WRIGHT AIR DEVELOPMENT CENTER

LINEAGE
Air Development Center
Wright Air Development Center

STATIONS
Wright Patterson AFB, OH, 1 Apr 1951-15 Dec 1959
Wright Patterson AFB, OH, 7 Dec 1959-1 Apr 1961

ASSIGNMENTS

COMMANDERS

HONORS
Service Streamers

Campaign Streamers

Armed Forces Expeditionary Streamers

Decorations

EMBLEM

EMBLEM SIGNIFICANCE

MOTTO

NICKNAME

OPERATIONS

Wright Air Development Center, largest Center of the Air Research and Development Command in terms of facilities and personnel, possesses a proud record of aeronautical achievement dating back to World War I. Through more than three decades Dayton has been the site of many military aviation milestones. Yesterday's development tasks appear as today's aircraft and equipment. Today's projects will be tomorrow's advancements.

Many -firsts" have highlighted Wright Air Development Center's history, beginning with flight tests of the World War I Liberty engine in 1917, and continuing to present-day accomplishments. The list is long, and includes such notable achievements as altitude and distance flight records, parachute experiments from the first free-style jump to current fully automatic systems, leak-proof tanks, reversible and variable pitch propellers, speed records, instrument flying, liquid coolants for engines, aerial photography, equipment and techniques, navigation, including automatic navigation, in-flight refueling, instrument landing systems, pressurized aircraft cabins, and many others.

Although its extensive engineering facilities are in many respects unique, the Center's role extends beyond the conducting of research and development projects. To implement the Air Research and Development Command's policy of calling upon science and industry, the Center monitors hundreds of contracts with these agencies, specifying, assisting and evaluating their work. In this sense, the Wright Air Development Center is a clearing house through which the efforts of many are funneled to the proper avenues for incorporation into superior aeronautical equipment and weapon systems.

This manifold task requires engineering investigations and awareness of progress in many fields of science. Wright Air Development Center personnel thus keep current in all phases of aerodynamics, propulsion, electronics, materials, aero medicine, armament, and the many related sciences utilized in the advancement of these arts.

Man's ability and inherent desire for knowledge form the foundation of the Wright Air Development Center.

Through teamwork, and the utilization of many and varied talents, the personnel of Wright Air Development Center labor today on the problems of tomorrow. Professional, administrative, clerical, skilled, semiskilled — all are dedicated to a single purpose.

Each performs a necessary task, whether he is an engineer, file clerk, truck driver or test pilot. The sum of their collective effort is stated in terms of the technological superiority of our aerial weapons.

These advancements demand the solution of scientific problems that grow more challenging each day. The accelerated pace of research and development is prompting investigations into many diverse and newly explored fields.

Their achievements form the story of the Wright Air Development Center.
Today, the personnel of Wright Air Development Center explore the earth and sea to find the metals required for supersonic propulsion. They search with radar for vision beyond the horizon. They calculate the shape of tomorrow's aircraft to insure its aero dynamic compatibility with swift speeds. They devise electronic wonders to serve them, then shrink them to diminutive size to conserve weight and space. They protect the human pilot from the uncontrollable forces of nature encountered high above man's natural environment.

The engineering test facilities of the Wright Air Development Center are the tools for aeronautical advancement.

Wind tunnels, whirl rigs, rotor stands, gun ranges, altitude chambers, high-voltage generators, soundless rooms, arctic and tropic test chambers, centrifuges, tumble wheels, fuel analyzers, computers, and dozens of other specialized devices are used daily in this never-ending quest.

Many are of an unusual nature, such as the 12-foot vertical wind tunnel; the Structures Test building where aircraft as large as a B-36 can be scientifically strained to the breaking point; the spin table for determining man's tolerance to the dizzy tumbling encountered during high-speed bailouts; upward and downward captive ejection seat test towers for emergency escape studies, and the climatic chambers where the effects of fungus, humidity, sun, rain, sand, dust, salt fog, and many other natural conditions may be studied.

These facilities, laboratories, shops, offices, and other Wright Air Development Center activities require nearly 200 separate buildings to house them. Their monetary worth totals hundreds of millions of dollars. Yet, their true worth is calculated not in dollars, but in their efficient utilization by experts, and their compatibility by virtue of being physically located at the same research center. Wright Air Development Center engineers with problems find many of their answers within walking distance of their desks.

Determining the aerodynamic shapes of future aircraft is a long-range task made urgent by world-wide competition and the knowledge that success is measured more directly in terms of national security than in speed and altitude records.

The basic problems of structural criteria for supersonic flight are, to a large extent, unknown. Some can be predicted from established theory, but very little

actual flight data is available to corroborate the theory. Whole new fields of problems are opened up in this new age of flight — problems which may require drastic changes in structural design.

Wright Air Development Center's role in this urgent task can be stated generally as furnishing guidance for the Air Force in future planning, evaluating studying and testing airframes for Air Force aircraft and missiles, and serving as technical consultant to the aircraft industry. Through hundreds of contracts, results of research and study at the Wright Air Development Center are translated into specifications and design criteria for use by manufacturers in developing and building aircraft and missiles with increased speed, altitude and range.

Most imposing of the elaborate testing equipment for this purpose at the Wright Air Development Center are the six wind tunnels and the Structures Test building. Included are tunnels with test section diameters of 20 feet, 10 feet, 5 feet, 2 feet, and six inches, as well as a 12-foot diameter vertical tunnel. They permit aerodynamic studies of models, before the full-scale aircraft is built, from very slow speeds to nearly three times the speed of sound. The vertical tunnel, one of two in the United States, can be used to determine the spin characteristics of exact scale model aircraft and the stability and performance of parachutes and bombs.

Utilization of these tunnels by military contractors and by other branches of the Armed Forces saves thousands of dollars and man-hours by thus establishing the design and construction criteria before the full-scale prototype aircraft is built.

The Structures Test building, probably the only one of its kind in the world, can accommodate aircraft as large as the B-36. By applying pre-determined, precise loads to the complete aircraft, or such assemblies as wings and tail surfaces, their exact structural strengths can be accurately determined before the aircraft is flown extensively.

Another task of the Wright Air Development Center is the preparation of various alternate designs for aircraft and missiles based on the expected knowledge and capability of the aircraft industry years in the future. The configurations of today's aircraft bear many similarities to the "advanced" models created here five or ten years ago.

Not only the physical shape of the aircraft is of concern to the Wright Air Development Center. Equally important is the development and improvement of the parts which make up the whole, such as wheels, brakes, fuel tanks, cowl fasteners, rivets, controls, emergency escape equipment, and many others.

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This emphasis is related in terms of accelerated investigations of all phases of current and proposed power plants, both for manned and unmanned aircraft. Under continual study are turboprop, turbojet, ramjet, pulsejet, liquid and solid propellent rocket engines, as well as reciprocating engines, supersonic propellers, and the application of nuclear power to aircraft propulsion.

One guiding policy of the Wright Air Development Center in propulsion improvement is the knowledge that the American aircraft engine industry is eminently qualified to design, fabricate and develop the end product. The Wright Air Development Center reserves to itself the task of directing and evaluating these efforts, and of solving the problems which arise from field operations. All aircraft engines accepted for use by the Air Force first receive the approval of the Wright Air Development Center. And this ap¬proval comes only after thorough testing here.

Utilized in the evaluation of these current and fu-ture engines are numerous facilities. Many are among the largest and most varied in the world, including engine test facilities for sea level calibration, and endurance and simulated high-altitude tests, turbojet test stands capable of testing engines up to 40,000 pounds thrust at sea level; ramjet test stands for simulating speeds of Mach 4 at 100,000 feet altitude, and numerous qualification and environmental test devices for fuel metering, controls, ignition, accessories, fuels and lubricants. Rocket engine tests here are supplemented by additional testing at other Air Research and Development Command Centers.

Research conducted on propellers and rotors at the Wright Air Development Center includes much test work for other branches of the Armed Forces. Currently under investigation are new types of tur-bine propellers to provide power for supersonic aircraft.

The propeller whirl rigs are powered by motors up to 30,000 horsepower that can turn rotating ele-ments.at speeds as high as 12,000 rpm and develop 150,000 pounds thrust. The helicopter rotor whirl rigs can handle 95-foot diameter rotors twirling from 150 to 600 rpm. Other equipment provides for vibratory fatigue testing of rotor blade sections up to 10 feet in length under tension loads as high as 100,000 pounds.

Housing these test devices requires more than 40 buildings with an estimated 800,000 square feet of floor space. The larger facilities, such as the rotor rigs and some rocket and jet engine test stands have been constructed out of doors.

In its relation to military aviation engineering, electronics is an across-the-board science involving aircraft control, communications, navigation, armament, photographic reconnaissance, propulsion, instrumentation and many other fields.

Historically, the application of electronics to aviation dates back a relatively short time, yet in this brief period the quantity of electronic gear carried aboard military aircraft has increased from a few scattered, inexpensive items until today electronic equipment may represent half the total cost of an aircraft. These systems and equipment have become so extensive and integrated with the aircraft that physical location in itself poses major design problems.

Responsible for research and development of all Air Force airborne electronic equipment, the Wright Air Development Center has developed a vigorous program through its own laboratories and through hundreds of private organizations to improve the reliability, efficiency, performance and utilization of electronic equipment, while decreasing its size, weight and cost.

These efforts result in a multitude of end items, systems, techniques and processes, some of which demand as much as 10 years' work from inception to final application.

gations and research contracts seek to improve communication, navigation and traffic control systems, components and materials such as radomes, relays, resistors, jacks, plugs and dynamotors. Engineers continually study interrelation of navigation systems with other problems such as strategic and tactical bombing, photo, radar and weather reconnaissance, and pursue advancement in electronic countermeas-ures, missile guidance, telemetering, antenna design, and many other fields.

The tools utilized at Wright Air Development Cen-ter to achieve the goals of research are numerous. Some are standard devices common to electronics research. Others are installations constructed here for specific applications, such as the unique antenna design facility, infrared tunnel, altitude, humidity, salt fog and fungus chambers, "noise room", anechoic (without an echo) chamber, and a 1,000,000-volt generator.

The development of new and improved materials, and creation of substitutes for critical materials, is an important Wright Air Development Center program. In addition, Wright Air Development Center is responsible for establishing standards of quality for all materials used by the Air Force, while giving technical assistance to other Air Force and government agencies on problems having to do with materials.

Scientists and engineers, skilled in metals, plastics, rubbers, textiles, chemistry, ceramics, lubricants and packaging techniques combine their efforts to effect these new developments. Solution of the problems the scientist faces is of primary importance, because jet and rocket propulsion, and the demands of the atomic age have imposed immediate challenges to the attainment of aeronautical superiority.

Present investigations consider the effects of thermal and atomic radiations on all types of material, and the possibilities for decontamination of exposed material. Constant striving for improved aircraft and engine performance has brought a continued rise in operating temperature requirements. Consequently, standard aircraft materials such as aluminum, magnesium, high temperature alloys, rubbers, oils, greases and plastics are reaching their limits of applicability to aircraft design. The use of corrosive and dangerous liquid and solid propellents in guided missiles and for assisted takeoffs has created new problems.

Wright Air Development Center's engineers must chart new paths in the development of materials to meet these new requirements. Consider just one of these fields—metals. Emphasis is placed on the development of titanium alloys, other high temperature alloys and ceramic materials to withstand the high temperatures and loads expected in supersonic aircraft. Work is progressing on binary equilibrium diagrams which reveal what happens at various temperatures when titanium is alloyed individually with other metals. High iron content alloys are being tested for jet engine use. Molybdenum, although promising for high-temperatures uses, is susceptible to oxidation, and accordingly a way must be found to overcome this.

Another development has resulted in magnesium alloys fabricated from powder which yield a magnesium extrusion and forging alloy far superior to current alloys.

Ceramics are being developed with satisfactory stress-rupture life at temperatures in the neighborhood of 2000 degrees Fahrenheit and under stresses of 25,000 pounds per square inch. Brittleness of these ceramics must be reduced, new aluminum casting alloys with properties superior to any other known alloy of its type are under evaluation.

Tomorrow's air weapons must be based upon sound scientific principles. Yet, most of the problems involving fundamental scientific knowledge cut across the traditional divisions of science. Thus, a team concept is emphasized at the Wright Air Development Center; it is not unusual to find an electronic scientist, a chemist and a mathematician working together on a common problem.

Primarily, Wright Air Development Center's re-search role is to look into the future, and through applied research in the sciences, provide new concepts, techniques, and the basis for new materials which will, in turn, serve as a basis for engineering development and improvement of operational equipment. In addition, Wright Air Development Center maintains an active awareness of world-wide scientific and technological advancements and their possible effects on future Air Force developments.

For example, the designing of a nose wheel landing gear that is directionally stable and at the same time will not shimmy under certain conditions of aircraft load and ground speed presents an extremely difficult engineering problem. During a 20-year period some 400 technical papers were written on this subject, but the problem remained unsolved. Recently Wright Air Development Center scientists learned more of the fundamentals of mechanics which provided them with exact knowledge of how to design an inherently stable landing gear.

Some of the current research programs have as their objectives the investigation and solution of such peculiarly aeronautical problems as transient aerodynamic heating, fuel ignition processes for jet engines, chemical compounds for use in synthetic lubricants, and improvement of metals and structural materials. Other vital research problems being attacked include flutter analysis, bombing computers, propeller control bomb trajectories, fire control, and equations of motion in aircraft manuevers.

Thousands of unrelated items of ground and airborne equipment are essential to make the modern military aircraft an effective weapon. Each must be designed and constructed to render the ultimate in efficient service.

Wright Air Development Center's program of providing this equipment includes the development and testing of items ranging from tiny filters to mammoth hangars. Indicative of this wide range are projects to develop crushers, anchors, auxiliary power vehicles, parachutes, crash fire vehicles, and general purpose shops. This wide diversity of effort in-cludes the creation of mobile control towers, lighting equipment for aircraft and airports, aircraft instruments, and training devices of all kinds, including flight simulators and radar bombing and navigation trainers.

Because its application is world wide, Air Force equipment must be dependable under all conditions. Wright Air Development Center determines this dependability in unique climatic chambers which accurately reproduce extreme conditions of heat, cold, fungus, humidity, aridity, sunshine, rain, sand storms, dust, and salt fog such as are encountered throughout the world.

Development and test work also is pursued on missile and target aircraft recovery, aerial pick-up and delivery, and photographic reconnaissance.

Photographic reconnaissance research and development in itself is a major program. Cameras must be designed and tested here which operate from altitudes of 100,000 feet and others which produce perfect low-altitude photos at aircraft speeds greater than 1,000 miles per hour. Since human reactions are too slow to control aerial reconnaissance cameras under these conditions, electronics are utilized to assist with timing, determining aircraft speeds and light conditions, and to adjust cameras to insure perfect photographs.

Increased aircraft speeds and range have meant a tremendous increase in the number of photographs obtained from a reconnaissance mission. To handle this large number of photographs without delay, Wright Air Development Center develops and tests air transportable, automatic processing machines which can produce tens of thousands of finished aerial photographs in a single day.

Developmental work also is pursued in stereo-scopic photography, radar recording cameras, geo-detic control of mapping flight lines, spark flash photography, pyrotechnic bombs and projectiles for night photography as well as photo installations in rockets and guided missiles.

Where high speed, high altitude flight is concerned, man is obsolete. He calls upon a Garden-of-Eden model body to keep pace with supersonic aircraft exposed to great unnatural stresses. Just as the aircraft must be strengthened, so must the man.

Determining man's tolerance to these forces, anticipating future demands upon his body for tactical reasons, and devising methods for him to extend his capabilities is effected through a major program at the Wright Air Development Center.

Not only is applied research devoted to this task, but new and unique types of equipment are devel-oped here and through contracts with universities and research institutions.

Broken into its basic fields of biophysics, physiology and psychology, the Wright Air Development Center's program in aero medicine is conducted by doctors of medicine, physiologists, psychologists, biophysicists, biochemists, anthropologists, as well as engineers in mechanics, aeronautics, acoustics, and electronics.

The diversity of their work is indicated by a brief list of some of the problems continually under in-vestigation. It includes: Problems of emergency escape from high-speed aircraft, including factors of tumbling, spinning, automatic parachute opening, wind blast, and many other considerations; rapid positive and negative acceleration; effects of "g force" in turns and dives; human reaction time in operating aircraft controls and equipment; insuring cockpit, controls and aircraft design compatible to human physical form and ability, effects of pressurization and loss of pressurization at high altitude; protection against temperature extremes; development of efficient survival equipment and food diets for use in any area of the world, and on land or sea; feeding aircrews in flight; oxygen requirements; effects of sound on humans, and many more.

All are concerned not only with protecting the human, but in keeping him reasonably comfortable to insure his unimpaired efficiency.

Research and testing equipment used in these programs at the Wright Air Development Center, al-though probably not unique, are rare and peculiar to aero medical research. A few of the more unusual types of equipment used by human volunteers would include several high-altitude chambers for testing reactions and protective devices to altitudes over 100,000 feet; low-temperature altitude chambers which can vary altitude from ground level to 50,000 feet and temperatures from normal to -70 degrees F; an all-weather chamber which can vary temperatures from 160 degrees F to -40 degrees F; 20 and eight-foot centrifuges for acceleration, gravity and tumbling, an anechoic chamber devoid of sound; a vibration table which produces vibrations in three directions, and test towers for both upward and downward emergency ejection studies.

In its anticipation of future demands upon the human pilot, the Wright Air Development Center generally works at about five years in the future, although a few studies obviously must be projected further.

Test work in this field often tends to be spectacular because of the human volunteers involved. Recent tests in this category have included bailouts at extreme altitudes and speeds, abrupt decelerations at near-crash intensities, near-starvation nutritional tests, and rapid decompressions at rates as high as 35,000 feet pressure differential in one-fifth of a second.

The crude beginning of aerial bombardment and gunnery, early in World War I, converted the airplane from a novelty and occasional reconnaissance vehicle into a weapon of war. Since those first efforts the military aircraft has remained primarily a weapon, its effectiveness measured largely in terms of its striking power; and in its ability to deliver a lethal bomb, rocket, missile or bullet when and where required.

Sharp bursts of automatic gunfire heard daily on the test ranges emphasize the urgency of the Wright Air Development Center's program for insuring maximum striking power through superior armament.

The program includes design and development of airborne bombing systems, defensive and offensive fire control systems, adaptation of handling, loading, carrying and releasing devices for special weapons, and all apparatus for the launching of projectiles.

In addition, the Wright Air Development Center pursues investigations in automatic and remote flight controls for aircraft and guided missiles as applied to fire control and bombardment.

These programs, requiring development of new armaments, and insuring their compatibility with the aircraft or missile, are projected many years into the future.

Indicative of the complexity of modern armament systems, and the time required to perfect them, is a bombing system currently used by the Air Force. It links automatic sighting with automatic navigation, permitting high-speed bombing at night or through overcast with greater accuracy than previous daylight methods at half the altitudes and speeds. Weighing 1700 pounds, the equipment contains 365 vacuum tubes.

It required 10 years' research and development from inception to final design.

Extensive flight tests are conducted here to prove the worth of new aircraft, equipment and techniques. In addition, the Wright Air Development Center devises means to control and operate military aircraft under all climatic and environmental conditions, and performs all-weather phase testing of Air Force Aircraft.

Conducting the flight test program is a team effort by the project engineer and test pilot. Their main ob-jective is to obtain fnaximum results at minimum expense. Each test flight contributes to the storehouse of knowledge which enables the Wright Air Development Center and the aviation industry to design and build better aircraft and equipment. And although in-novations and changes in design criteria are tested thoroughly in wind tunnels, it is the flight test that provides the final evidence to prove the engineer's theory.

Typical flight evaluations at Wright Air Develop-ment Center, combining laboratory development and flight test achievements, include such special projects as in-flight refueling, parasite fighters, aircraft towing, assist takeoff, and effects of extreme heat and cold on aircraft. Flight testing is conducted on numerous aircraft components and items of auxiliary equipment, such as engines, generators, supersonic propellers, aerial cameras, drag parachutes and plastic fiber glass wings.

Techniques are perfected for radar air traffic control, completely automatic takeoff, flight and landing, and aircraft artificial stability and control.

All sorts of aircraft are used by Wright Air Development Center to conduct these flights, from the older, reciprocating engine types to the latest production and experimental jet models.

The purpose of the all-weather phase testing by the Wright Air Development Center is to determine the ability of aircraft to fly under adverse weather conditions, and to make recommendations for instrument and night flight operations. Missions are flown day and night, and under a variety of weather conditions. Data from these flights are compiled in a comprehensive evaluation of the aircraft's all-weather capabilities and used as a basis for operating instructions to all Air Force pilots.