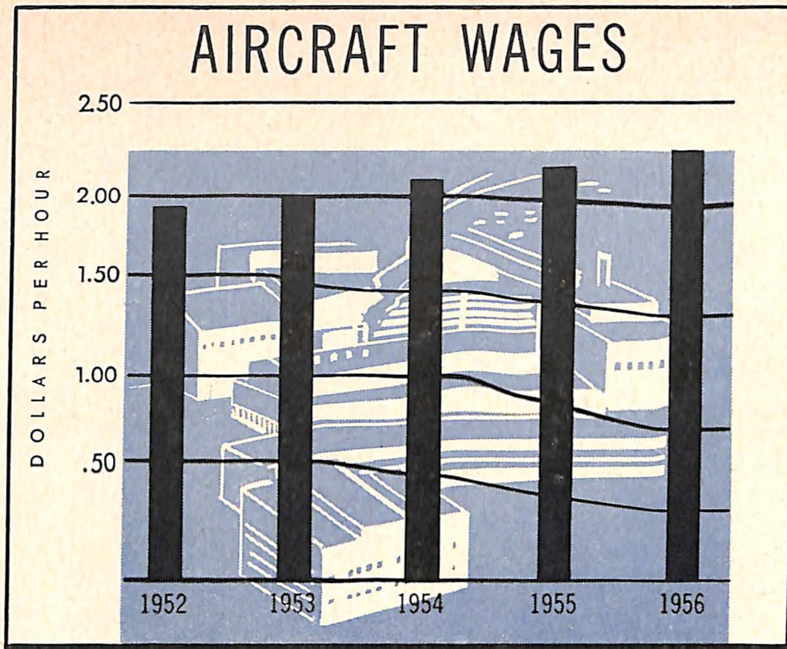
During national emergencies it is necessary to use contract short cuts to satisfy the war effort. These are not always economical. They have only the virtue of speed. In these emergencies we do need reviews of all elements of cost after the contract has been performed. Today, however, we are largely converted, in our contract techniques, to a stabilized peacetime economy.

Today's contracts are fair to the buyer and seller alike in the various situations that occur in Air Force procurement. They are fair because of a day-to-day review of costs which take into account the situation that existed at the time of a particular expenditure. Military procurement officers have worked intimately with many contractors over the entire period of the contract which, in cases of long production runs, may have a life of several years. These close relationships enable the Air Force to know the high degree of technical and managerial skills involved in each weapons system. A final review, taking into account all factors, is promptly made when the contract is completed.

The Air Force is engaged in a continuous program of encouraging its contractors to invest their earnings in additional facilities. These contractors would be necessarily chary of committing their investments into facilities for development and production of military materiel if they had to project their investments against the unknown quantity of a reassessment made years after contract completion.

The Air Force recently opened the USAF Advanced Pricing School at Santa Monica, California. Here we are going to give additional instruction to our procurement officers on sound pricing. Buying is a job requiring great skill and the Air Force wants professional buyers. Pricing and the type of contract used are interrelated and must be considered together. We are departing from blind reliance on the mathematical or accounting approach to pricing, based on what the product has cost to a more positive pricing philosophy of what the product should cost. The aircraft industry has been very cooperative in making the school a success. Representatives of industry are participating in the instruction and conferences. Air Force officers will visit plants to relate their pricing techniques to actual production processes.

There is one firm yardstick that governs every action by management: Will it reduce costs or economically improve the quality of the product? The Air Force, with its contract techniques, directs its efforts toward creating an atmosphere of incentive where every management decision will be measured by this yardstick.




**Wages for hourly workers in the aircraft industry have increased an average of ten cents an hour each year for the last five years. The higher skills required in the production of modern weapons systems have contributed to the increase in wages which, in turn, contributes to the higher price tag on new aircraft and missiles.**

**—PLANES**

# Remote Control 'Copter Possesses Memory

A highly sensitive "drone" helicopter which will execute commands transmitted by a ground controller, and which possesses a "memory" unit as well, has been developed by the U. S. aircraft industry.

The remote control system of the unusual helicopter was developed after four years of experimentation by an aircraft manufacturer under a joint Army-Navy program. Such experimentation is a normal practice in the aircraft industry, which continually seeks better performance for the nation's armed services.

One of the more unusual features of the system lies in its ability to "remember" an order and carry it out even though the ground control station is secured. The electronic signal will continue to operate the drone until another signal is received. In this manner, control of the 'copter can be passed on to a chain of control stations or to another airborne helicopter.

The drone helicopter demonstrated mounted a television camera in its nose, permitting the ground controller to carry out extensive reconnaissance over unfamiliar or enemy-held territory. Since the helicopter can be operated entirely by the ground controller without the necessity of its being manned during flight, it is expected also to be useful in aerial monitoring of areas damaged by nuclear weapons.

In addition to these advantages, the use of the TV camera would also enable the ground controller to land the helicopter safely in remote areas to deliver cargo, troops and supplies, or to evacuate the wounded.

# 'Flying Seat' Aids Safe Ejection

Development of a new pilot ejection system incorporating a "flying seat" with a "bug deflector" will permit pilots to escape safely from aircraft flying faster than 1,500 miles per hour, according to the manufacturer.

The parachute-equipped "flying seat" has complete aerodynamic stability and windblast protection, and will enable jet crew members to eject with safety at stratospheric heights and at speeds up to Mach 2 and as low as 400 feet at 850 miles per hour.

Extensive design evaluation and wind tunnel tests have already been successfully completed with one-tenth scale models, and full-scale tests are currently underway by ejecting the seat from the rim of a precipice at ultra-sonic speed by a rocket-propelled sled.

To operate the "flying seat," an air crew member need only pull up on a D-shaped ring located between his feet. From that point on, everything happens automatically. Knee guards snap into position to prevent leg spreading and to counteract the effect of outward airloads. Arm support webbing flips up to prevent outward movement of the arms while allowing airloads to offset inertia forces. Metal stirrups pull the feet close to the body and hold them securely until time of man-seat separation. Lateral head supports clamp against the sides of the helmet to relieve neck loads.

Immediately after the device has cleared the plane, the "skip flow generator" telescopes forward and the seat's side vanes swing open. The "skip flow generator" operates like a "bug deflector" mounted on the radiator ornament of an automobile—protecting the crew member from air blast damage in much the same manner that the "bug deflector" prevents flying insects from hitting a car's windshield.

The seat will then "fly" completely stable, until a parachute attached to the seat opens automatically at a predetermined altitude and airspeed. After the parachute opens, the seat separates and falls free.

## Big Move

**An idea of the enormity of air travel in 1957 becomes apparent with the confident announcement by a single airline that it will fly 2 million passengers to Miami before Jan. 1, 1958. This is the equivalent of flying the entire population of Los Angeles, Detroit or Philadelphia to Miami in a single year—yet this is the prediction of only one airline operating into the Florida resort city.**

# NATO Forces May Soon Be Equipped With U.S. Missiles for Defense

During the fiscal year 1956, the United States obligated approximately $2,500,000,000 as its contribution to the Mutual Security Assistance Program, and in the first six months, more than 50 per cent of those funds were for aircraft and aeronautical items, according to Air Force Lt. General Leon W. Johnson.

Speaking at a dinner sponsored by the Aircraft Industries Association for military attaches of the free world in Washington, General Johnson declared, "Of this $2.5 billion total, over $840 million were obligated or reserved by the Department of Defense for direct military assistance, and $1½ billion were obligated by the International Cooperation Administration for other than direct military assistance.

"During the first six months of 1956," he said, "almost $2 billion dollars worth of military equipment was shipped to nations cooperating in the mutual defense of the free world. Over 50 per cent of the value of the military deliveries was made up of planes and Air Force items. Some 40 per cent of this amount represented tanks, ammunition, artillery and other ground forces equipment. Ships, naval aircraft and other naval items made up the remaining 10 per cent. These deliveries brought the cumulative total of military equipment furnished to other friendly nations since the beginning (in 1949) of the mutual defense assistance program to a total of over $20 billion. This is a lot of money. In every day language, if a man went into business during "Year One" with $1 billion and lost $1,000 per day every day, he would be in business for 800 more years.

"The free nations of the world have," General Johnson continued, "as a result of our financial help, enormously increased their capabilities to defend their liberties. This increased capability on their part, together with our ability to retaliate instantly, has thus far deterred any would-be aggressor from striking against the free world.

"Our security depends in very great measure upon scientific and technological superiority. This superiority must be maintained, and in thinking of this it is well to remember that our partners have a vast reservoir of scientific and technological skills and facilities to supplement our own. Under one program, the United States helps them to maintain this reservoir by providing technical advice and limited financial assistance in work on selected projects initiated by scientists of European countries. Before too long, we hope to see the NATO forces equipped with more modern weapons, such as the 'Corporal,' 'Honest John,' 'Nike,' and 'Matador.'

"If we can maintain our strength and deter aggression, then we can move forward confidently into the unfolding nuclear age—thinking not so much in terms of the terrible destructive power of the atom, but rather in terms of its broad promise of a better future for all mankind. We can look forward to a new era of peace, freedom and justice among all men.

"In this respect: NATO today is a principal instrument poised for peace. NATO today binds over 450 million people together in one common objective—to be free and to live in peace. NATO today maintains the integrity of the most sensitive political line in the world—the 4,000-mile long line between it and the Soviet bloc."

## MATS Crosses Oceans 100,000 Times

In August, 1956, planes of the Military Air Transport Service passed the 100,000 ocean-crossing mark. This meant that the big transport planes operated by MATS have averaged an Atlantic or Pacific crossing every 48 minutes since the creation of the MATS command in mid-1948.

In 1956 alone, however, an unprecedented figure of one transoceanic flight every 23 minutes was set.

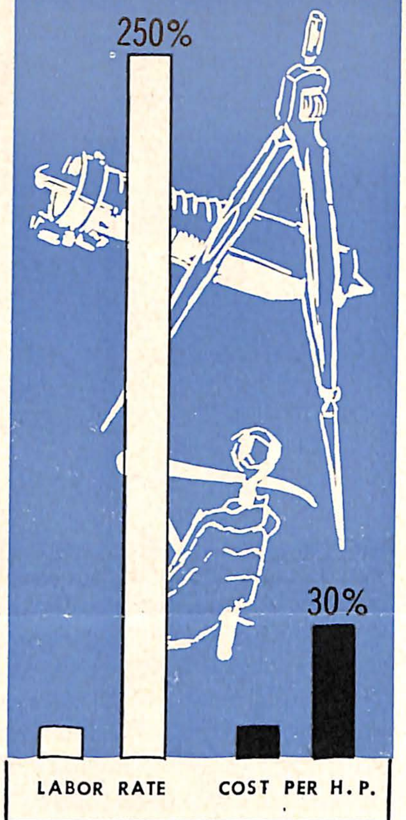
What helped establish this new record were upheavals in the Near East and in Hungary. MATS undertook spur-of-the-moment airlifting operations to deploy United Nations troops to the Suez area, and "Operation Safe Haven" in which thousands of refugees from Communist tyranny in Hungary were flown to new homes in this country. Both operations were completed successfully by MATS' global operations.

Lt. Gen. Joseph Smith, MATS Commander, declared that "these two airlifts, ordered on a moment's notice, are dramatic, first-hand proof that demonstrate the state of readiness maintained by MATS. Once again, the need for a combat-ready transport command trained to divert its activities quickly in the event of any emergency has been emphasized. Despite the operation of these two airlifts, the day-to-day mission of transporting military personnel of the Army, Navy and Air Force, plus patients, mail, dependents, and priority cargo, still was accomplished."

Over all, MATS transport, air rescue, air evacuation, weather, and other aircraft logged 1,190,000 hours during 1956—an increase of some 20,000 hours over record-breaking 1955. Once again, transport operations accounted for half the total.

Every hour of the day, MATS airlifted about 100 passengers and nearly 20 tons of cargo for all branches of the Defense Department. Accidents were reduced by 18 per cent over 1955 for an all-time low of approximately five accidents for every 100,000 flying hours. This is a tribute not only to the flying acumen of MATS airmen, but also to the superiority of the equipment flown by MATS, all manufactured by the aircraft industry of America.

## Designing Economy




**Cost reduction is a never-ceasing effort by the aircraft industry. This effort cuts across the entire operation of building superior air power. For example, the base labor rate of an engine manufacturer increased 250 per cent over a ten-year period, but the cost per horsepower produced during that time increased only 30 per cent. One important reason is the development of better tool and machinery designs. Production of a modern jet engine requires approximately 20,000 tools.**

'PLANES'

## Rugged Tests Prove Engine Reliability

A new turbopropeller engine which is slated to become standard equipment as the nation's airlines convert to the faster types of propulsion, has already proved itself hail-safe and chicken-safe.

Engineers testing performance of the new powerplant wondered what would happen to the engine in flight if it encountered a hail storm. They fired hailstones—some as large as baseballs—into the engine at 425 miles per hour. Through a series of 20 tests, they learned the powerplant was undaunted by hail.

Next, the engineers became concerned about the possible effect of flying a propjet through a flock of birds. They hurled a chicken carcass into the path of the engine. The propjet's compressor just gulped it down like a garbage disposal.

Suggested motto for the new jet engine: "Neither snow, nor rain, nor heat, nor gloom of night, nor chickenstorms, stays this engine from the swift completion of its appointed rounds."

## Light Waves Used for Measuring

How close is close? A research engineer for a major aircraft engine manufacturer has devised a method to measure with complete accuracy up to one-tenth of a millionth of an inch—approximately a 30,000th part of the thickness of the sheet of paper upon which this story is told.

Intense interest on the part of the United States government and the aircraft industry—in fact all major industry—in the new capability is acute because precision requirements of modern machining operations are demanding a degree of accuracy never before obtained.

Nature's own yardstick, the wave length of light, is the tool whereby this fine degree of measurement can be achieved. An industry-government research team is already at work devising a gage capable of gaging to one-tenth of a millionth of an inch. The project involves determining means to control temperatures to one-hundredth of a degree Fahrenheit; controlling humidity; vibration; and barometric pressure.

With the development of the new gage, a degree of manufacturing accuracy hitherto unknown will be available to industry. Precision of this caliber will result in longer life, more efficiency, ease of assembly and lower manufacturing costs of aircraft, aircraft engines, guided missiles and their components.

## Booklet on Aviation for Children

The implications of living in the jet world of tomorrow are vividly described in *Jets*, one of several booklets published by the National Aviation Education Council, a non-profit organization dedicated to strengthening the educational foundations of American youth living in the air age.

Graphically written, *Jets* points out all the skills, talents, and time required to develop, from a designer's dream, the sleek, streamlined, super-plus jet aircraft that will make tomorrow a twelve-hour world—a small world—but a good one, if the people in it are good neighbors.

Striking illustrations depict the varied processes involved in creating this latest aviation wonder—drawings based on what plane is to do, testing small model in wind tunnel, prototype flight by test pilot, and finally mass production utilizing the abilities of thousands of people. The booklet describes the mechanics of a jet engine in easy, understandable language, and the reader is left with the final thought, "How can you help this to be a better jet world?".

An excellent supplement to the study of social and physical sciences, *Jets* tells an exciting and informative story.

Designed primarily for the 10 to 14 age group, this two-color booklet may be obtained by writing to Dr. Evan Evans, Executive Director, National Aviation Education Council, 1025 Connecticut Ave., N. W., Washington 6, D. C. Price is 50 cents.