NAVAL AIR DEVELOPMENT CENTER
WARMINSTER, PENNSYLVANIA 18974

PA
10 February 1971

MEMORANDUM

From: Commander, NAVAIRDEVCEN
To: Distribution List

Subj: TECH-TALK Information Program

Encl: (1) TECH-TALK Folder w/TECH-TALKs

1. The Public Affairs Office is producing and will distribute TECH-TALKs and convenient, sturdy folders for your information and as a marketing device to publicize the Center's technical capabilities. Enclosure (1) is being distributed for your retention; you will receive copies of TECH-TALK, as they are produced.

2. The TECH-TALK will appear on a more or less regular basis - like a newsletter - and will provide a rather painless method for you to learn, in useable detail, those capabilities on the Center outside the area of your responsibility. The education process as well as the ultimate availability of a rather complete reference work on the Center's technology, should make it easier for the separate departments, divisions and branches at NADC to operate as a "Center of Excellence" in aeronautical systems.

3. The TECH-TALK program provides an increasingly useful brochure to be taken on technical trips and visits. It will make such trips and visits more useful to the Center in a marketing way by enabling you to answer questions outside your immediate area of interest and even distribute copies of TECH-TALK at possible sources of NADC business.

4. It is intended to produce indexes as the number of TECH-TALKs increases that will contain a convenient request form for ordering any or all TECH-TALKs and folders.

5. Your suggestions are invited by the Public Affairs Office for distribution of TECH-TALKS beyond this initial distribution.

Joseph G. Dahms
JOSEPH G. DAHMS
By direction

Mr. H. Stein

NADC TECH TALK

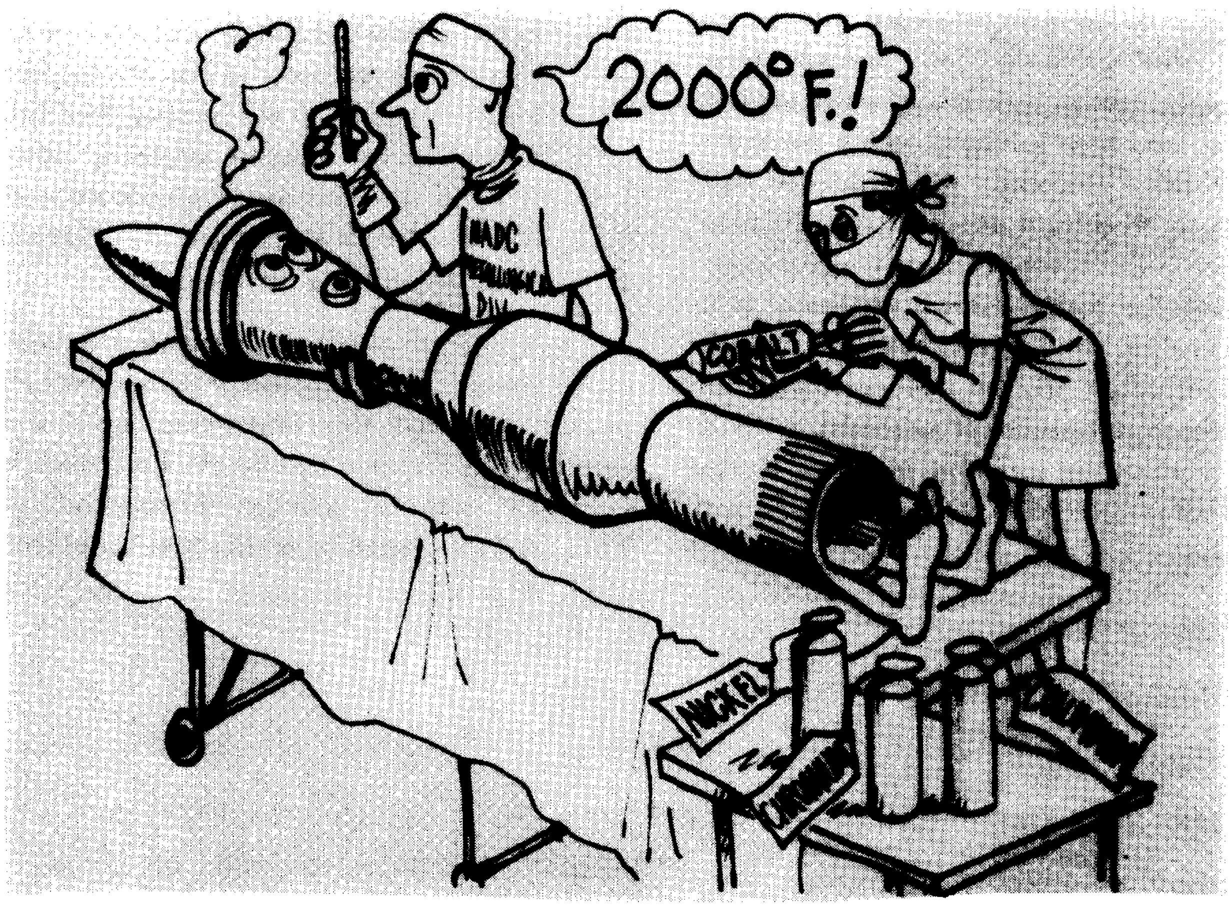
4ND-NADC-5721/2 (6-70)

MA-1-71

PROPULSION SYSTEM MATERIALS

As engine temperatures climb higher and higher, metallurgists must constantly seek new ways to extend the operating limits of the propulsion system materials. Right now, the maximum operating temperature for metals is about 1900°F., and raising this even 50°F. would be significant.

(continued)



NAVAL AIR DEVELOPMENT CENTER, WARYINSTER, PENNSYLVANIA 18974

Here at the Metallurgical Division of NADC, we are investigating many new materials in the search for higher strength and greater heat resistance. Among these are cobalt and nickel dispersion strengthened alloys, chromium alloys, columbium, intermetallics, ceramics and directionally solidified alloys.

Developing New *Materials*

Much of our research is aimed at directionally solidified alloys and ceramics. In the ceramics area, we are growing single crystals and developing floating zone melting and refining techniques. These techniques help us produce stronger, denser ceramics.

The directionally solidified alloys hold some exciting possibilities. Basically these alloys are eutectic materials in which the two phases have been solidified with a particular orientation. Hopefully this technique will allow us to tailor a material's characteristics to our needs. We will choose the phase constituents for their corrosion resistance, then directionally solidify the eutectic for high strength. Currently we are developing an iron-titanium eutectic. If successful, we will try boosting the corrosion resistance of the material with additives, such as aluminum and chromium.

Operating *Conditions*

Choosing the best material for an engine application requires a knowledge of the aircraft's operating environment. But it is practically impossible to pin-point the operating conditions of a naval aircraft. Each plane experiences a different combination of time spent in flight and time spent on the carrier deck ingesting salt air.

To better define the operating environment, we examine the scale on the engine blades with metallographic techniques and determine the elements present. From this information we can determine the primary mode of attack.

It Isn't What We Thought

We found that we can relate our analysis of the scale with the oxidation data developed by researchers and from it determine the effective oxygen pressure at the surface of the blade. Apparently the oxygen pressure is lower than metallurgists originally believed. If this is true, then the protective oxide coatings take longer to form and corrosion occurs more rapidly than we thought.

Discoveries such as these will help us select propulsion system materials more effectively. But these discoveries are not accidental. It takes an effective R&D team with an extensive materials background — and that's us, the Metallurgical Division of NADC.

FOR FURTHER INFORMATION, CALL OR WRITE:

DIRECTOR, AERO MATERIALS DEPARTMENT

Telephone 215-672-9000 AUTOVON 441-1110

NADC TECH TALK

4ND-NADC-5721/2 (6-70)

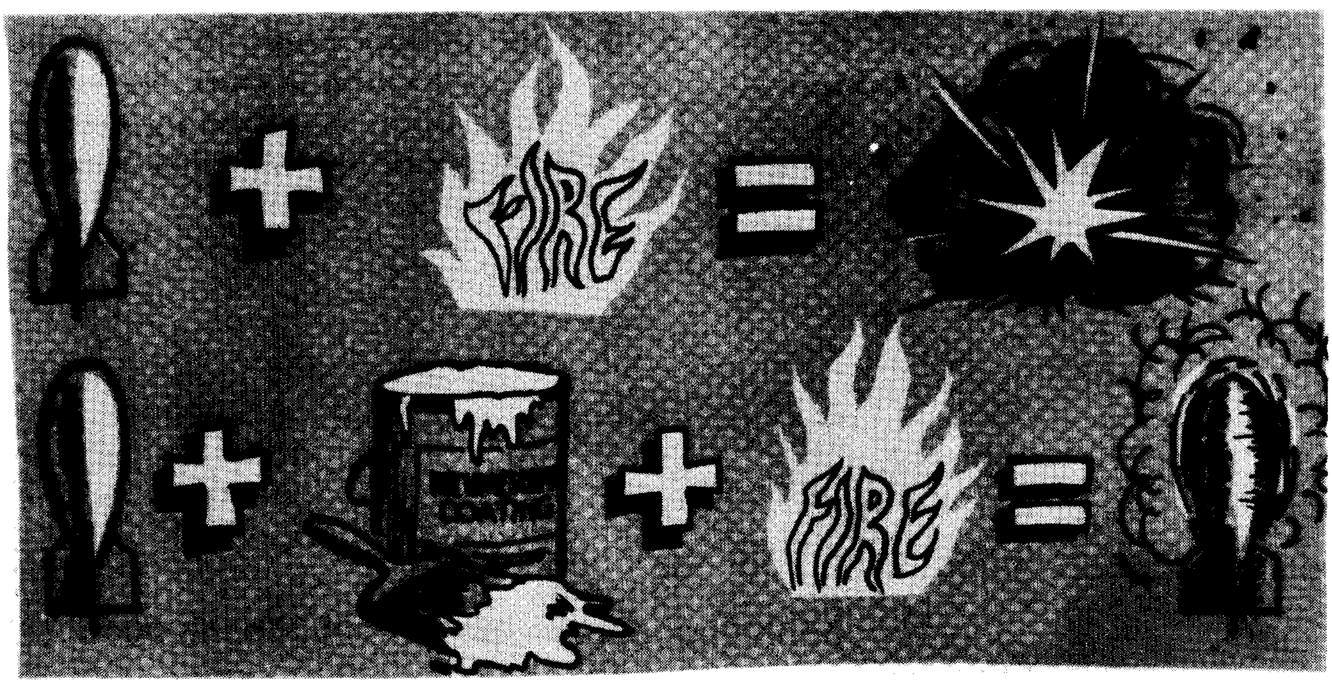
MA-2-70

ORGANIC COATINGS

- CAN YOU HELP ME FORMULATE A COATING REDUCER THAT WILL MEET THE ANTI-POLLUTION LAWS IN LOS ANGELES?
- IS IT TRUE THAT THERE IS A COATING THAT DEVELOPS BETTER HEAT INSULATING PROPERTIES WHEN EXPOSED TO FIRE?
- WHAT COATING OFFERS THE BEST CORROSION PROTECTION FOR ALUMINUM?

These are just some of the questions that we at the Organic Coatings Branch of NADC have been asked to answer. These are only a few of the questions that we are able to answer.

(continued)



Finding better ways to combat corrosion is our most important job. Our R & D programs are constantly evaluating new organic coatings and updating existing formulations.

Corrosion not only means downtime, it can cause catastrophic failures. The problem 'is especially acute with the high strength aluminum alloys from which aircraft are fabricated, because these alloys are less corrosion resistant than standard grades of aluminum. The environment to which naval aircraft is subjected compounds the problem. Not only does salt water pit aluminum, but the stack gases on a carrier contain sulfur dioxide. When the sulfur mixes with salt spray or even dew, a weak sulfuric acid is formed that attacks the aluminum.

PREVENTING CORROSION

How do you prevent this corrosion? Well, coatings are one of the major ways, and picking the right coating is our job. We are constantly investigating new coatings. By using accelerated weather testing, we can weed out the unpromising ones.

Both the coating inhibitor and the primer are targets for our examinations. Presently, the inhibitors receiving the most attention are strontium chromate and calcium chromate.

Chemical corrosion isn't the only thing to attack aircraft. Rain can act like supersonic bullets hitting a radome. Since a radome can't be protected by metal, what can you use?

For years a neoprene coating absorbed the onslaught of the elements. But it took 50-60 coats of neoprene and a total of two days to apply all those layers. We evolved an elastomeric urethane coating that cut application time in half.

INTUMESCENT COATING

Probably one of the most interesting coatings we are investigating is a class that develops better insulating properties when heated. Known as intumescent coatings, these materials generate gas when heated. The gas forms gas pockets in the material, insulating the surface to which the coating is applied. When perfected, these materials will be used to delay explosion of munitions in a shipboard fire. They might also find application as fuel tank insulation.

Our chemists and materials engineers have either developed or improved many of the paints, preservatives, and sealants used in aircraft corrosion control. We handle not only Naval coating problems, but we also consult industry. If you have a government-related organic coating problem, we can recommend a solution!

FOR FURTHER INFORMATION, CALL OR WRITE:

DIRECTOR, AERO MATERIALS DEPARTMENT

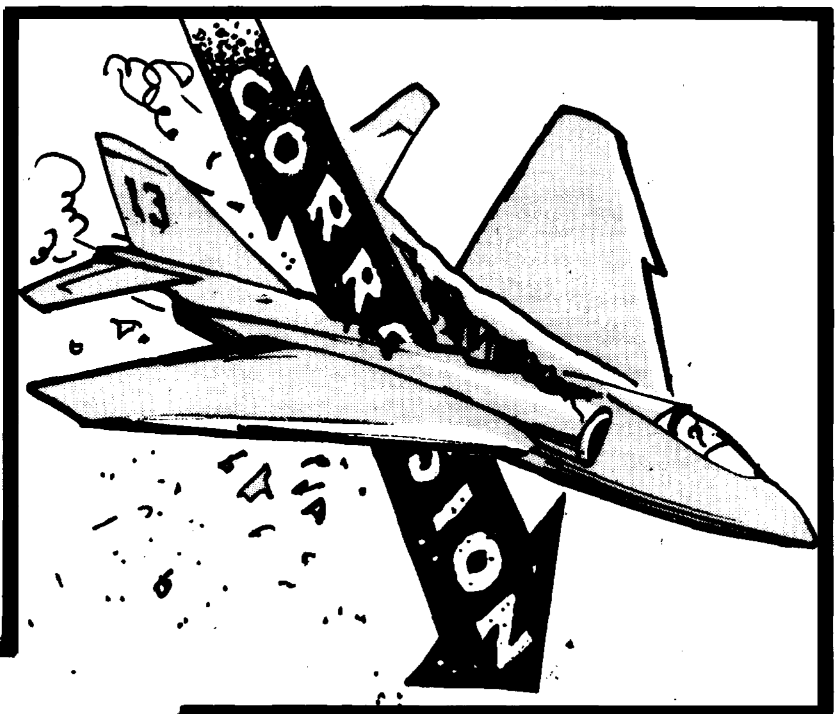
Telephone 21 S-672-9000 AUTOVON 441-1110

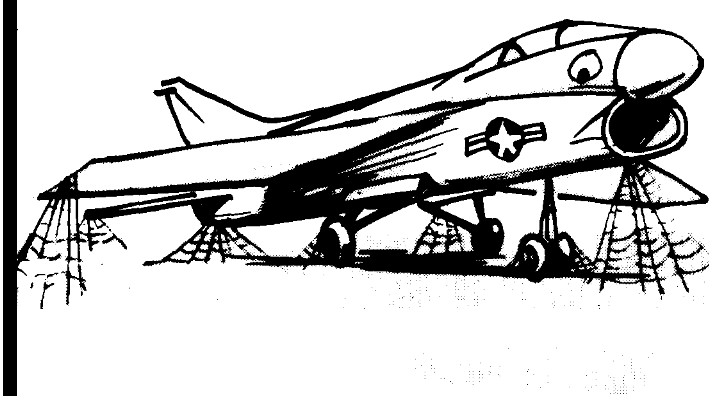
NADC TECH TALK

4ND-NADC-5721/2 (6-70)

MA-I-70

IS CORROSION YOUR PROBLEM?





CAUSES OF CORROSION

Corrosion, like a disease, is best treated by an "ounce of prevention" rather than a "pound of cure." But what *is* the best preventive medicine against costly corrosion damage? Is it a coating; is it the choice of material; or is it the treatment of the material?

There is no general answer to all corrosion questions, but there is a right answer for each specific' application. Finding that right answer is our job at the Chemical Metallurgy Branch of NAVAIRDEVCEN. Working at the forefront of corrosion R & D, we are the country's "information center" on material protection.

(continued)

There are many factors that affect a material's corrosion resistance. For example, the manufacturing process, the fabricating process, even improper heat treating.

By developing a basic understanding of what exactly takes place when corrosion occurs, we are finding better ways to fight corrosion. Finding these better ways means studying new alloys, together with protective coatings.

STANDARDIZATION

What makes it so difficult for any engineer to determine whether one material is better than another is that the various materials labs around the country use different tests to check for exfoliation and stress corrosion. As a result, you can't compare the results from one lab with those from another. We are standardizing these tests so that data from one test can be correlated with the results of another.

METALS AND COMPOSITES

Primarily three metals, plus a number of composites are receiving the attention of our metallurgists. These metals are aluminum, titanium, and steel.

In the past few years, many new aluminum alloys have come on the market. These are now being evaluated by our metallurgists. In additional existing chromate conversion coatings, used as paint bases on aluminum, are being updated. Through extensive testing we have pinpointed the processing variables that affect the performance of these coatings and from this knowledge we have developed strict specifications.

Titanium, which is playing an increasingly important role in naval aircraft, is very susceptible to seizing and galling. To prevent fretting corrosion, the material must be coated. Right now we are evaluating TFE, nylon, bronze, and ion vapor deposited aluminum as potential coatings.

HYDROGEN EMBRITTLEMENT

Titanium shares a major area of concern with high strength steel-hydrogen embrittlement. Trying to determine just what amount of hydrogen will produce this degradation is another problem we are grappling with. We have two well-known authorities on hydrogen embrittlement-Dr. Walter Beck and Edward Jankowsky. These scientists recently co-authored a book on HYDROGEN EMBRITTLEMENT OF AEROSPACE ALLOYS. Scheduled for publication in early **1971,** this book will cover the state-of-the-art on hydrogen embrittlement of ferrous and non-ferrous alloys.

Coatings, materials, material treatment— all these we study in the Navy's battle against corrosion. What we have learned can help you in your battle against the same villain. If corrosion is your problem, we probably have the solution. QUESTIONS, ANYONE?

FOR FURTHER INFORMATION, CALL OR WRITE:

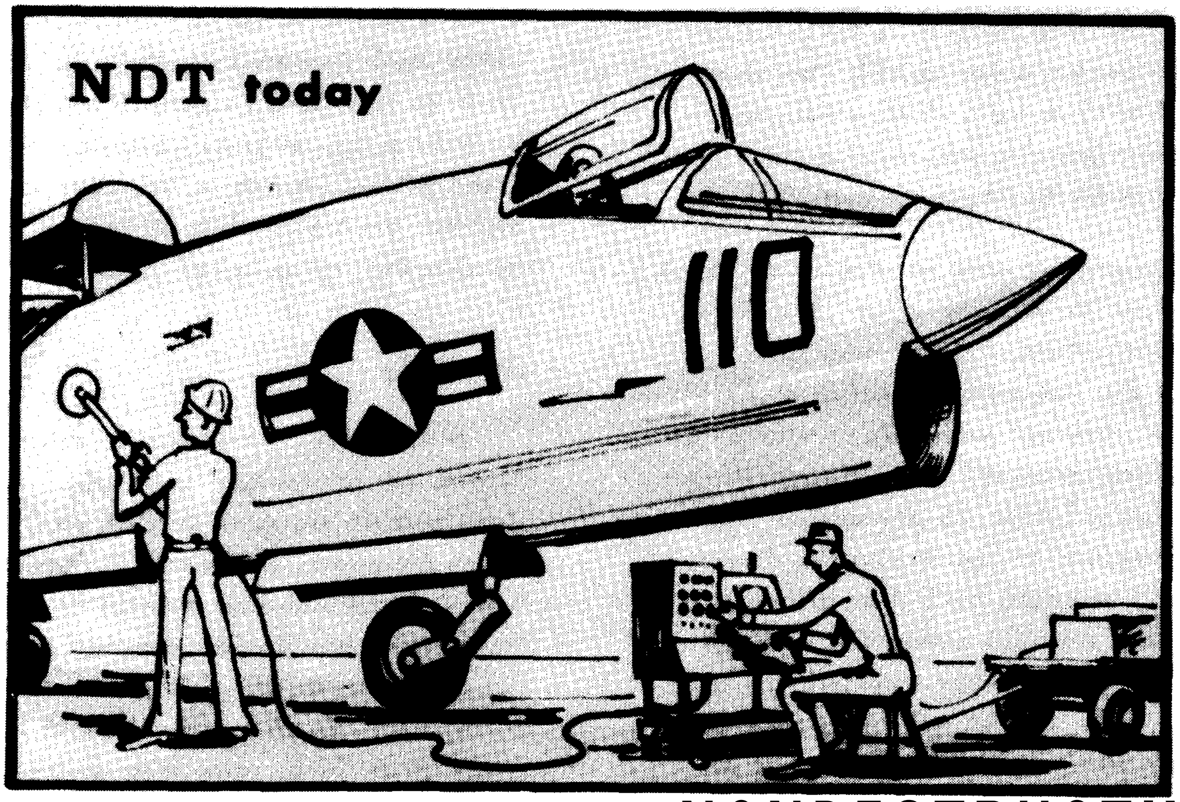
DIRECTOR, AERO MATERIALS DEPARTMENT

Telephone 215-672-9000 AUTOVON 441-1110

Mr. H. Stein

NADC TECH TALK

4ND-NADC-5721/2 (6-70) MA-2-71



NONDESTRUCTIVE TESTING

Why *NDT?*

It simply isn't economical or practical to disassemble an aircraft system every time you want to check it. Not only does it take time and labor, but it also costs money. In addition, there is always the chance that a functional part that is disassembled will be reassembled incorrectly.

Ideally we would like to check all parts

(continued)

NAVAL AIR DEVELOPMENT CENTER, **WARMINSTER,** PENNSYLVANIA 18974

without taking them off the aircraft. New nondestructive testing (NDT) techniques and equipment are bringing us closer to the day when we can do just that.

Latest NDT Techniques

When a part has been overloaded, a residual tensile or compressive stress remains after the load has been removed. How useful it would be if we could measure this residual stress and relate it to service-induced damage as it influences the life of the part.

Ultimately we may be able to do this through the *Barkhausen effect.* The Barkhausen effect refers to the discontinuities that occur in the magnetization curve of ferromagnetic materials when the magnetizing force is being increased. These discontinuities are believed to be due to a reorientation of the atomic structure. If a material under stress is placed in a magnetic field, these discontinuities produce electrical noise. The characteristics of the noise change with the sign and level of stress. Having a knowledge of the history of the part, we hope to relate this noise to susceptibility to catastrophic failure by stress corrosion. *Neutron activation analysis* may help us identify trace particles of a material in oil. In this technique we make a sample radioactive by irradiating it with a neutron source. Then taking these radioisotopes and observing their energy and half life, we identify the elements present. Even microgram amounts can be detected. If we can measure oxygen and nitrogen by this technique, we may be able to detect embrittlement of iron, tungsten or molybdenum.

We discovered that we can *detect accelerated high temperature attack* on turbine blades in its incipient stages. When this hot corrosion occurs, magnetic phases are formed. These phases strongly affect eddy current readings; we can use these readings as an indication that corrosion has started.

Debonds

Because composites and laminates are playing an increasingly important role in naval aircraft, we must develop good techniques for detecting debonds. Fortunately a debond forms a natural thermal barrier, so that when we heat the part, a thermal gradient develops across the bond. We can detect this gradient with an *IR scanner or with liquid crystals* that change color with temperature.

These are but a few of the available NDT techniques. But no matter how many we have, we are always finding newer and better ways to do the job.

FOR FURTHER INFORMATION, CALL OR WRITE:

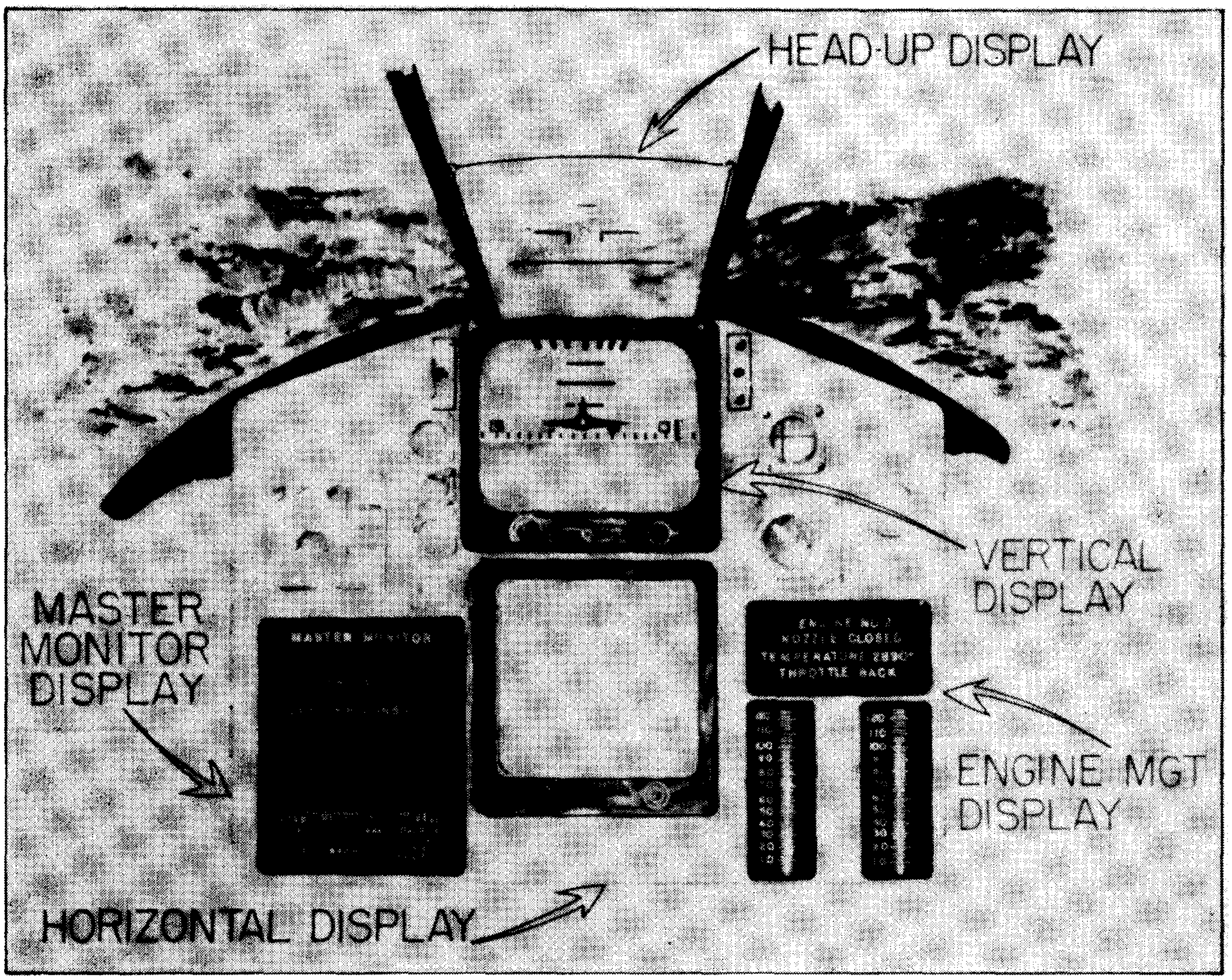
DIRECTOR, AERO MATERIALS DEPARTMENT
Telephone 215-672-9000 AUTOVON 441-1110

NADC TECH TALK

4ND-NADC-5721/2 (6-70)

VT-1-72

PILOT DISPLAYS



So much information is required to fly high performance aircraft that the number of instruments on the control panel is staggering. Even if we don't run out of room in which to place the necessary dials and gages, we will soon exceed the pilot's capability to scan all this instrumentation.

Here at the instrument and Control Branch of NADC, we arc trying to solve this problem of multiplying instrumentation. Our job is to find out what to display and how to display it.

One technique that cuts instrument scanning time is to display information, such as engine temperature, and oil pressure, only when the conditions are out of spec. Another technique is to integrate the information so that fewer individual details are displayed, but the total amount of information remains the same. For example, instead of the pilot reading the gages, performing a mental calculation and then picturing what is happening to his aircraft, the necessary calculations would be made for him and he would be presented with a pictorial display only. A typical display might show the position of the runway with respect to the aircraft. As the aircraft maneuvers, the display would change accordingly.

The information displayed could be changed to suit the aircraft's mission. In addition, it might be possible to display recommended action under existing conditions.

One integrated display is the head-up display – a tilted, transparent screen on the windshield of the aircraft. This screen displays required information but eliminates looking up and down at the control panel, an important feature when the pilot is coming in for a landing, searching for another aircraft, etc.

For use on the head-up display, we are working on lasers and holographic lenses. These techniques, now under development, promise many significant improvements over existing equipment.

We are one of the very few groups in the country doing three-color hologram work. One of the state-of-the-art displays we are developing is a three-color map stored in holographic form and projected by a laser. Normally, holographic information is stored on film. We are developing techniques for storing this information in a small crystal. When the crystal is rotated to the proper position, the desired information can be read-out. Many three-color maps can be contained in a single crystal.

Our plans for the future include the development of modular displays. These displays will be interchangeable among aircraft. With such a system, displays will not have to be completely redesigned for each type of aircraft.

All of our work is aimed at helping the pilot fly his aircraft with as few instrument burdens as possible. The more rapidly we can give him the necessary information, the faster he can make decision. By cutting the time he has to devote to instrument reading, we can improve flight safety under low visibility conditions.

If we can integrate the many elements of information required and improve the means of displaying it, then we increase the chances of mission success.

For further information, call or write:

DIRECTOR, VEHICLE TECHNOLOGY DEPARTMENT

TELEPHONE: 215–672–9000 AUTOVON 441-1110

NADC TECH TALK

4ND-NADC-5721/2 (6-70)

AE-1-70

ANTENNAS AND RADOMES

When you think of an airborne antenna, you automatically think of the antenna as being mounted on the aircraft. But does it have to be in that order? How about an aircraft mounted on an antenna! It may sound bizarre, but this "flying antenna" is an advanced concept that we at the Radar Division have carried past the feasibility stage. In fact, it's what we envision for naval reconnaissance aircraft 10 years hence.

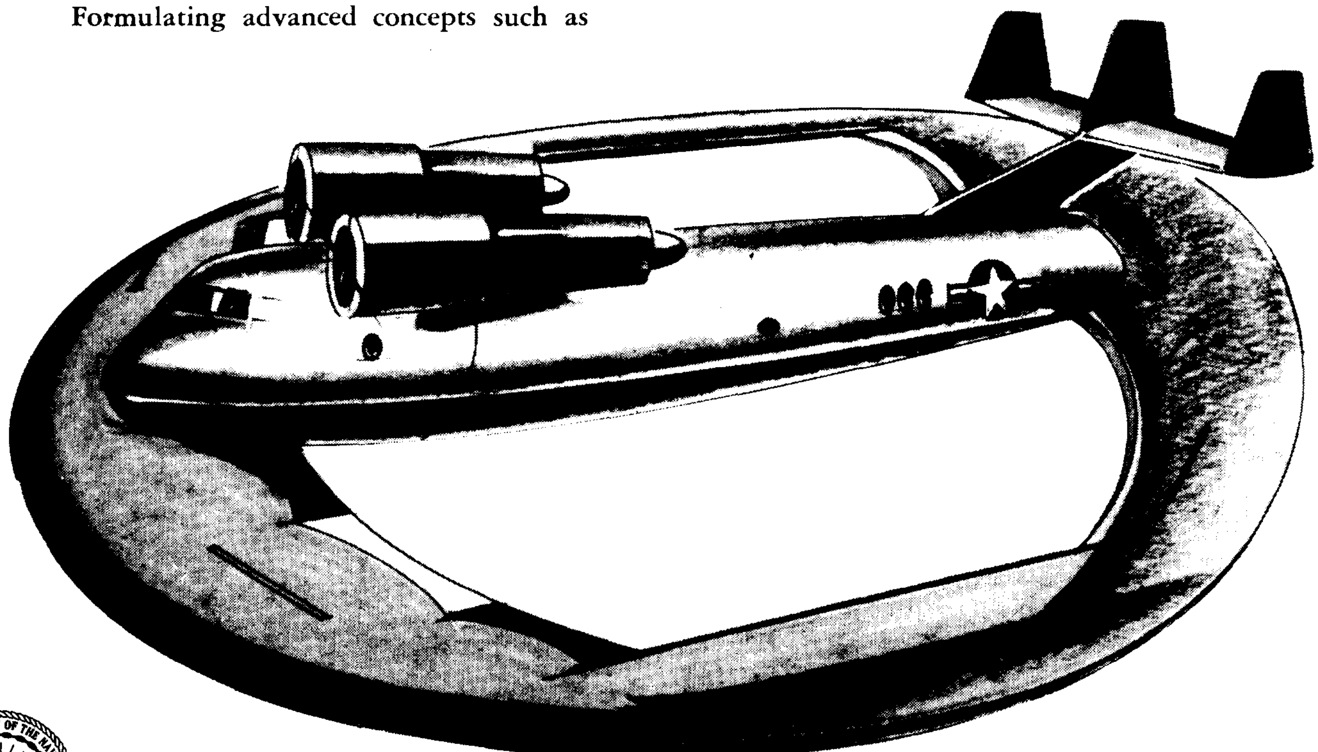
The "flying antenna" is an aircraft with collapsible wings that unfold in flight to form a complete circle. Spaced around the wings are numerous transmitters sequentially controlled by computer. These transmitters create a traveling scan pattern that circles the wings, eliminating the need for a rotating antenna.

Formulating advanced concepts such as this is but one part of our work. Our capabilities extend to design, testing and evaluation of antennas for any avionic application.

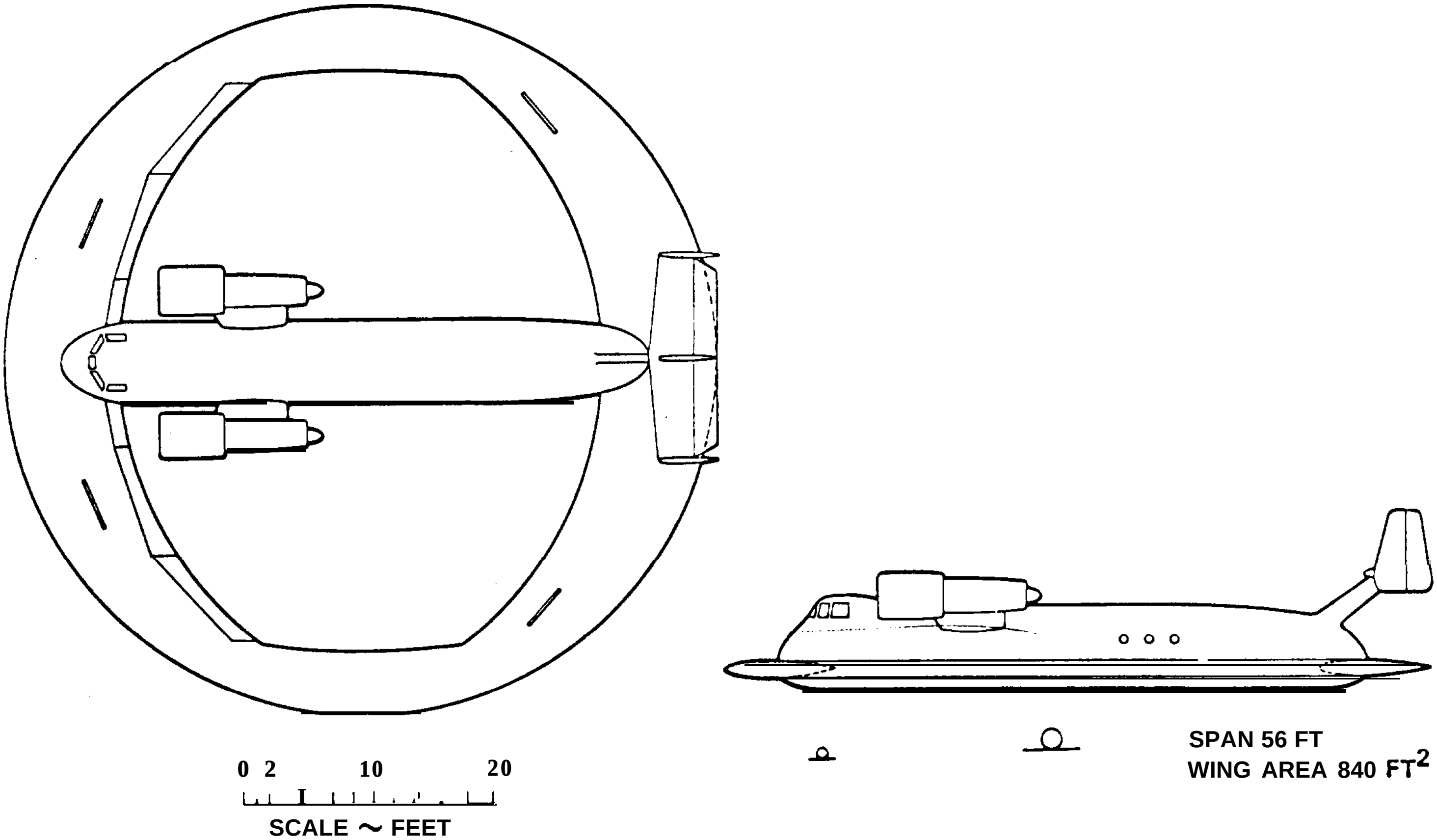
For our test work we have a unique antenna range situated on 30 acres of flat ground. This test site is automated completely; the operator only has to change antennas. He can remotely raise and lower the transmitting antenna, operate the transmitter, and dial in any transmitter frequency from 20 megahertz to 100 gigahertz. From the console he can manipulate the receiving antenna through 3 degrees of freedom to within 1/10 deg.

In our electronic countermeasures work,

(continued)



NAVAL AIR DEVELOPMENT CENTER, WARMINSTER, PENNSYLVANIA 18974



we are both designing antennas for the detection of enemy radar, and investigating new antennas that will enhance our jamming capabilities.

While we want to detect enemy radar, we want to avoid detection by the same radar. We combat detection by shielding the aircraft with various energy-absorbing materials. We evaluate these materials on model aircraft in our antenna test range.

Radome design goes hand in hand with antenna development. Designing the best radome for the job is another of our tasks. As an example of our “know how”, we redesigned a Navy missile radome-cutting the cost of this radome in half and saving an estimated $12 million dollars over the program.

Our changes included different machining techniques and reshaping the radome. Reshaping not only cut the weight, it also reduced drag, thereby improving the tactical performance and speed of the missile. In addition, we improved the resistance to rain erosion by using a glass-ceramic radome with a titanium noseplug.

Because of our expertise, we are called on to monitor the development of all new aircraft. In addition, we act as consultants on practical solutions to fleet antenna and radome problems, and evaluate contractors’ test facilities and measurement data. We perform design analysis, measurement evaluation and prototype fabrication of both radomes and antennas. Ours is a capability that can meet any antenna or radome problem.

FOR FURTHER INFORMATION, CALL OR WRITE:

TECHNICAL DIRECTOR, AERO ELECTRONIC TECHNOLOGY DEPT.

Telephone 215-672-9000 **AUTOVON 441-I 110**

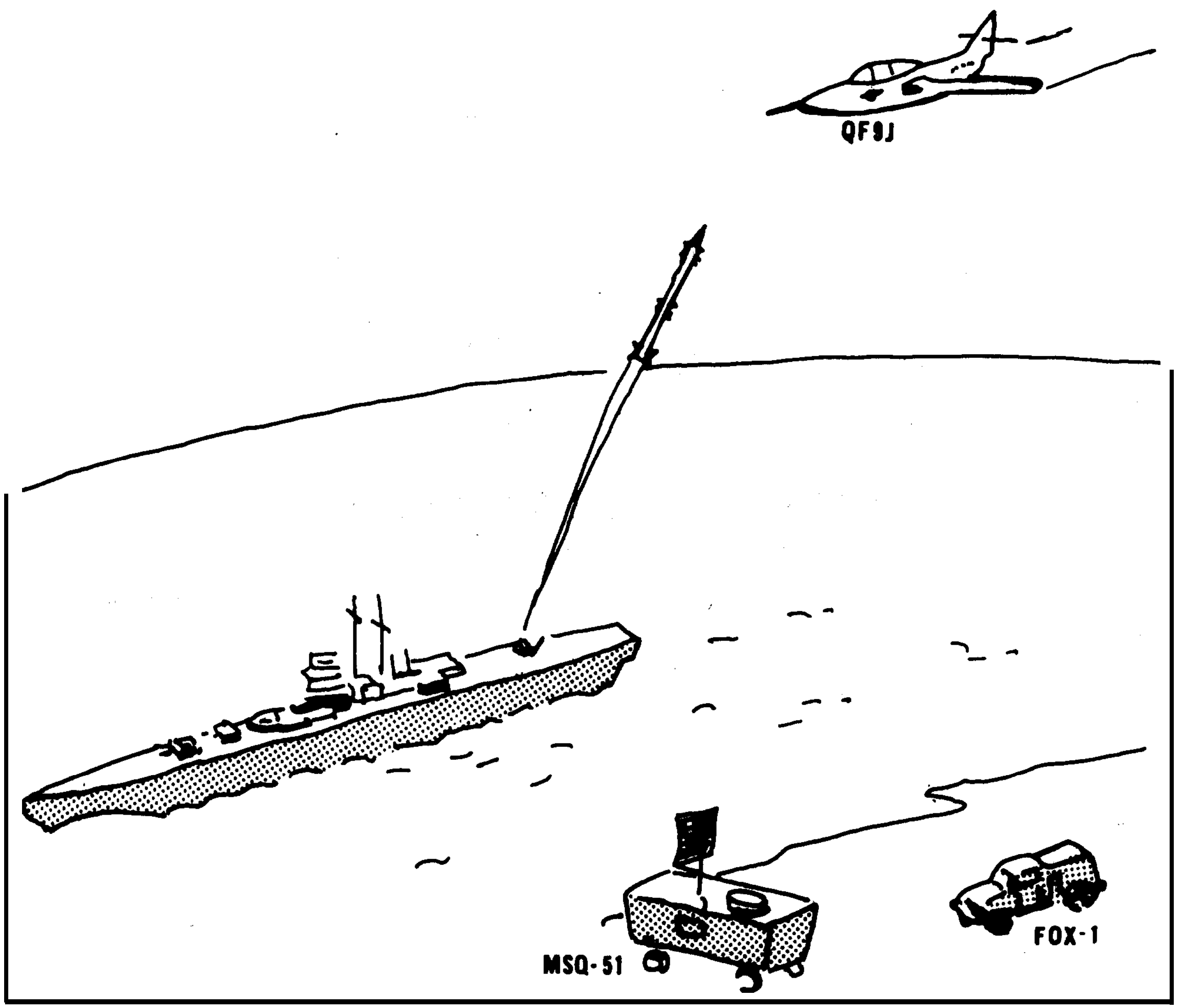
Mr. H. Stein

NADC TECH TALK

4ND-NADC-5721/2 (6-70)

AM-2-71

TARGETS AND DRONES



Vital to the development of a new weapon system are the test firings at unmanned aircraft and other vehicles representative of enemy threats. From these firings important data on weapon system performance and maneuvering capability are gathered. Only with this information can a new system be evaluated properly.

For short-range firing with ground-to-air and air-to-air missiles and guns, tow targets are used. As the name implies, these are targets towed by an aircraft. The targets are modified so that their radar reflectivity and IR signatures simulate those of the actual target that the weapon system is designed to attack. But even with

NAVAL AIR DEVELOPMENT CENTER, WARMINSTER, PENNSYLVANIA 18974

numerous modifications, they can represent the actual target only in a limited manner.

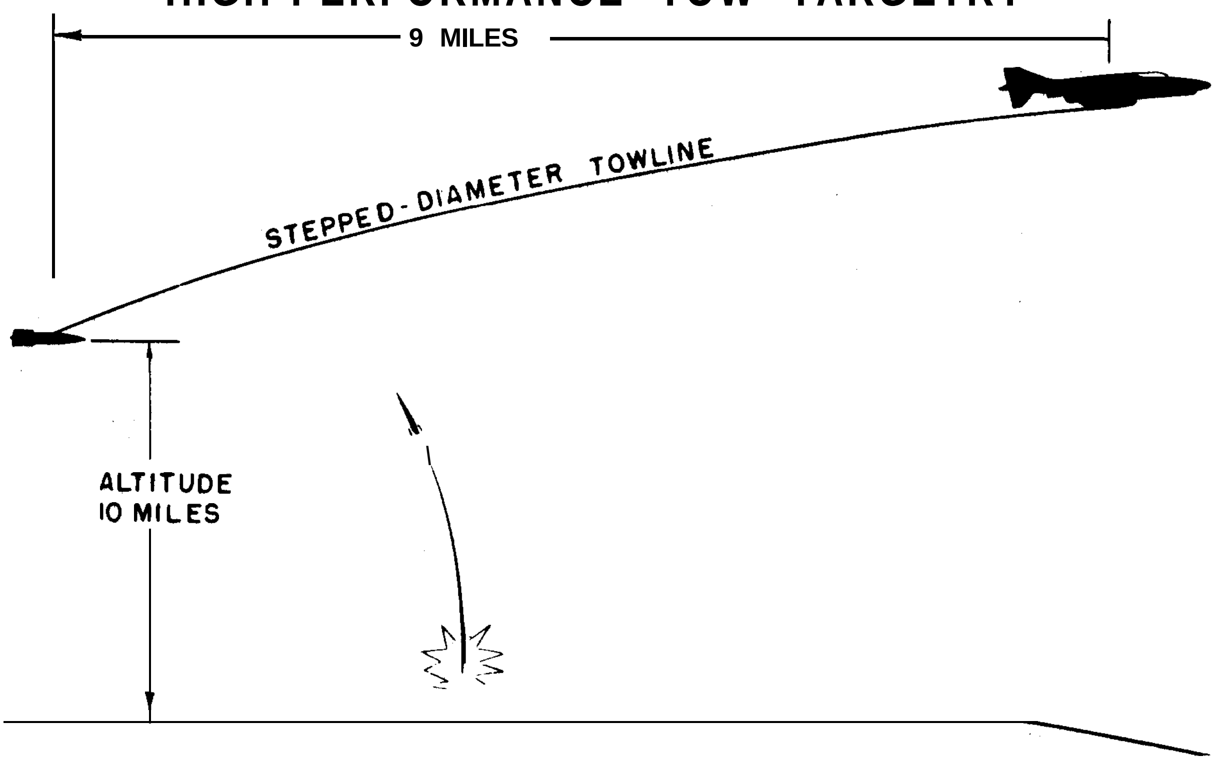
To provide a more realistic test of weapon performance, obsolete aircraft are converted into targets. These full-size targets closely simulate the target the weapon system will encounter, and, of course, cost considerably less than building a full-size target from scratch. The aircraft are outfitted with automatic pilots and remote controls. In addition, auxiliary systems are incorpyrated that detect how well the weapon is performing and transmit this scoring information to the ground in real time.

The design of the tow targets and also the design and conversion of the aircraft targets arc performed by the Aeronautical Engineering Division at NADC. This group handles the entire target system, including the design of target launchers. For tow target launching, the group nas developed state-of-the-art cable handling techniques. They can reel-in and feed-out 30,000 feet of cable at the rate of 5,000 feet per minute in flight. A speed of 10,600 feet per minute has been achieved in the laboratory. As missile systems become increasingly complex, more sophisticated techniques are required to evaluate them. One advance target concept being worked on at NADC is a remotely controlled aircraft that will duplicate the maneuvering of an enemy aircraft during a dog-fight. A target like this will be useful not only in weapon evaluation, but also will be a valuable training tool for pilots.

Based on their past experience, the aeronautical engineering division has deterniined the requirements and developed recommendations for a family of future targets ranging from supersonic, very low altitude to high supersonic high altitude and full size targets with all altitude maneuvering capability. And their work does not stop with aerial targets. They have converted a tank and a PT boat into radio-controlled targets for surface practice.

Regardless of whether it is a land or aerial target, improving its similarity to the actual target improves the accuracy with which a weapon system can be checked. It is through sophisticated target development that we can produce highly reliable weapon systems.

HIGH-PERFORMANCE TOW TARGETRY



For further information, call or write:

DIRECTOR, AERO MECHANICS DEPT.
Telephone 215-672-9000 AUTOVON 441-1110

m. H. Stein

NADC TECH TALK

4ND-NADC-5721/2 (6-70)

CS-1-71

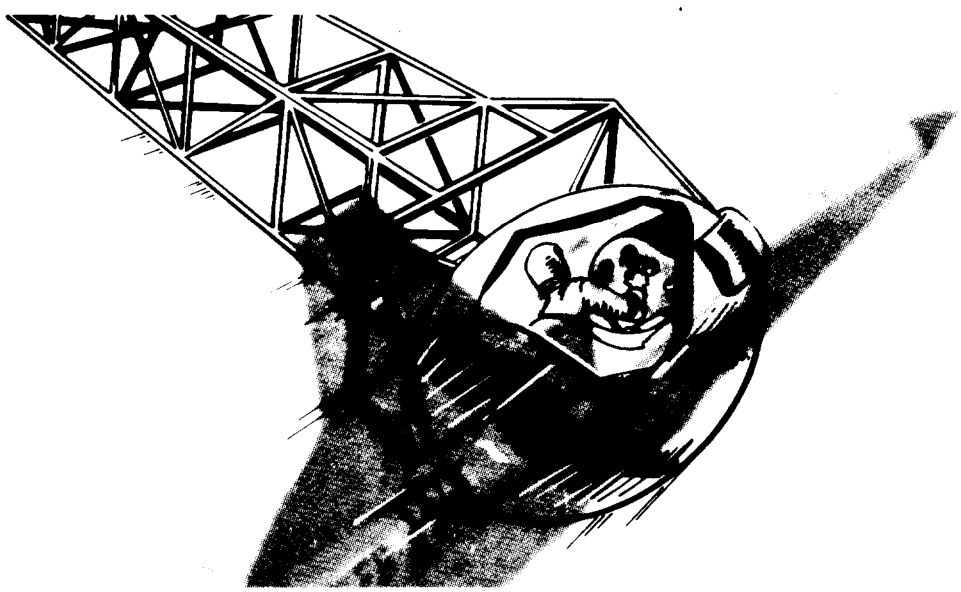
DYNAMIC FLIGHT SIMULATION

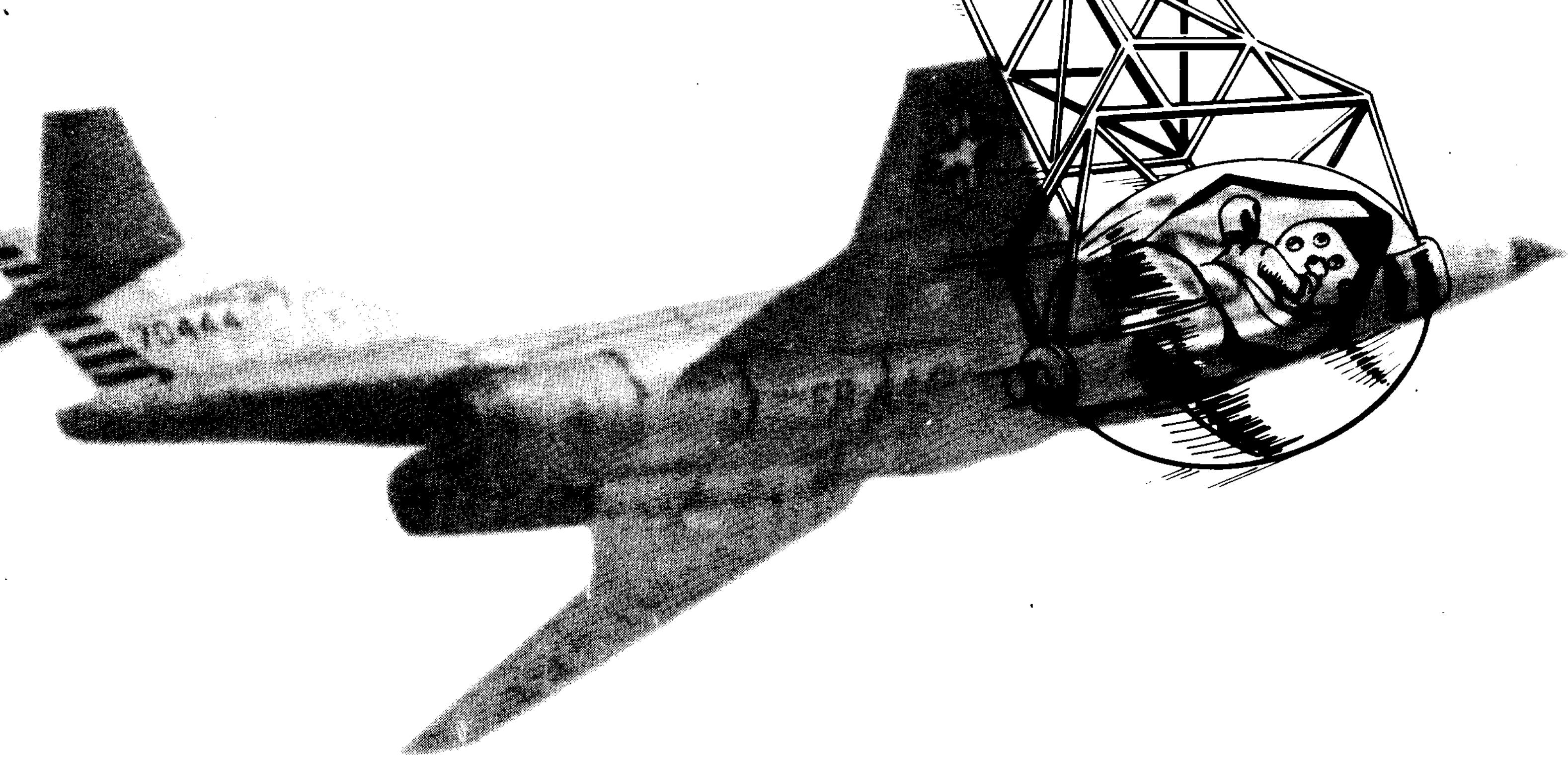
. The history of the human centrifuge at NADC is the fascinating story of today's Dynamic Flight Simulation capability. This unique flight simulator might well prove as revolutionary to the field of flight simulation as once did the wind tunnel to the science of aerodynamics.

. Basically, the centrifuge is a force simulator, not a motion simulator. It was originally used to better understand man'sphysiologicalreactions to acceleration stress ("G" force). Its use during the early years of the space program, when the astronauts trained here, introduced a new, more complex dimension of reproducing acceleration stress. By making use of vehicle data, computers were able to command the centrifuge so that actual flight acceleration profiles could be reproduced in real time. Constant improvement of this simulation technique soon "closed the loop" with the pilot. Thismeant that the pilot was able to "fly" in the centrifuge as he would in an actual aircraft or spacecraft.

■ Today at the Center, a pilot sits in a realistic aircraft cockpit mockup mounted within a 1 O-foot-diameter gondola. The gondola, in turn, is supported in a 2-axis gimbal system at the end of the 50-foot centrifuge arm. Commanding the 4,000-horsepower, 180-ton centrifuge is the pilot. In 4 seconds the motor can accelerate the pilot from standstill to 10 G and back again. Pilot control is monitored and guarded by a specially adapted analog computer. The computer continuously controls the speed of the centrifuge and positions the pilot via the gondola axis system with respect to the resultant accelerations. The resultant accelerations on the pilot at any time are those he would be experiencing in actual flight.

. These accelerations are calculated from the equations of motion and the aerodynamic characteristics of the specific aircraft being simulated.





■ Commanding the centrifuge to produce realistic aircraft acceleration profiles is only one of the computer's tasks. It also drives the cockpit instruments so that they are coordinated with these profiles. Out-the-window visual displays, pressures in the gondola for altitudes up to 120,000 feet, hydraulically-controlled cockpit vibrations and control stick "feel" systems – all are features available to centrifuge dynamic simulation programs.

■ Actual simulation programs that have been conducted at NADC include the following:

1. F-4 spin investigation and pilot training
2. FAA study of the effects of turbulence on commercial swept-wing jet transports.
3. Mercury, Gemini, and Apollo Astronaut Training program.
4. Effects on the pilot from catapulting aircraft from a carrier during night launches.
5. Pilot performance during transonic buffet.

All these programs have demonstrated unprecedented effectiveness in the techniques of dynamic flight simulation.

■ Future usefulness of the centrifuge appears limitless. A comprehensive data package is available, which may include all or part of the spectrum of man's physiological response to acceleration through his piloting performance. Also available are the dynamic and structural responses of the aircraft with the man in the loop. So far, centrifuge dynamic flight simulation has proved to be the safest, most efficient and most economical method of studying the problems of today's sophisticated aircraft and previewing tomorrow's challenges.

■ Upon obtaining results from the FAA turbulence simulation program, the Director of the Bureau of Aviation Safety wrote, " . . . this was one of the most comprehensive professional jobs of safety research ever performed in this country."

For further information, call or write:

DIRECTOR, CREW SYSTEMS DEPT.
Telephone 215-672-9000 AUTOVON 441-1110

NADC TECH TALK

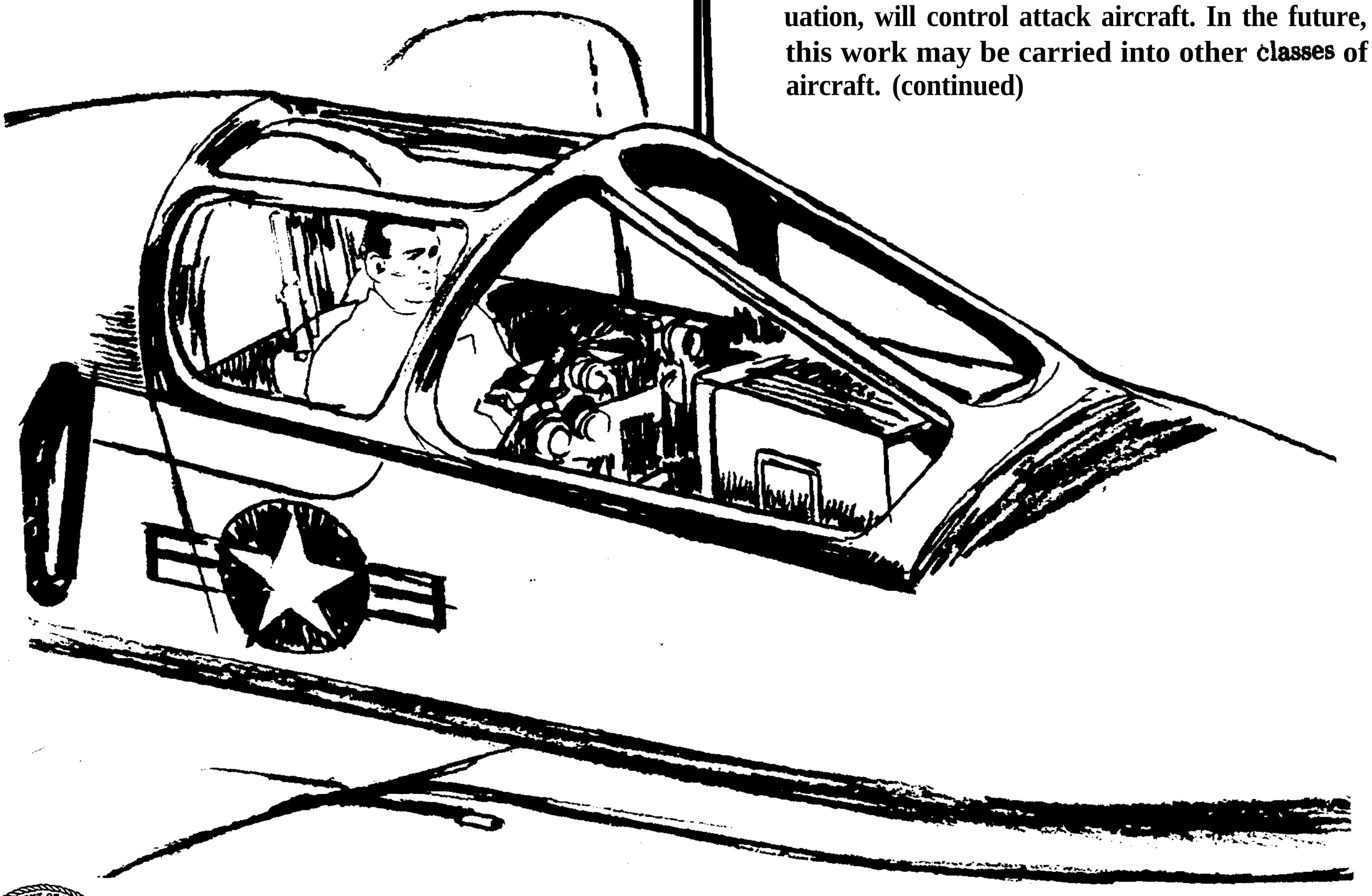
AM-1-70

4ND-NADC-5721/2 (6-70)

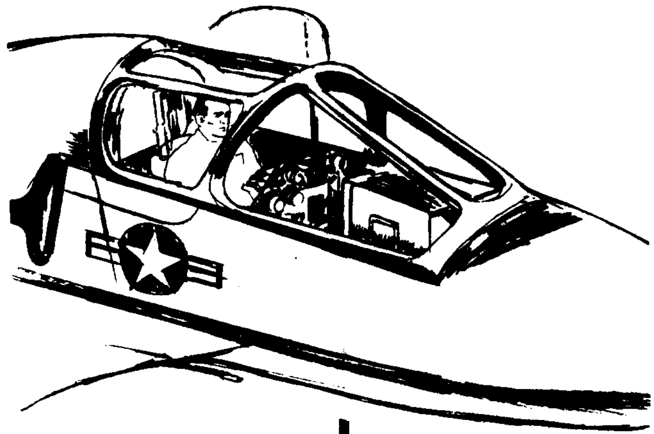
STABILITY' AND CONTROL

Located at NADC is the Navy's largest group of aerodynamic experts in stability and control. Unique in its capability to analyze complete flight control systems, the Flight Analysis Div. can generate basic aerodynamic data, develop autopilots and mechanical actuators, and test systems complete with the human element in the control loop.

In many areas of stability and control, NADC has produced "firsts". One "first" is the universal autopilot. Presently NADC is developing an autopilot that can be used for a whole class of planes, eliminating the expense of designing a new autopilot for each. plane design. This first universal autopilot, now undergoing flight evaluation, will control attack aircraft. In the future, this work may be carried into other classes of aircraft. (continued)



NAVAL AIR DEVELOPMENT CENTER, WARMINSTER, PENNSYLVANIA 18874



NADC has pioneered the development of a fluidic artificial "feel" system. This system produces a stick force that is a truer representation of the forces on the aircraft's control surfaces than is produced by present systems. In addition, NADC is developing a buffet simulator to evaluate the effects of buffeting on a plane's ability to track a target.

Also under development is a wave-off decision maker. The decision maker will take the "guess work" out of determining when a plane is no longer on a safe approach course to the carrier. Based on characteristics such as weight, sink rate and speed, a computer will calculate the approach path and indicate when conditions are unsafe.

To locate any problem areas that the human element may cause, pilots "fly" new stability and control systems in the huge centrifuge at NADC. The centrifuge, previously used to train astronauts, is an excellent dynamic flight simulator. Equations of motion, representing the aircraft's response to the system, are fed into the computer driving the centrifuge. Through the computer, aerodynamicists can vary the stability and control characteristics of the system and test pilot reaction to these variations.

The aerodynamicists are also using the centrifuge to test the spin characteristics of the F-14. Spin testing is an extremely hazardous part of flight testing. By testing recovery techniques in the centrifuge, recovery procedures can be developed and, if necessary, recommendations can be made for design changes in the aircraft.

Planned for the future is a flying simulator. This simulator will be a plane modified so that its flight characteristics can be varied. With this plane, aerodynamicists will be able to collect actual flight data, as well as determine pilot reaction to variable stability and control characteristics.

As you can see from this bird's eye view of its work, the Flight Analysis Div. has a broad range of experience in stability and control. Its unique capability to handle the complete system is a capability you can put to work for you by contacting ....

TECHNICAL DIRECTOR, AERO MECHANICS DEPARTMENT
Telephone 215-672-9000 AUTOVON 441-1110

NADC TECH TALK

4ND-NADC-5721/2 (6-70)

AM-2.70

MEASURING THE WEATHER

As military operations grow more complex and sophisticated, they become increasingly sensitive to the weather. To plan operations for maximum performance, accurate long range weather forecasting is needed.

Of course, it's the meteorologist who makes the forecast based on existing weather data, but the accuracy of his predictions depends on the accuracy of the collected data. Surprisingly enough, collecting accurate measurements, such as pressure, temperature and humidity is an extremely complex engineering job.

Most data is collected either by balloon sondes, or by rocket sondes fired from the ground or from a weather reconnaissance aircraft. Designing, developing and building these sondes is our job at the instruments & Navigation Branch of NADC. We not only develop the measuring instruments; we also develop the package in which they fly. Our job requires a knowledge of everything from rockets to radar, then implementing this knowledge into working hardware.

(continued)

IT TAKES A LITTLE BIT OF EVERYTHING

As weather sonde men, we are **jacks-of-all-trades**. We have to understand aerodynamics so we can minimize the boundary layer influence of the plane on the trajectory of the sonde. We use our knowledge of rockets in picking the best propulsion system. In addition, we build launchers and design test facilities for checking out the finished hardware. Once the sonde is launched, we use our expertise in radar and photography for tracking the sonde. Our knowledge of data processing helps us handle the data after it is collected.

INNOVATION

In each area of sonde development, we innovate. For our test work, we designed a special fixture that generates an acceleration step function. We designed and now fabricate our. own transformers. Working with industry, we developed a battery unlike any other on the market. It is inertially-activated and does not start functioning until after launch, so, in effect, it has infinite shelf life. Our innovations have won us patents for parachute, launcher and high power transmitter design, and also for the design of a radar cap that prevents aircraft-generated RFI from prematurely firing the sonde rocket.

SYSTEM-ORIENTED

As you can see, we are system-oriented. We take all aspects of sonde design, and integrate them into a working system. We can handle any part of the system or we can handle the whole system. With our unique combination of engineering skills, we are qualified to tackle any sonde-related problem.

FOR FURTHER INFORMATION, CALL OR WRITE:

DIRECTOR, AERO MECHANICS DEPT.
Telephone 215-672-9000 AUTOVON 441-I 110