RESEARCH FACILITIES CUT PLANE COSTS

USAF Cites Need For Top Talent

The aircraft industry must attract and retain the best managerial talent, or the United States will face the likelihood of a second class Air Force which invites "catastrophe," Dudley Sharp, Assistant Secretary of the Air Force, declared.

In a recent address before members of the National Security Industrial Association in Washington, Secretary Sharp, who directs USAF's huge multi-billion dollar material program, said that the Air Force considered the industry profit structure and compensation of aircraft executives both necessary and just. Both items have been subject recently to debate on Capitol Hill.

"In negotiations with the industry," he said, "the Air Force gives detailed consideration to all elements of cost, including profits. The experience USAF has gained throughout the years in aircraft production is used to measure costs and to estimate as accurately as possible what the cost of an aircraft should be. Air Force officials have developed sound statistics, such as the learning curve, for estimating and negotiating costs, and constantly review, evaluate, and modernize these yardsticks to further adapt them to the even more complicated aerial weapons of the future."

"In our negotiations," Secretary Sharp explained, "we do not attempt to establish the profit factor by formula. We believe that the profit allowance of each contract must be negotiated in relation to the value of the particular job to be done. We encourage use of the profit factor in such manner as to induce the contractor to perform more efficiently than he otherwise might, by affording him an opportunity to earn more profit thereby. Since costs represent the greatest portion of price, use of the profit incentive to exert pressure on costs results in the greatest savings to the Government."

"Flat rates of profit or preconceived percentages," he declared, "must be avoided, for, in the long run, such concepts tend to increase the cost reduction program, from which we benefit significantly."

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Aircraft Industry Continues To Show Progress In Development Of Jet Engine Suppressors

Confounding the old proverb "silence is golden," the U.S. aircraft industry is investing considerable effort, time, and "gold" to achieve noise reduction in today's powerful jet engines-and with encouraging results.

One aircraft company, for example, has embarked on a specific program to develop a noise suppression device for their jet transports, involving several coordinated tests programs with both small and full-scale nozzles.

The jet engine nozzle is the opening at the rear of the engine through which the tremendously expanded gases developed within the engine escape. These expanded gases ejected outward through the nozzle, give the engine "thrust" power.

A series of acoustical and thrust tests conducted by the aircraft company indicated that considerable engine sound abatement could be achieved by modifying the shape of the nozzles.

In the first small-scale tests, greatest noise reduction appeared to be associated with deeper grooves or greater periphery at the nozzle exit.

Several scale-model nozzles were then made which increased the periphery and to which many bars or wedges were added to further increase the rate of mixing the jet exhaust. Tests with these nozzles showed that considerable noise reduction had been achieved.

Further tests with full-size nozzles on an actual engine, set up in a test cell, revealed the need for refinement of the nozzle shape at the plug. Additional nozzles to accomplish this are now under construction.

When the "silencing nozzles" were tested in a high-speed transport prototype airplane, the results showed reduction in maximum noise up to 15 decibels over-all and 20 decibels in the lower frequencies. This reduction in the low frequencies was very

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New Wind Tunnels Prime Need

Qualitative superiority of U.S. airpower, the keystone of our national defense program, is maintained through three major activities of the aircraft industry:

1. Substantial research and development programs.
2. Incorporation of changes in production aircraft to boost performance.
3. Production of new models to replace older production aircraft.

The basis of qualitative superiority in airpower is research and development. While the battle of the laboratories will be as significant as armed battles were in the past, today, the aircraft industry spends more money on research and development than any other segment of the U.S. industrial structure, and employs approximately 25 per cent of all research and development personnel working in all industries.

Despite this record, more and more research and development facilities are needed to meet Russia's technological challenge.

The cost is high. A supersonic wind tunnel costs approximately $1,500,000. The aircraft industry is plowing back large amounts of its earnings to finance these facilities. The record of one airplane manufacturer's expenditures on company-sponsored research and development illustrates the ever-increasing gains. In 1950, the company spent $337,000 on research and development; the expenditures in 1955 mounted to $4,400,000—an increase of 793 per cent in five years.

The use of research facilities, despite their high cost, produces eventual savings in the production of aircraft. The military requirement for high performance aircraft has created major technical problems. A combination of greater engine thrust, extraordinary stresses, thinner wings and new configurations permit vastly increased speed. But the speed in turn generates a host of problems, such as disintegration of aircraft skins due to high temperatures. Problems in testing and controlling and stabilizing the plane in flight and preventing structural break-up while maneuvering at high speeds.

The solutions to these problems must be found as early as possible. They can be solved by analytical

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The Immutable Factor

America has always relied upon the genius of industry and labor to produce in gigantic quantity all the things it needed to enjoy its present and national peace-time standard of living. In wartime, with equal reliance, it has depended upon industry to produce weapons and materials needed by our military forces in such abundance that we have even been able to supply much of the equipment needed by our allies.

However, we forget that it took the aircraft industry and other major industries of this nation more than two years to divert, expand, gird and marshall its productive efforts to meet the war emergency.

In industrial parlance the immutable factor of productive effort from design to quantity production is lead time—the time it takes to get something done after the decision is made to do it. Time then is the priceless ingredient. Time is the common denominator for all activities in peace or war—here, and in Russia.

The Soviet Union is challenging and may be expected to continue to challenge the technical position on which our aeronautical first line of defense is based. They have cut lead time required for aeronautical weapons development by exploiting four basic concepts of operation unique to Soviet philosophy and economic policy.

First, their development program is dictated solely by military expediency with complete disregard for the requirements of a free economy. They can and do make unilateral decisions at the highest level without fear of political consequence.

Second, they can devote any desired amount of their budget to military programs.

Third, Russian policy is to design and standardize one weapon for one specific purpose.

Fourth, the Soviets definitely hold the initiative in starting a war and therefore, are free to concentrate their efforts on specific programs required by their war planners.

In light of these sobering facts, the United States must make an all-out effort to maintain our still existing technical predominance. Next, we must improve our research and development capabilities by improving our nation’s educational facilities and stimulating in youth the desire to pursue scientific careers.

Thanks to the efforts of the aircraft industry, this nation, so far, still possesses qualitative and technological superiority in aircraft. This has been stated repeatedly by our military leaders. But of grave importance to our national security these days is the incredible rate of progress being made by the U.S.S.R. in achieving a capability to design, develop and mass produce superior air weapons.

The United States has clear warning that it can no longer be complacent in going about research and development of new and radically improved aerial weapons. Only by continually advancing the state of the art and by an aggressive development program utilizing the latest findings of basic research, will the aircraft industry be able to maintain technological superiority.

But to achieve these ends, the aircraft industry must expand research and development of its current programs and be given more latitude in exploration of radical and revolutionary weapons.

This can only be accomplished by the enlightened support of the American public and its representatives in Congress. To maintain aeronautical supremacy will cost money. But if we do not face up to the reality that Russia is fast closing the gap, we may soon be outdistanced by them in the race for technological supremacy.
Sharp Describes High Reinvestment Of Industry Earnings In Facilities

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Gun Camera Adjusts Like Human Eye

Shutter bugs will envy a new motion picture gun camera developed by the aircraft industry for fighter pilots.

The camera is capable of automatically adjusting itself to varying light conditions much like the human eye to control the amount of light reaching the film. Correct film exposure is insured.

The new camera automatically compensates for light changes during combat through the use of a neon light which shines at a constant intensity on the camera shutter which is coated with selenium. The reaction of the light on the selenium sets up an electrical impulse. At the same time, sunlight enters the camera lens and shines on the selenium-coated shutter producing a second electrical impulse. A miniature computer inside the camera picks up the two impulses and compares them 64 times per second. If the impulse set up by the sunlight varies from the neon-produced impulse, the computer adjusts the lens opening until the two impulses match, the correct amount of sunlight is entering through the lens.

Adjustments can be made through the seven lens openings — f 2.8, 4, 5.6, 8, 11, 16 and 22 — to an accuracy of within one-half stop in just 1.8 seconds.

Research and development programs of the aircraft industry are constantly producing better, more effective guns. These new guns are designed to counteract from numerous mechanical functions.

Gun cameras are standard equipment on fighter aircraft. They are used to record the effects of gunfire and the maneuvers of enemy aircraft in combat. They start with the firing of the guns and are generally located in the wing or on the gun sight.

are already apparent, as evidenced by the fact that aircraft companies are planning to make substantial investments in research and production facilities.

In connection with the salaries and fringe benefits accorded top aviation executives, the USAF’s top material executive stated: “One of the areas in which we have some times been criticized is that of executive compensation in the aircraft industry. Here we have a very real problem, because the Government is almost the exclusive customer. At the same time, we must recognize that it is vital that aircraft companies be in a position to attract and retain top flight personnel to plan, direct and execute courses of action which will give us complex weapons we require to maintain air supremacy. Aircraft are just about the most technically complex articles in production in this country today.

For this reason, we need the very best available brains to perform the research, engineering and production of these complicated items. Unless the aircraft industry can attract and retain the best managerial talent, we are faced with the likelihood of a second class aircraft industry, manned by second rate people, producing second class aircraft. And a second class Air Force invites catastrophe. Initially, at any rate, each company must determine for itself what amount must be paid to attract and retain top flight executive personnel necessary to provide successful production of such an important product.

To a very great extent, we are forced to rely on the operation of our competitive economic system to establish generally, the levels of executive compensation in the aircraft industry.”

Everything Goes Up — Except The Fares

Commercial air travel, which soared to new highs during 1955, dropped in one important aspect — ticket costs to passengers.

The level of average air fare in 1955 remained just about where it stood in 1938, but in terms of 1938 dollars the average air fare was slashed by about 60 per cent.

The travel public’s ability to spot a bargain is indicated by the phenomenal gain of almost 10,000 per cent in revenue passenger miles since 1933.

During 1955, the nation’s scheduled domestic airline fleet flew a combined 5.6 billion dollar mark in total operating revenues, and the airline industry offered four times as many available ton miles last year as in 1946.

The aircraft industry has provided the airlines with a series of new transport models that carry more passengers at greater distances. Jet airliners are scheduled for delivery in 1958.

Man’s survival at supersonic speeds and stratospheric altitudes is one of the most challenging tasks facing the aircraft industry.

Certain conditions are necessary for man’s comfort. Without clothing or housing, he is adapted to a temperature of about 85 degrees Fahrenheit. He is most comfortable at about 68 degrees when clothed and working. The air he breathes is composed of approximately 78 per cent nitrogen and 21 per cent oxygen. He is accustomed to 14.7 pounds per square inch of air pressure at sea level. When these basic conditions are removed or altered, man loses his sense of well-being and confidence.

High aircraft speeds produce tremendous heat. Just below the speed of sound, the temperature inside the cockpit reaches 150 degrees when the outside temperature is zero. At Mach 2 (twice the speed of sound) the temperature rises to 290 degrees. Lack of oxygen at high altitudes causes loss of coordination, unconsciousness and death.

The aircraft industry, which spends a high proportion of its earnings on research and development, is constantly engaged in projects to produce superior airpower. And progress in one area of aeronautics produces additional problems in another.

The problem is complicated because there is no means of obtaining cool air for air conditioning because of the high temperature air around the aircraft. The solution for cooling today’s aircraft is the jet engine—the machine which makes high speed possible in the first place.

High-pressure, high temperature air is taken from the engine compressor for the power to provide cooling to combat high-speed heat. The device is the air cycle refrigeration system. It takes high pressure air from the engine at a temperature much higher than the air around the aircraft. The air around the aircraft, therefore, is used as the “heat sink” to which heat can be conducted. A heat exchanger, similar to an automobile radiator, transfers the heat from the engine air to the air around the aircraft. The cooler high pressure air is then expanded through a turbine where the temperature is further reduced by giving up energy in the form of work. This work is used by the turbine to drive a fan that pulls air through the heat exchanger. The cold air from the turbine is then used to cool the aircraft cabin and the occupants.

The problem of low air pressure is solved by cabin pressurization. But today’s cooling systems will not be able to cope with the rapidly rising speeds and altitudes of tomorrow.

One possibility of providing cooling in the future is the use of liquid oxygen—“lox.” It is proposed to spray lox directly into the cabin to provide, not only cooling, but a breathable atmosphere and pressure level.
Research Spending Gains Rapidly

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means in laboratories or through flight testing, and the cost of dev-
oping aircraft will vary geometri-
cally with the time required to ob-
tain the solutions. Even the analyti-
cal method requires expensive items,
such as electronic computers —
and their ability to provide a complete
solution is limited. Wind tunnels
are used to obtain further results,
and the problems that are not solved
through analytical and laboratory
methods must be worked out in de-
velopment flight testing.
A development program cannot
be delayed until complete data is
available. Decisions must be based
on the best data available, and each
decision affects other decisions
as the program moves along. If early
decisions are wrong, this means that
expensive changes must be made
later in the program. This proce-
dure wastes money, time and valu-
able engineering man-hours.
Many of the expensive, time-con-
suming changes would not be neces-
sary if proper facilities were avail-
able to the aircraft industry. There
is a shortage of wind tunnels capable
of tests in the supersonic ranges.
For example, the testing of one high
speed model was delayed 4½
months after the model was ready,
because of the lack of a wind tun-
nel. Although the tests could not be
completed, they revealed that
changes had to be made in the wing
and the vertical fin. If these changes
had been discovered sooner, the
substantial loss of engineering man-
hours and the delay in the program
could have been avoided. A similar
problem developed on the stabilizer,
not because the wind tunnel testing
was delayed, but because a transonic
tunnel was not available during the
development period, and the trouble
was not discovered until the aircraft
was built and flown at Mach .95, or
95 per cent of the speed of sound.
A 10-month delay in wind tunnel
availability made it necessary to
start the redesign of a section of the
fuselage without complete data at
supersonic speeds, and similar de-
lays in tunnel programs needed to
solve other problems slowed de-
velopment of the aircraft. The planes
involved would have been brought to
combat-readiness many months
sooner, and the development cost
reduced, if adequate wind tunnel fac-
cilities had been available.
This particular research tool, the
wind tunnel, is able to pinpoint on
the ground weaknesses that previ-
ously were obtainable only through
expensive and hazardous flight test-
ing.
Another example of saving money
and lives through research facilities
is the use of a flight simulator for
new aircraft, which enables engi-
ners to "test" the plane under de-
velopment. The simulator duplicates
the full scale control system of the
aircraft. At an early stage in the
development program, the simulator
detected a control deficiency in the
supersonic plane under development.
Correction of this problem prevented

Suppressor Test Program Reveals Jet
Sound May Be Less Than Piston Level

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encouraging, as this meant that at
greater distance the over-all noise
should be further reduced. High-
frequency noise is weakened more
rapidly than low-frequency noise,
both by distance and interference of
building walls.
To give an illustration, a deep-
voiced, low-frequency fog horn may
be heard much farther than a shrill
high-frequency whistle, though both
may measure the same in over-all
decibels at the source.
To weight the realities which might
be expected from these weird shapes
—the full-scale test nozzles weighed
about 100 pounds more than the
standard nozzles. These were so-
called "boiler plate" test articles,
not suitable for flight.
On the positive side of the weight
problem are: 1. Structural benefits
which are experienced on the under-
side of the wing in the region of
jet exhaust. 2. Probable reduction
of amount of sound-proofing ma-
terial for the aft end of the passenger
cabin.
Although not complete, the
test program has even now reduced
the noise by an amount which could
result in jet aircraft considerably
quieter than present piston-engine trans-
ports.
This is just one approach to the
problem of sound abatement being
made by one aircraft company. The
entire industry is hard at work on
a solution—and one will be found.
The experts are far enough along toward
a solution to assure that when giant
jet transports join the nation's air-
lines, their engines will be equipped
with practical and efficient noise sup-
pressors.

The Ultimate Decision

"Once you have won the air power
battle, then there is no doubt about
the outcome—the ultimate decision.
You may or may not have to go on
and destroy other military forces in
being and resources, but the survival
of one nation's air power over that
of another decides the issue."—Gen.
Curtis E. LeMay

Riveting Today Needs
Fine Tolerances

Probably no other job in airplane
manufacture has come to typify the
aircraft worker more than the
riveter. But most people don't really
know the finer points of the job.
Riveting is not only of first im-
portance in aircraft building, it is also
a constantly changing job. Today's
job is as different from that of 10
years ago as rockbreaking is from
watchmaking.
For one thing, tolerances are much
finer—as little as .0015 of an
inch. Fifteen ten-thousandths is to an
inch what eight feet are to a mile,
what one parking space is to 45 city
blocks. This is exacting work con-
sidering the fact that more than
900,000 rivets are needed in the
manufacture of a single U. S. jet
bomber.
Today's sleekly lethal jets are crammed
with all manner of combat equip-
ment to aid the crewmen in their
mission. And, to crow their extra
miles in range into these giants, the
aircraft designer placed the fuel
tanks within the wings. Then, to
save weight, the designers decided
to use the wings themselves as fuel
storage tanks. As a result, riveting
engineers had a design problem all
their own—how to rivet metal wing
skins which would be fuel-tight.
But scientific ingenuity figured a
way. So in riveting today, the inno-
vation is the method of making air-
tight rivet joints. A rounded head
rivet is inserted into a counter sunk
hole from the inside and the blunt
end is rounded until the countersunk
is filled. Fit in this area is so criti-

cal that special precautions must be
taken during the process to keep the
metal absolutely clean. Even the
riveting guns are allowed only two
drops of lubricant since grease on a
rivet would break its sealing quality.