



July 28, 1958

Vol. 14, No. 7

planes

Airplanes • Missiles • Helicopters • Aircraft Engines • Spacecraft

OFFICIAL PUBLICATION OF THE AIRCRAFT INDUSTRIES ASSOCIATION OF AMERICA

★ All material may be reproduced with or without credit.
★ Mats of all charts available free.

SPACE PROGRAM EXTENSION OF AIR AGE

USAF Dyna-Soar Weapon Program Poses Great Challenge to Aircraft Industry

The most advanced weapon system under development today, posing the greatest challenge ever faced by the management and technical skills of the aircraft industry, is the U. S. Air Force's Dyna-Soar, a manned vehicle which will have orbital flight potential.

The magnitude and complexity of the Dyna-Soar program is such that major airframe, propulsion and guidance companies have formed teams to cope with the technological and management problems, pooling the best available talents.

Development contracts have been awarded to two teams of manufacturers, each headed by an airframe company.

The rocket-powered vehicle—a combination spacecraft, aircraft and missile—embraces speeds from 0 to 18,000 miles per hour. Eventually it could be launched from a base, climb to an orbital altitude with a final blast thrusting it into orbit

where it continues in a flight path through centrifugal force that equals the pull of the Earth's gravity. Dyna-Soar can break out of its orbit, re-enter the atmosphere through a boost-glide technique and land at any selected base.

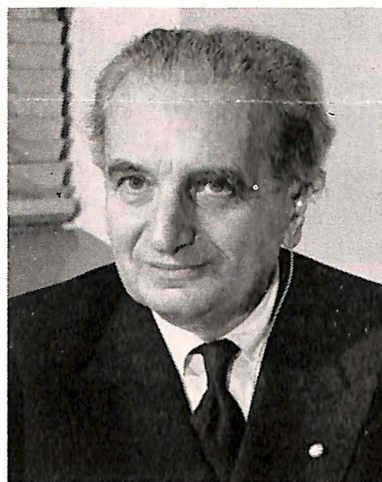
Dyna-Soar will have both reconnaissance and bombing capabilities. The higher altitudes will be used for reconnaissance missions and weapons can be fired and guided toward earth targets from the lower altitudes.

Based on technical studies started by an aircraft company more than five years ago, the entire weapon system program, despite its technical magnitude and the great development effort required, is feasible. Dyna-Soar is not a research project; it is a program aimed at producing operational weapons for the USAF inventory.

The technical problems involved are among the most challenging ever (See DYNASOAR, Page 3)

Solutions to New Problems Speeded by Experience with Aircraft

By Theodore von Karman



Dr. Theodore von Karman is the chairman emeritus of the USAF's Scientific Advisory Board, and served as its first chairman. He is also chairman of NATO's Advisory Group for Aeronautical Research and Development (AGARD). Dr. von Karman is regarded as one of the world's foremost authorities on aeronautics, and holds degrees from the University of Goettingen (Germany), University of California and Princeton.

It is natural that spectacular, new, scientific ventures should catch the public eye, particularly in the present impetus to "inaugurate the space age."

But the success of a few worthy projects in space technology has resulted in some extraordinary conclusions by a number of serious people, including scientists, engineers and industrialists. They seem to believe that most problems in the domain of so-called conventional aircraft or jet engines, which we considered quite important a year ago, are no longer significant.

There are few voices that have the courage to point out that the new age of space science and technology is essentially an extension of our activities in the same direction that science and technology followed in the last half century.

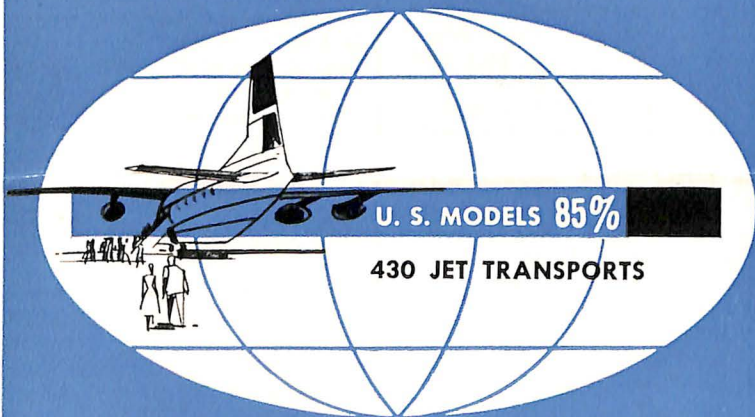
We like to talk of certain "barriers" to flight. The first was the sound barrier, although there never was a convincing reason why an aircraft should not fly faster than sound; ballisticians took for granted two hundred years ago that projectiles accelerated in a gun barrel would fly with supersonic speeds. Science trailed along behind, in that the ballisticians took the empirical point of view while theoretical aerodynamicists first achieved an understanding of the laws of supersonic flight in the early thirties. To be sure, the theory of supersonic flow in nozzles was considerably older.

Two more barriers were supposed to limit speed and altitude; the new barrier to speed was called the "heat barrier," due to the high temperatures developed by air friction at very high flying speeds; the barrier of altitude seemed to be given by the limits of functioning of air-breathing engines.

Space flight is not limited by either of these barriers. The heat barrier may cause serious difficulties when we want to re-enter the dense atmosphere of our own planet or enter the environments of other planets, moons, or stars. However, this is a transient process, whose duration can be limited, and many solutions are already promised. The altitude problem requires several developments; stretching of the possibilities of air-breathing engines to

(See von KARMAN, Page 3)

GLOBAL JET LEAD



Preference for U. S.-built commercial airliners is dramatically shown in the orders placed for turbojet transports by 39 U. S. and foreign airlines. The latest tabulation shows that out of approximately 430 jet transports on order for delivery starting this year through 1961, more than 85 per cent are U. S. models. This overwhelming endorsement is a tribute to the succession of safe, economical and comfortable transport planes designed and produced by the U. S. aircraft industry. The U. S. manufacturers have a global program of after-sales service to customers that insures continued safety and maximum operational time for their aviation products.

'PLANES'

'Strongback' Rig Tests Aircraft Fuselage

High performance requirements of aircraft and missiles call for the most intricate testing equipment used by any industry today—equipment that can measure in millionths of an inch or exert pressure in hundreds of thousands of pounds.

One of the largest testing rigs is the "strongback" which can hold the wing or fuselage of our largest jet bombers by one end only, leaving the entire length freely suspended for test loading.

This massive testing instrument required 2,700,000 pounds of concrete and steel in the foundation alone. The 11-foot thick foundation rests on 196 piles driven deep into the ground. Above the foundation, the strongback is 40 feet wide, 25 feet high and 8½ feet thick.

Temperature, loads and deflections are measured by gauges, deflection indicators and thermocouples. The readings are recorded automatically and electronic computers give the results in terms of "what happened."

PLANES

Planes is an official publication of the Aircraft Industries Association of America, Inc., the national trade association of the designers, developers and manufacturers of aircraft, missiles, spacecraft, their propulsion, navigation and guidance systems and other aeronautical systems and their components.

The purpose of *Planes* is to:

Foster public understanding of the role of the aviation industry in insuring our national security through development and production of advanced weapon systems for our military services and allies;
Foster public understanding of commercial and general aviation as prime factors in domestic and international travel and trade.

Publication Office: 610 Shoreham Building, Washington 5, D. C.
New York Office: 150 East 42nd Street, New York 17, New York.
Los Angeles Office: 7660 Beverly Boulevard, Los Angeles 36, California.
ALL MATERIAL MAY BE REPRODUCED WITH OR WITHOUT CREDIT
—MATS OF CHARTS—PRODUCED IN UNITS OF STANDARD NEWS-
PAPER COLUMN WIDTHS—ARE AVAILABLE FREE UPON REQUEST
Editor: Gerald J. McAllister Art Director: James J. Fisher

Cost Reduction Barriers

By Orval R. Cook

President, Aircraft Industries Association

The ever-increasing complexity and cost of modern aircraft and missiles, dictated by military requirements for higher performance, has widened the circle of specialized skills required to develop and manufacture the thousands of components that go into the end product.

Today, prime manufacturers of weapon systems are even more dependent on the unique skills and ingenuity provided by small business firms. These companies, because of their size and normally lower overhead, often are able to produce a specific item more efficiently than larger firms.

This is the main criteria used by prime manufacturers in selecting subcontractors: The ability to produce, on schedule, a quality product at the lowest possible cost.

Defense appropriations are relatively high, but the amount available in relation to the job that must be done is not over-abundant. The Defense Department properly demands that defense contractors exert very effort toward better pricing. Prime contractors must demonstrate more than technological competence to win contracts for modern weapon systems. All defense producers, large or small, must recognize that minimum cost production is a prime consideration to their staying in business. Competition for contracts is becoming even more intense, and prime contractors must select their subcontracting teams with a constant eye on the price tag.

But cost reduction efforts of both prime contractors and their subcontractors are being hamstrung by artificial barriers.

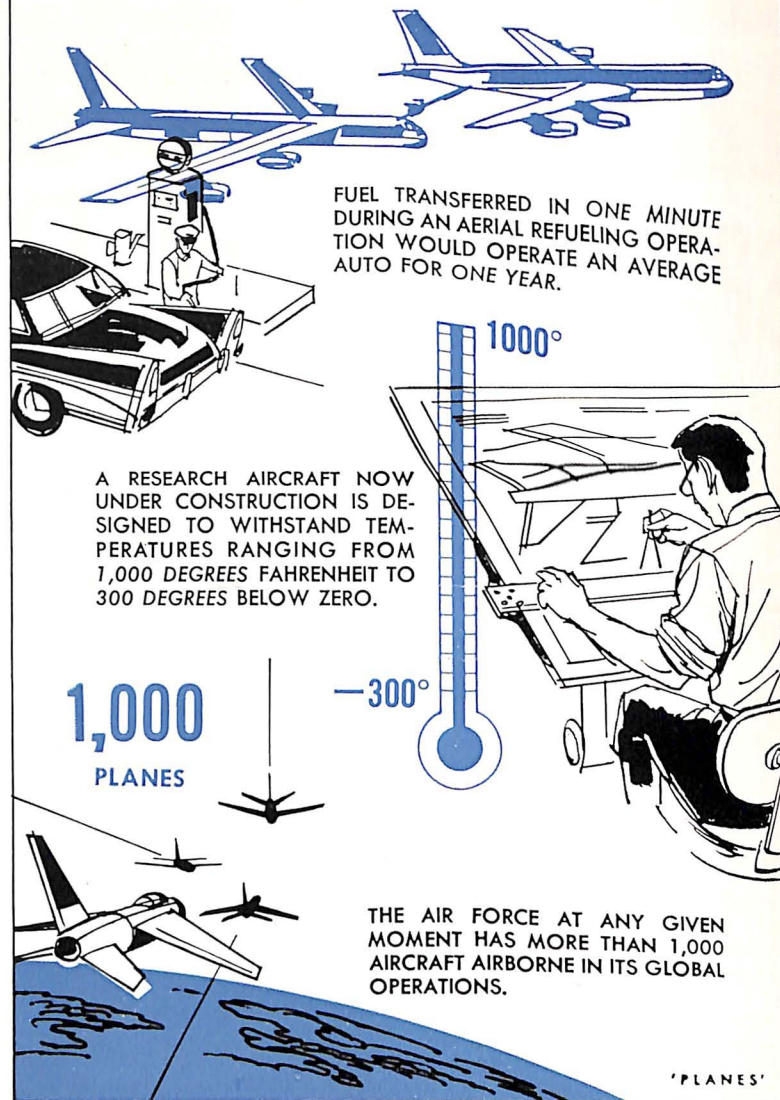
Two of these obstacles are the Renegotiation Act and the question of proprietary rights on new designs. These are problems which affect small and large firms alike, but in some cases the effect on small business is more pronounced.

There have been cases where a prime contractor has been penalized because of a renegotiation regulation which states that a company which subcontracts work "may not reasonably expect to be allowed as large a profit thereon as if it had done the work itself." Economic logic would seem to dictate the contrary: That the prime contractor who can save the government money through placement of an efficient subcontract should be rewarded rather than penalized. The practice provides little incentive for expanding the area of small business contribution.

The small businessman should also be afforded protection for designs developed within his company. Such design data is his stock in trade and should not be circulated among his competitors. Failure to provide adequate protection of proprietary rights is a deterrent to incentive and, as such, a stumbling block to progress in the vital area of research and development.

In the aggregate, small business represents a segment of national defense as important as the prime contractors or the users of weapons systems. Every effort should be made to insure complete utilization of the special skills they possess and any steps that can be taken to increase their productivity are steps toward an even more efficient defense manufacturing system.

Plane Views



Airlines to Determine Depreciation Rate

Airlines management will be permitted to determine depreciation formulas for aircraft spare parts and equipment without regulation by the Civil Aeronautics Board, according to a recent Circuit Court of Appeals decision.

The ruling struck down a CAB order which required airlines to change their depreciation policies, and had the effect of increasing the amount of money the carriers would be forced to keep tied up in equipment.

A similar CAB depreciation order involving aircraft is now before federal courts. If the decision on this order follows the reasoning in the spare parts decision, it will permit airline management to determine depreciation formula by the soundest estimates of competitive effectiveness of aircraft in use, financial capabilities and technological advances.

These cases are significant in the light of the financing problems facing the airlines on the eve of the jet age.

The Circuit Court said that the Civil Aeronautics Act did not authorize CAB regulation of depreciation policy, and Congress did not intend CAB to assume this power.

AIR QUOTE

"... I continue to feel encouraged by our own industrial strength. The fact that the productivity of the American worker is four times as high per man hour as that of the Soviet worker is in itself an indication of our present superiority. We must maintain this superiority.

"Militarily, we have the most powerful retaliatory force in the world for use if an all-out war were forced on us. We also have the means of meeting quickly the needs of any aggression less than general war. Our weapons development programs must be pushed vigorously to insure that we maintain these forces strong, modern, and ready. Here is where the advances of the space age will help.

"However, we cannot discard weapons systems of known reliability until the new systems have been proved out. So, our problem involves reconciling our readiness today with our readiness of tomorrow. Until we know more, we need to be extremely cautious before we can claim that control of space necessarily means control of the atmosphere, sea and ground."—Gen. Nathan F. Twining, Chairman of the Joint Chiefs of Staff, July 1, 1958.

von Karman Cites Science Needs

(Continued from Page 1)

higher Mach numbers and lower densities than are accepted nowadays, more scientific developments of rockets and "unconventional" propulsion methods like plasma-jets, the exploitation of secondary power sources such as solar energy and electric and electromagnetic fields for particle acceleration.

I do not see any point in these developments which would indicate that:

a) our aeronautical research institutions, such as the National Advisory Committee for Aeronautics, the university and industrial research laboratories cannot do the basic and exploratory research and the collection of theories and facts, as they did with such evident success in the domain of flight within the atmosphere;

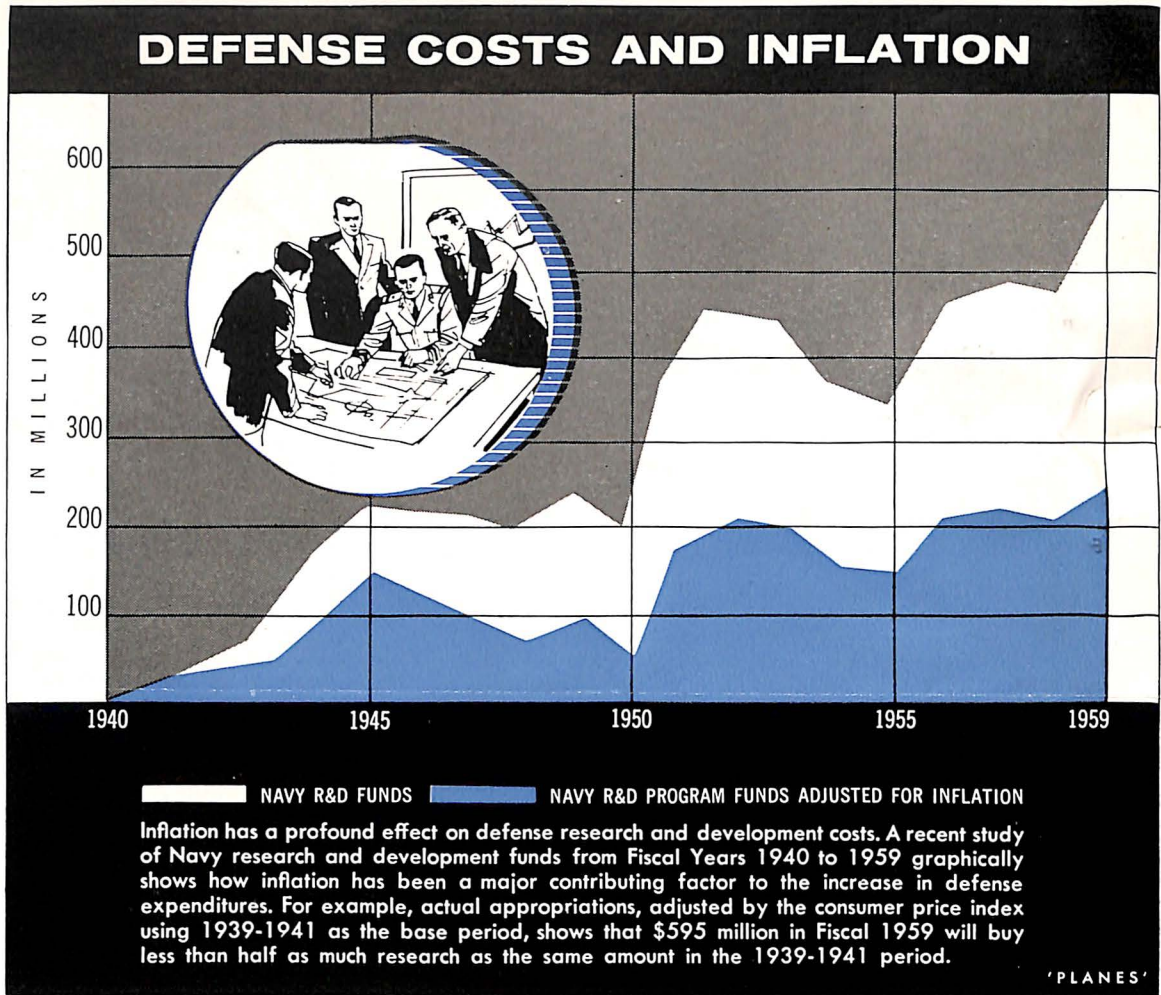
b) the military services should not consider the new activities as a natural extension of their missions and carry out the operations within the framework of their command system;

c) the aeronautical industry should not undertake the design of prototypes and production of standardized items on the same basis as they developed radically new types within the limits of atmospheric flight. I am also convinced that the solution of the new problems will be greatly facilitated by use of the experienced staffs of the companies now engaged in aircraft and engine design and production.

It is, I believe, a natural conclusion that the best way of administering space projects would be the utilization of an agency like the National Advisory Committee for Aeronautics, which presently combines long experience in administration with far-reaching vision for future developments.

Of course, we aeronautical engineers have to broaden our views and fields of investigation. In addition to thermodynamics, which has always been involved in the problems of high-speed flight and engine design, we have already combined aerodynamics with chemistry for the solution of combustion problems especially in jet engines and rockets. I suggested the term "Aerothermochemistry" for this branch of the aeronautical sciences, and aerothermochemistry has become more and more important because of the chemical changes—dissociation and recombination—occurring in flight at the frontiers of the atmosphere. Finally, we have to renew and expand our high school knowledge of astronomy, and perhaps devote time and thought to a new branch of fluid dynamics: "Magnetoaerodynamics."

However, those who would say that all that we teach and all that we investigate under the name Aeronautical Engineering is obsolete, seem to assume that by some miracle the designers of space vehicles will not encounter problems involving such classical sciences as fluid mechanics, structures, materials, and vibrations: I am sure that this will not be the case.



Dyna-Soar To Have Orbital Potential

(Continued from Page 1)

faced by the aircraft industry. Dyna-Soar must operate effectively at its maximum or near-orbital speed of approximately 18,000 miles per hour, and also at the very low speeds necessary for landing. It combines the latest aeronautic and astronautic advances.

Here are some of the other problems:

Thermodynamic heating as the Dyna-Soar re-enters the atmosphere.

Precise control of the tremendous power generated by its rocket engines.

Provision for its crew to operate the weapon system while being subjected to very high "G" (gravity) forces, and later to function in weightless, airless medium.

Automatic navigation and guidance with the pilot responsible only for command decisions.

No single manufacturer possesses the vast scientific skills necessary for successful completion of the Dyna-Soar program. But by pooling proven talents, under the direction of a team "captain," the full force of highly specialized abilities can be fully utilized. This is the same general plan the Air Force has been using in its weapon system concept of contracting for modern weapons. The Air Force, in effect, buys the technical management available in the aircraft industry, and turns the detailed job over to them under USAF's general policy and technical guidance.

Costs of new weapons will continue to rise in a degree roughly

USAF Ballistic Missile Report Is Comprehensive Study of Largest Peace Time Military Program

The USAF Report on the Ballistic Missile is a comprehensive study of the "largest military development program ever undertaken by this country in peacetime."

The authors are Air Force officers directing the ballistic missile program, and the 12 chapters cover the IRBM's and ICBM's from design to manufacture and operational employment. The weapon is placed in its true military perspective, and there is a welcome absence of wild claims concerning its capabilities.

For example, Colonel Claude E. Putnam states that the "inherently limited flexibility of missiles must be offset by the more flexible manned airplanes, and programs must be implemented in such a way that missiles are integrated without creating even a temporary hiatus in our day-to-day combat capability."

Regarding the new industrial facilities required for development and production, Maj. Gen. Ben I. Funk says, "... there has been a demand for highly specialized facilities that would be of no value to a contractor for other work. Defense

comparable to the gains in performance. Tomorrow's weapons, as exemplified by Dyna-Soar, could be prohibitively expensive without the unified team approach.

This pioneering of systems management is paying dividends in national security and economical defense budgets as we move into the space age.

contractors normally are unwilling to invest large amounts of their own capital under such high risk circumstances. . . . Yet, the Government has provided to the total of all contractors in the ballistic missile program a smaller dollar amount of industrial facilities than was previously provided a single Air Force contractor for facilities in support of an aircraft engine program. Contractor investment (\$100,000,000) has been substantial, in spite of the fact that the work to date has been principally developmental and that no contractor has complete assurance he will be given a contract for quantity production."

"Report" is must reading for a clear, precise account of ballistic missiles. It is available through the Airpower Book Club, sponsored by the Air Force Association at a 10 per cent discount to members. Publisher is Doubleday & Co., and the cost is \$4.00.

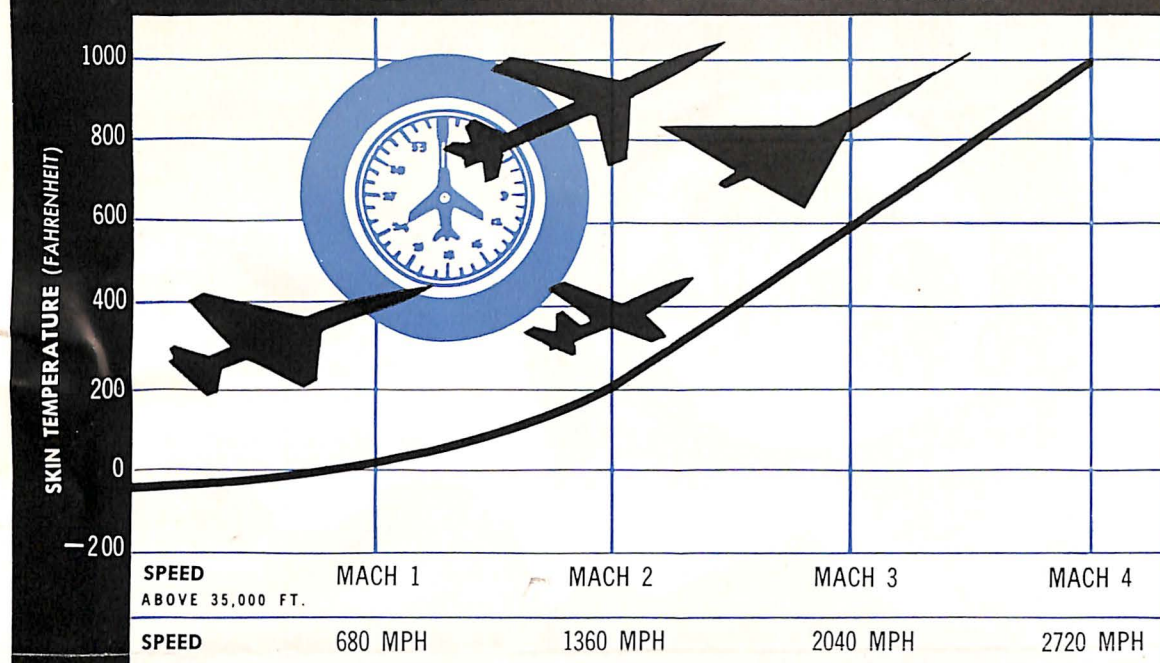
Versatile 'Copter Gives D. C. Traffic Report

Radio-listening rush hour drivers in Washington, D. C. get their traffic reports from a unique source—the helicopter!

A traffic expert covers all of the principal arteries into and out of the Capital from a helicopter which whisks from point to point.

From this unusual vantage point, he informs the public about road conditions and the traffic situation that lies ahead.

SPEED AND TEMPERATURES



The rapid increase in skin temperature as aircraft and missiles reach multiples of the speed of sound is one of the prime problems of design engineers. At the speed of sound, the skin temperature of an aircraft flying at 35,000 feet is less than 50 degrees Fahrenheit; but at four times the speed of sound (Mach 4) the skin temperature is 1,000 degrees Fahrenheit. Vigorous research programs of the aircraft industry are solving these problems by discovering new metals and alloys to endure these high temperatures.

PLANES

Water-Soluble Glass Proves Economical Coating in Titanium Alloy Treatment

Two aircraft industry engineers have discovered a unique use for a formerly worthless material. Material: Water-soluble glass. Use: Protective coating in heat treating titanium alloy.

When titanium is heat treated in an air furnace at 1,700 degrees Fahrenheit, it is subject to contamination from gases in the air, which cause embrittlement and scale. Formerly, an aluminum-silicone paint coating was used to prevent gas contamination. This involved a long, tedious process (about 30 hours), and the protective paint sometimes proved stubborn to remove, causing the titanium sheet to be badly etched.

Searching for a more efficient method of heat-treat protection, two research engineers came up with a new protective coating made of water-soluble glass—a material which was formerly useless to industry. The new coating process is applied easily and cheaply and protects the titanium sheet from contamination during heat treat. It is fast drying and easily removable afterwards.

The water-soluble glass in powder form is added to a binding agent and then held in suspension in a liquid. Using the new mixture, titanium sheet is given two or three spray coats and then popped immediately into the furnace—an elapsed time of *one* instead of 30 hours. After heat treat and quench, the coating is removed in a caustic soda solution in half the time possible with aluminum-silicone paint.

Besides the shortened flow time, the coating can be patched if it becomes scratched prior to heat treat. (No satisfactory method could be found to patch aluminum paint coating; the panel had to be stripped and repainted). No etching of the titanium is apparent and protection against contamination is better than before.

All these things add up to a better product at less cost.

When sprayed on a titanium sheet, the new coating looks like white paint. During heat treat, the organic materials burn off and the glass fuses. On removal from the furnace, the titanium sheet appears to be encased in a transparent glass envelope.

Electrolytic Grinding Cuts Tool Costs

A new electrolytic grinding system in a U. S. aircraft plant has cut tool grinding time by more than one-third; grinding wheel replacement has been cut 90 per cent, and tool life has been considerably increased.

The new method is an application of an old principle—electroplating, but with one important difference. The metal removed from the part being ground is not deposited on the grinding wheel as in conventional electroplating. Instead, insulating abrasive particles, imbedded in the face of the steel wheel, speed the removal of metal from the part, prevent metal buildup on the grind-

Novel Device Solves Trouble with Bubbles in Potting Compound

Aircraft industry ingenuity has now come up with a device to eliminate "bubble trouble" in insulation material for aircraft electrical components.

A potting compound applied around terminals and connections and used for filling electrical plugs, provides both strength and insulation. But before the compound can be used, small air pockets within it must be eliminated. Otherwise, these bubbles could expand when the airplane reaches high altitude. The bubbles could form air passages large enough to contain small particles of moisture and cause short circuits in high-voltage lines.

An aircraft company devised a unique container to eliminate the troublesome bubbles while the compound is being mixed. The two-gallon container is specially rigged with a vacuum unit, so that air is drawn out the top while a small propeller-type agitator stirs the compound. A tube installed at the bottom drains out the air-free mixture. Result: Trouble with bubbles ended!

ing wheel, and provide precision control of metal removal.

An electrolytic fluid flows between the tool and the wheel, and a high ampere, low voltage current serves to dissolve or de-plate the tool. Fully automatic controls regulate current density, and material is removed far faster and with much greater precision than is possible with conventional grinding methods. In addition, a finer cutting edge and higher finish is produced.

'Pilot Shop' Tests Production Ideas

A miniature "factory within a factory" is now in operation at one aircraft company which will save time and money in researching new manufacturing techniques.

Called a "pilot shop," the new area will act as a proving ground for the producibility of a drawing board design, speeding design off the drawing board and into shop production efficiently and economically.

Under former methods, manufacturing research engineers went into production areas to work out production problems. This was expensive and sometimes conflicted with current production efforts. With the new shop, engineers can pull much research work out of production areas.

The pilot shop occupies some 4,000 square feet and is well equipped to simulate actual factory production, including a plastics and ceramics area, machinery for sheet metal research, brazing furnaces, and equipment for perfection of other manufacturing efforts.

Producibility studies are conducted in brazing, bonding, plastics, ceramics, sheet metal, welding and machining. Most studies are brought together in a centralized location, and production problems are ironed out in a systematic and orderly fashion.

When a new technique is perfected, the pilot shop then becomes a training ground. Shop people who will use the new techniques are brought into the miniature factory and shown how to apply the new development.

Manufacturing research engineers then provide follow-up assistance to the factory until the technique becomes a routine operation.

Advanced weapon systems designed by the aircraft and missile industry require imaginative manufacturing techniques for efficient, economical production.

250,000-volt X-ray Speeds Inspection

A 250,000-volt X-ray tube recently installed in a U. S. aircraft plant is speeding up the inspection of parts and metals ranging from very thin aluminum to stainless steel 1½ inches or more in thickness.

The X-ray machine is used to inspect the welds of missile ground support equipment, aircraft control surfaces and miscellaneous parts and assemblies. It is housed in a room lined with lead ¼-inch thick, covering 1,468 square feet and weighing 21,653 pounds.

Safety in operation of the X-ray equipment is a prime concern of the inspection department. Safety switches prevent operation of the X-ray machine until the doors are closed.

Switches also are used in the darkness to prevent the door from being opened inadvertently, causing damage to film during processing.