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THE TRAINING AND UTILIZATION OF AIR FORCE EXPERIMENTAL TEST PILOTS

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PREFACE

The subject of this research paper has been a matter of intense interest to me from the very first year of my assignment as an Air Force experimental test pilot. From early 1942 until December 1943 I was assigned to the Aircraft Laboratory Engineering Division, Headquarters Air Materiel Command, as a test pilot and project officer. Upon my return from overseas in January 1945 I was assigned to the Flight Test Division, Headquarters Air Materiel Command, as a test pilot and have been there up to the date of my assignment to the Air Command and Staff School, Headquarters Air University. I have successfully completed both the Performance Test Pilot School and the Stability and Control Test Pilot School. During these latter four and half years I have conducted many flight test projects, such as: the flight performance evaluation of German jet propelled aircraft; the structural integrity flight tests of the B-29; the performance and stability flight tests of the XB-45; the performance and stability flight tests of the YB-49; project officer in charge of the X-1 project; and many other varied and sundry functional ~~and laboratory~~ flight tests.

I wish to acknowledge and extend my sincerest appreciation and thanks to the Flight Test Division, Headquarters Air Materiel Command for information furnished which greatly aided in preparing this research paper.
The ideas ~~conclusions~~ and ~~recommendations~~ OPINIONS expressed are primarily my own and not necessarily those of the Flight Test Division, Headquarters Air Materiel Command.

SECTION I

INTRODUCTION

The rapid development of aviation during recent years has posed many and varied problems for the United States Air Force. One of these problems which hits deep at the roots of future Air Force progress is the proper training and utilization of Air Force experimental test pilots. It is therefore proposed to analyze the Air Force test pilot, his duties, qualifications, and training. To recommend changes in policy that presently affect his training, status, and assignment. It is further proposed to show wherein these changes of policy will benefit the using organization as well as the United States Air Force in general. In order to approach the problem with a clear understanding of the situation it will be necessary to discuss briefly the following questions: What is the purpose of Flight Testing? What Air Force organization is charged with the responsibility of conducting Flight Tests? Once these questions have been answered the problem can be developed with regards to the individual test pilot.

Purpose and Organization for Flight Testing

The overall purpose of flight testing in its broadest sense is to assure that the Air Force will receive the optimum in engineering and materiel commensurate with the capabilities of our aviation industry, and the finances available. A further study of this flight test purpose indicates that there exists three general headings which can be classified as Evaluation, Development, and Research.[1] All three are closely interrelated and the line of demarcation between them is best defined by the requirements of the Flight Test Organization necessary to serve each purpose. The primary purpose of the present Air Force flight test activity is to evaluate aircraft and aircraft component parts which have been purchased and designated as service articles. This evaluation requires only such engineering as is necessary to accurately measure the movement of the aircraft through space for a given configuration of power and control settings. The second purpose of flight testing is to serve the development of aircraft and component parts. It can be readily seen that after

the first model of an aircraft has successfully flown it may often be desirable to change its characteristics or operating characteristics of certain component parts. This can best be accomplished by rigorous and continuous flight testing of all proposed changes.[2] The third purpose and that requiring the most comprehensive engineering study is the <u>research</u> for design criteria of future aircraft.

> . . . Development should not be confused with research. In development, the end is a product, not an answer to a problem. A product may be developed solely by cut-and-try methods, but frequently research must be employed. The product of research is an ANSWER to a problem, and this information is represented by the research report.[3]

In order to properly fulfill this mission, Headquarters USAF has issued appropriate Air Force Regulations which designate the Air Materiel Command as the sole activity responsible for conducting flight tests on Air Force Aircraft.[4] This responsibility is further delegated to the Flight Test Division by Air Materiel Command Regulation 20-303 which provides for the organization and mission of the Flight Test Division.

There are two major exceptions to this centralized control of Flight Testing. The first is that the Using Activities, Air Proving Ground, and Air University are authorized to evaluate operational and tactical methods, improve techniques or identify undesirable characteristics of the Aircraft assigned to the activities involved.[5] The second exception is with regards to the conductance of Accelerated Service Testing on new type aircraft. Air Materiel Command still retains responsibility for the accomplishment of this type mission, but they provide only the necessary facilities and key personnel. The organization that is to receive the new type aircraft furnished the majority of the flight and maintenance personnel.[6] These exceptions have caused a continuous duplication of flight test effort. The following statement by Lt. Col. R. E. Horner, Chief of the Flight Test Division, Test Engineering Subdivision, clearly illustrates this fact. . . . "This organization [Flight Test Division] is continuously being requested for technical assistance, instrumentation, and facilities by other activities to help them conduct flight tests."[7]

The scope of the main problem prevents any further discussion of the duplication of flight test effort within the USAF. It was briefly discussed at this time since it will have a bearing on the recommendations to be made by the writer.

Importance of the Test Pilot

The purpose of flight testing has been stated--the importance is obvious. If the Air Force is to succeed in its Mission, her aircraft and equipment must possess a technological advantage over the aircraft and equipment of other nations. The industrial power of our nation is unquestionably the best in the world. It is reasonable to assume that our aeronautical engineers and scientists will produce the ultimate in aircraft design. The burden of accurate and scientific evaluation, development, and research will then lay squarely on the shoulders of the pilots who perform these flight tests. This is a tremendous responsibility, the importance of which cannot be over-emphasized. There are many who believe that flight testing will someday, in the not too distant future, be conducted by remote control of full scale aircraft. This would be extremely desirable, however, it is doubtful if man will be able to design a remote control mechanism that will have the power to utilize judgment and to qualitatively evaluate the characteristics of the aircraft. During a recent meeting of the Royal Aeronautical Society, Mr. H. Davies, M.Sc., A.F.R. Ae. S., had this to say regarding the importance of flight testing and the test pilot:

> . . . The importance of attempting to analyse these effects in flight, however, cannot be over-emphasised, particularly from the point of view of obtaining direct full scale checks on model [wind tunnel] and theoretical work.[8]
> . . . It is only by using to the fullest extent all the available resources that we can hope to solve the immense problems with which we are still faced, and there is no doubt that piloted flight research should continue to form one of the most important links in this work.[9]

Mr. G. R. Edwards of the Vickers-Armstrong Ltd. aircraft company made the following remark during the discussion period of this meeting:

> . . . The work of high speed flight testing was probably more important at this stage than ever it had been, and the correlation of the results of high speed flight tests was of the utmost importance to the future of aviation in this country.[10]

Summary

The problem has been presented and limited as to scope. A certain amount of background material was presented as a base upon which to build the problem and to assure that future material would be more understandable. The purpose and organization for flight testing was developed in order to bring into sharp focus the importance of the Air Force experimental test pilot. With this last point clearly established the writer may now proceed with the analysis of the test pilot.

NOTES FOR SECTION I

[1]Lt. Col. W. E. Kinney, "Air Force Flight Test System," a lecture presented to Air Command & Staff School 1946-47 (AC&SS Instructional Folder ND-62), passim.

[2]Benson Hamlin, B.Ae.E., M.I.A.S., Flight Testing Conventional and Jet Propelled Airplanes (New York: The MacMillan Co., 1946), p. 2.

[3]C. E. Lucke, "Experimental Engineering Methods," Mechanical Engineering, (October, 1948), pp. 793-794.

[4]Air Force Regulation 20-41, Organization General, Experimental Engineering (Washington: Headquarters USAF, 14 April, 1949), para. 3.

[5]Ibid., para. 4.

[6]Air Force Regulation 55-7, Accelerated Service Testing, Allocation, and Transition Flying of New Type Aircraft (Washington: Headquarters USAF, 2 September, 1948), para. 3.

[7]Flight Test Division--Directorate, Research & Development, a briefing given to USAF Air Inspectors' Field Team by FTD Staff Officers (Dayton: Headquarters AMC, not dated), p. 9.

[8]H. Davies, M.Sc. A.F.R., Ae.S., "Flight Research at High Subsonic Speeds," The Royal Aeronautical Society Journal, London, England, (August, 1948), p. 495.

[9]Ibid., p. 503.

[10]G. R. Edwards, Vickers-Armstrong Ltd., "Discussion of Flight Research at High Subsonic Speeds," The Royal Aeronautical Society Journal, London, England, (August, 1948), p. 504.

SECTION II

THE TEST PILOT AND HIS DUTIES

An experimental test pilot is a rated officer who pilots all type of aircraft, both conventional and unconventional, for the purpose of acquiring research, test, experimental, and investigational data. He is designated as an experimental test pilot by Flight Test Division office instructions and is required to perform the duties prescribed therein.[1] These duties are many and varied. The variance in duties is directly proportional to the degree of skill and training possessed by the individual test pilot. Personnel possessing the higher degree of skill and training will naturally perform the majority of the important and difficult flight tests. The Chief, Operations Subdivision, selects the pilot personnel for these flight tests from a recommended list of pilots submitted by the Chief of the operations section concerned with the pilot and the test.[2] It was previously mentioned that the duties varied proportionally to the degree of skill and training possessed by the test pilots. These varying degrees and classes of pilots will be presented in the following paragraphs. It is well to mention that although treated separately, any pilot may become qualified in one or all of these different classes.

Stability and Control Pilot

"Stability and control evaluation requires the highest degree of flying skill and technique of any of the evaluation tests."[3] It is for this reason that this type of test pilot is usually qualified for all classifications of experimental flight testing. The stability and control pilot enters the field of research and development at the testing and investigational stage to test and investigate the design, construction, and inherent stability of aircraft and equipment developed for use by the Air Force.[4] The result of the programs conducted by him are recorded and prepared in report form. The data acquired through stability and control tests is studied by the pilot; and recommendations are included in the report, which have as an objective, improvement in design

and contruction of aircraft and equipment, or the adoption of new types.[5] The stability and control pilot frequently coordinates with the engineer in drafting and specialization writing of the details necessary to accomplish his recommendations by either the laboratory or the contractor. All of the above has reference to experimental and research aircraft and equipment, as well as improvements on standard material.

In the accomplishment of the above, the stability and control pilot conducts tests and investigations to indicate compliance of experimental aircraft and equipment with predetermined specifications. These tests and investigations consist of precision flights in aircraft completely instrumented with aileron, stick, rudder force, and position indicators.[6] The tests include determination of stall data; dynamic and static longitudinal, directional, and lateral stability; elevator, rudder, and aileron control power and control forces; longitudinal, directional, and lateral high-speed requirements; trimming devices; control system friction; pilot mechanical advantages; and altitude requirements.[7]

The ability to conduct the above tests and investigations requires knowledge and technique which can only be gained by study, training, experience, and constant practice. Extremely close tolerances must be maintained at all times on air speed, control force, control position, heading, altitude and attitude.

Performance Pilot

The performance test pilot enters the field of research and development in the same stage as the stability and control pilot, since phase II tests consist of the three components: Stability and Control; Performance Tests; and Aircraft Power Plant Cooling Tests.[8] Therefore, the general duties of this pilot are similar to those of the stability and control test pilot, but the specific duties vary insofar as the actual flight program is concerned. It is well to note that in actual practice the Aircraft Power Plant cooling tests are in most cases incorporated as part of Performance testing and will not be treated separately in this discussion.

The performance test pilot assists in carrying out flight research programs by piloting various types of experimental aircraft and new

production aircraft on specified flight tests; such as: airspeed calibrations, high speed tests, operating speeds, sawtooth climbs, check climbs, take-off and landing tests, rate of fuel consumption, and asymetric power performance.[9] All of these tests are designed to measure the quantitative performance of an aircraft, and require specialized knowledge of flight test methods and procedures, plus the ability to perform precision flying, and to prepare data for and to write reports of results of flight tests. In addition, he confers with and interprets test data for project, factory, and NACA engineers.

Research Project Pilot

The research project pilot may be a performance pilot or a stability and control pilot, but it is desirable that he be qualified for both positions since research involves both performance and stability interpretation. However, when in charge of a project, there are certain responsibilities and duties peculiar to this assignment which demonstrate the added importance of this position to the field of research and development.

In addition to the actual flying of the aircraft connected with the project, the pilot must be thoroughly familiar with the liaison of his activity with various laboratories and research sections in order that all phases of the investigation can be coordinated. This pilot must, therefore, have an intimate knowledge of the functions of each of those activities, as well as the ultimate object or result of the project which he is conducting. This pilot must be qualified to record all flight data acquired during such tests and to confer with the project engineer concerning such data, making recommendations for changes and improvements in the program or project.[10]

During the flight tests, the pilot supervises the overall program, including the test crew, the instrumentation of the aircraft, and maintains liaison with the contractor. He flies the aircraft to test and investigate its characteristics, and to evaluate the equipment included thereon. The data resulting therefrom is recorded in report form, along with recommendations for changes and modifications in the design and

construction of the airplane or equipment.

It is rather obvious, but it must be stated that this type of test pilot should be a graduate aeronautical engineer in addition to his other qualifications.

Functional Pilot

Under this heading comes all the other types of tests; such as: pacer calibrations, laboratory tests, special tests and accelerated service tests. The majority of these are of a routine functional nature that do not require the services of a performance or stability and control pilot. In some cases performance data is required and therefore it is advantageous that the pilot be qualified as such. A functional pilot is usually one who is becoming oriented with the Flight Test Division while awaiting his opportunity to attend the performance school or the stability and control school. In most cases, however, he has completed the performance school but is serving his apprenticeship under the guidance of the more experienced test pilots, and the Chief of his operations section.[11]

Classification of Experimental Test Pilot

Faced with the preponderance of material presented thus far, it would be hard to refuse to accept the fact that the experimental test pilot is not only important, but that he is a highly skilled individual possessing specialized knowledge and experience. Headquarters USAF has stated: ". . . The importance to the USAF of identification of these highly skilled individuals is not questioned." [12] Yet at the present time there does not exist a Military Occupational Specialty to accurately identify these pilots.

The common error is to classify the experimental test pilot with the MOS Flight Test Maintenance Officer, SSN 4821, whose duties are: ". . . Performs all necessary ~~thest~~ test flights to check safety of operation of all parts of a particular type aircraft after repairs have been made."[13] This exact specialty definition does not identify the skills of an experimental test pilot. As a temporary expedient, the MOS Design and Development Officer, SSN 7050, with designated field (Experimental Test Pilot) has been authorized by AMC to identify these positions.[14] The broad scope of the SSN 7050 does not specifically define the required skills of the Experi-

mental Test Pilot, but in lieu of a narrower identification this SSN most nearly identifies the duties being performed. The adverse results of faulty classification should be recognized by all officers. However, in order to clarify this specific case, several of the disadvantages will be pointed out.

First is the matter of personnel accounting. Periodic personnel inventories submitted to Air Force Headquarters account for officers by the classification specialty in which they are qualified.[15] Inasmuch as a classification, SSN 7050, has been authorized for use by AMC, the records of that command will show a sharp increase in authorized SSN 7050's which is a critical engineering Military Occupational Specialty.[16] Therefore further requests for Design and Development Officers would require justification and needless explanations. If the test pilot is accounted for in the inventory by some other qualification such as a Jet Fighter Pilot, then at the end of his 15 months of specialized training no accounting would be made of his additional training and experience since a new classification is not available other than SSN 7050 which does not indicate this training.

The second adverse effect is a considerable waste of talent. When Air Force Headquarters directs AMC to furnish a quota of officers in a specific category, this quota is based on personnel inventories. As a consequence, whenever a test pilot is transferred to fill a quota, the highest qualification of the officer is not utilized.

A third unfavorable result occurs in the assignment of officers to the Flight Test Division. At present, personnel requisitions are for Cargo, Fighter, and Bomber pilots; however for several years the turnover of officers in the organization has been extremely high and undoubtedly there are well qualified officers who might be available for duty with the Flight Test Division if their qualifications were properly identified.[17]

The last consideration is that of Morale. The writer knows from personal experience that the morale of the Flight Test Division is one of the highest in the Air Force. Yet correct classification as an Experimental Test pilot and the premium that such a classification carries with it in

both military and civilian life would be an added incentive for greater achievement.[18]

Summary

An attempt has been made to define and analyze the experimental test pilot. His duties and the varying degrees of skills required have been presented in order to establish the high degree of skill necessary to perform the duties of an experimental test pilot. The lack of proper classification for this position was explained and the adverse effects were discussed.

NOTES FOR SECTION II

[1]Office Instruction No. 36-2, Qualifications, Recommendations, and Utilization of Experimental Test Pilots (Dayton: Flight Test Div. Headquarters AMC, 6 October, 1948), para. 2.

[2]Office Instruction No. 11-6, Test Crews for the Conduct of Phase II Flight Tests (Dayton: Flight Test Div., Headquarters AMC, 9 August, 1948), para. 4a.

[3]Lt. Col. R. E. Horner, "Flight Testing in the USAF," a lecture presented to Air Command & Staff School, 22 April, 1948 (Air University Library Folder M-32581-NC), p. 10.

[4]Benson Hamlin, B.Ae.E., M.I.A.S., Flight Testing Conventional and Jet Propelled Airplanes (New York: The MacMillan Co., 1946), p. 1.

[5]Office Instruction No. 11-5, Standardization on Reporting Results of Phase II Flight Tests (Dayton: Flight Test Div., Headquarters AMC, 24 May, 1948), p. 2.

[6]AAF Technical Report No. 5242, Stability and Control Flight Test Methods (Dayton: Headquarters AMC, 14 July, 1945), p. 100.

[7]AAF Specifications No. R-1815-A, Stability and Control Characteristics of Airplanes (Dayton: Headquarters AMC, 7 April, 1945), pp. 1-15.

[8]Office Instruction No. 11-7, Contents of Phase II Flight Tests (Dayton: Flight Test Div., Headquarters AMC, 6 October, 1948), pp. 1-2.

[9]Ibid., pp. 2-3.

[10]Lt. Col. R. E. Horner, "Flight Testing in the USAF," a lecture presented to Air Command & Staff School, 22 April, 1948 (Air University Library Folder M-32581-NC), pp. 12-15.

[11]Office Instruction No. 36-2, Qualifications, Recommendations, and Utilization of Experimental Test Pilots (Dayton: Flight Test Div. Headquarters AMC, 6 October, 1948), p. 3.

[12]Request for New MOS, Experimental Test Pilot, a letter from Director of Military Personnel to Headquarters AMC (Washington, 26 July, 1948), para. 1.

[13] AAF Manual 35-1, Military Personnel Classification and Duty Assignment ( ), pp. 398-399.

[14] Request for New MOS, Experimental Test Pilot, a letter from AMC Military Personnel Division to Chief of Staff, USAF, Washington DC (Dayton, 4 May 1948), para. 2.

[15] Major F. H. LaMarre, "Personnel Reporting," a lecture presented to Air Command & Staff Students, 22 April, 1949, passim.

[16] Annual Report of the Secretary of the Air Force for fiscal year 1948, a report prepared for the National Military Establishment (Washington: Government Printing Officer, 1948), p. 192.

[17] ~~Flight Test Division--Directorate, Research & Development, a briefing given to USAF Air Inspectors' Field Team by FTD Staff Officers (Dayton: Headquarters AMC, not dated), p. 3, para. 5.~~

18. J. A. Crosby Warren, M.A., A.F.R., Ae.S., The Flight Testing of Production Aircraft (London, England: Sir Isaac Pitman & Sons, Ltd., 1943), p. 5.

[redacted] LETTER

17. FLIGHT TEST DIVISION, INFORMATION FROM TECHNICAL OFFICER (Dayton: FTD HQS AMC 5 SEPT 1949)

SECTION III

QUALIFICATIONS OF THE TEST PILOT

This analysis would not be complete without a consideration of the individual qualifications necessary to be an experimental test pilot. The very nature of the work is physically strenuous, and demands that the test pilot be in the best of mental and physical condition. Doctors F. E. Poole and R. W. Besser conducted a medical survey on a group of experimental test pilots over a period of five years from 1942 to 1947. The results of their research has been published and it is interesting to note their opinions on physical fitness.

> . . . In all occupations there is some degree of correlation between physical fitness and successful performance. Many enterprises have been capably directed from a bed or wheelchair. In such instances the degree of correlation between physical fitness and success is low. There is, however, a high degree of correlation between health and successful performance as a test pilot. In no other occupation is there such uncompromising need for mental alertness, fast reaction time, manual dexterity, muscular co-ordination, and stamina.[1]

The truth of the above statement has been borne out in many instances. Some very promising future Air Force test pilots have been handicapped by not being in the best of physical condition. At present time when a pilot is assigned to the Flight Test Division, he is considered qualified for test pilot training if he has passed a "64" physical examination. These physical examinations are given once a year and were suspended last year. Therefore most pilots have not had a physical examination during the past two years.[2] Under these exacting conditions a pilot may be allowed to finish his training and begin to perform test pilot duties without any kind of physical check-up. This is both dangerous to the pilot, and not in the best interests of the service since reduced physical standards may result in loss of an expensive experimental aircraft.[3] Furthermore, the financial cost and time spent in training a test pilot is wasted if future physical examinations expose physical defects. It can therefore be said that the future test pilot and those presently assigned should be given rigorous periodic physical examinations to determine that they do meet the most exacting of physical requirements.

Interest

The primary and most important single qualification is a keen and earnest interest to become a test pilot. A pilot could be a perfect physical speciman with an aeronautical engineers degree and yet if he lacked the interest his efforts would be mediocre. A test pilot without a sincere interest in his occupation will begin to balk at flying certain tests.[4] This in turn will lead to lack of confidence and a mental distrubance that isdangerous in this type of duty. It is this lack of interest and later the loss of interest in test flying that can lead to serious consequences. Doctors Poole and Besser realized this mental condition to be of importance and have stated:

> . . . No selection tests other than physical examinations have been used. However, in view of our observations over a period of several years, we believe it would be highly desirable to utilize a group of mental selection tests, including temperament and personality.[5]

A further consideration is again the waste of time and money in training a test pilot who lacks interest. His service will soon be lost to the Flight Test Division. Lt. Col. Leo Moon, Chief of the Air Materiel Command Performance and Stability School had this to say on the subject of interest in would be test pilots: ". . . Interest in test flying is the really serious factor--we can put up with most anything except lack of interest."[6]

Therefore it can be seen that a really good test pilot, or future test pilot, must have a full hearted interest in turning "green" or raw aircraft into live things that will be a benefit to the Air Force, and assure the safety of the crews that will eventually fly them.

Flying Skill

This, of course, is the basic qualification for a good test pilot. It is desirable that a future test pilot be among the leading pilots in the service. Basically he should be assessed as possessing exceptional or above average ability as a pilot.[7] "Hot pilots" and those that are prone to have accidents definitely do not qualify since there is too much at stake. The old fashion version of the test pilot wrapped in its hazy aura of glamorous high adventure is gone. No more do they judge a test pilot's flying

quote

skill by his ability to tear the wings off the aircraft in a screaming terminal velocity dive. This has been replaced by flying abilities capable of holding very close tolerances in airspeed, altitude, and rate of climb while engaged in read ng data, adjusting power, and writing down observations. It is an exact science requiring precision flying of the highest caliber.[8]

Quote

Education

Based upon the duties of a test pilot that were presented in Section II, it would be extremely desirable if all test pilots were graduate aeronautical engineers. The Navy has a very strong opinion on this matter. They claim that the test pilot must be an aeronautical engineer if his test results are to be dependable.[9] This is a rather strong statement since pilots with aeronautical engineering degrees are a rare specie in the Air Force. The Naval test pilots' school at Patuxent River, Maryland have cut this prerequisite down to read two or more years of college engineering.[10] This is more in line with the requirements of the Air Force and the Royal Air Force test pilots schools. It is worthy to note that all three schools are in agreement that a sound education in engineering is a highly desirable prerequisite.[11]

Of equal importance, if not more so, is the capacity and ability to learn. A pilot that meets all the afore mentioned qualifications and has the capacity to learn, should not be disqualified if he does not have the required educational background. The training received in the test pilots school plus other educational opportunities can overcome the formal education barrier. A very good example of this capacity and ability to learn is Capt. Charles E. Yeager who though possessing only a high school diploma has developed into one of the Air Force's leading supersonic research test pilots. The training received at the test pilots school and sincere personal applications towards advancing his knowledge of engineering principles have advanced Capt. Yeager to an educational level where he can converse intelligently with leading aeronautical engineers.

Summary

This section presented the essential qualifications necessary for

a pilot to possess in order to qualify as a test pilot. The physical aspects were discussed, and the need for a rigorous physical examination program was established. It was pointed out that interest was the primary and most important factor to consider in selecting test pilots. Exceptional or above average flying skill was established as being the basic prerequisite for a successful test pilot. The educational problem was discussed and an attempt was made to illustrate that although a formal engineering degree was desirable, the capacity to learn was of equal if not greater importance. It is hard to really classify all of the qualifications in their order of importance since they are all important and all interrelated. A pilot who aspires to become a test pilot should possess all of the afore mentioned qualifications.

NOTES FOR SECTION III

[1]F. E. Poole, M.D., and R. W. Besser, M.D., "Health Maintenance of Test Pilots," The Journal of Aviation Medicine, XX (February, 1949), pp. 47-48

* [2]Circular 375, Air Force Letter 160-13, Medical Examinations (Washington DC: Government Printing Office, 3 December, 1948), para. 1.

[3]Air Command & Staff School Pamphlet No. 45, Logistics, Medical Service (Montgomery: Air University, 1 August, 1949), Chapter 3, Section IV, p. 7.

[4]F. E. Poole, M.D., and R. W. Besser, M.D., "Health Maintenance of Test Pilots," The Journal of Aviation Medicine, XX (February, 1949), pp. 55-57.

[5]Ibid., p. 55.

[6]Lt. Col. Leo C. Moon, Chief AMC Flight Test Division Performance and Stability School, "Cirriculum of School and Qualities of Test Pilot," a letter of information (Dayton: Flight Test Division, 5 September, 1949).

[7]Air Ministry Orders A.499, The Empire Test Pilots School (England: Air Ministry, Royal Air Force, 7 July, 1949), p. 9.

[8]R. M. Stanley, Chief Engineer, Bell Aircraft Corp., Flight Testing Conventional and Jet Propelled Aircraft by Benson Hamlin (New York: The MacMillan Co., 1946), p. V.

[9]Rear Admiral Apollo Soucek, Commandant U. S. Naval Test Center, "The Story of Patuxent," Aero Digest, (December, 1948), p. 34.

[10]Indoctrination and Training of Naval Test Pilots, a letter of information from Commander Naval Air Test Center to Commander Naval Div. AC&SS (Patuxent River, Maryland, 29 September, 1949), p. 1, para. 2.

[11]Office Instruction No. 36-2, Qualifications, Recommendations, and Utilization of Experimental Test Pilots (Dayton: Flight Test Div. Headquarters AMC, 6 October, 1948), p. 2, para. 4d.

SECTION IV

THE TRAINING PROGRAM

The exact science of flight testing is a dangerous and highly specialized profession that requires specialized training.[1] There are three flight test pilot schools presently in operation to provide such training. The Royal Air Force Empire Test Pilot School is located at the Royal Aircraft establishment, Farnborough, England.[2] The United States Navy established their Pilot Training Division in May, 1948. This training division was activated under the Naval Air Test Center, Patuxent River, Maryland.[3] Headquarters Air Materiel Command was delegated the responsibility of establishing and maintaining the Air Force Test Pilot Performance and Stability School. This school was activated in 1944 under the operational and administrative control of the Flight Test Division, Headquarters AMC, Wright-Patterson Air Force Base, Dayton, Ohio.

Importance of A. F. Test Pilot School

The importance of proper and extensive training in this field is obvious if the test pilot is to successfully accomplish the duties mentioned in Section II. A pilot may possess all the necessary qualifications for a test pilot, but without the proper training he is lacking the tools with which to successfully apply his profession.[4]

The civilian aircraft industry have no such schools to train their test pilots. As a result, most of their test pilots are older due to the fact that they have had to acquire this training the hard way - through experience and personal endeavour. All the aircraft companies have long realized that the final quality of their products must depend upon the quality of their test pilots. In this highly competative field of aircraft production this is a very important factor. For this reason the aircraft companies have placed a large premium on the graduates of the Air Force Test Pilot School. There are at present approximately seven or eight former Air Force test pilots employed by various aircraft companies. These pilots are all graduates of the Air Force Test Pilot School who were lured away from the service by offers of substantial increases in income. An example

of this fact is shown by the Want Ad that was published not long ago in Aviation Week.

CHIEF TEST PILOT

There is a top pay job open right now for the right man who can qualify as a chief engineering test pilot. Should have formal engineering education; should be graduate of Wright Field AAF Test Pilot School; should have 4 engine experience. Will be engaged in flying experimental single, twin, and 4 engine aircraft.[5]

BEECH AIRCRAFT CORPORATION
Wichita 1, Kansas

This aspect of training was presented not as a rebuke against the aircraft industry or the former Air Force test pilots, but rather as a means to establish the importance of the present Air Force training program. These pilots though not in the service are still aiding in the overall development of better aircraft for the United States.

Curriculum

A comparison of the Air Force and the Navy course of study and practice tests flown indicates that there is no appreciable difference in the curriculum of the two schools.[6] The curriculum of the Royal Air Force Empire Test Pilots School is also very similar and is a nine to ten month course.[7] The Air Force school is divided into two courses which takes a total of seven to eight months to complete. The Navy's course of instruction is approximately two months shorter than that of the Air Force school. Since the instruction presented in all three schools appears to be approximately the same, the curriculum of the Air Force Test Pilots School will be presented as a representative course of instruction. Due to the bulk of materiel contained in the curriculum outline, it is presented as Appendix A.[8]

In addition to the Air Force Test Pilots School, there are advanced courses available to outstanding graduates of this school. The most important of these courses is the Flight Test Aerodynamics Course at Princeton University. One interesting problem concerning these advanced courses is that the Flight Test Division is never assured that the students will be reassigned to the Division upon their graduation. This indicates waste of talent and experience due to current Air Force assignment policies.[9]

Selection of Students

This phase of the training appears to be a weak spot in an otherwise sound training program. The only pilots authorized to attend the Performance and Stability Test Pilots School are those pilots that are assigned to the Flight Test Division. There are a few exceptions, such as an occasional civilian test pilot student or an Air Force pilot from another organization. All Flight Test Division pilots are initially assigned to the Accelerated Service Test Section if they possess all the necessary qualifications specified in Section III. The section chief maintains a close survelliance on the newly assigned pilots in order to ascertain their relative flying ability, temperment, personality, and intelligence. Students are then assigned to the school on the basis of the recommendations made by the section chief. The classes are limited to approximately six students every four months. Those pilots that are not assigned to the school remain in the Flight Test Division as functional pilots and may at some later date be allowed to enter the school as a student.

"interest flying skill"

This system employed by AMC does not take advantage of selection from the pilots available throughout the entire Air Force. Both the Navy and the Royal Air Force take full advantage of this wider field from which to select future test pilots. They issue periodic calls for recommendations from all commands and units in their respective services.[10] The pilots that are recommended are then interviewed either by a selection board as in the Royal Air Force or by the Commandant of the Test Center as in the Navy.[11] The outstanding graduates are retained by the respective flight test activities, and the other graduates are returned to their original organizations or other operational units that require the knowledge and experience of a test pilot.[12] In this way they are assured of a high standard of flight testing, and are constantly building up a reserve pool of test pilots who through their training are capable of increasing the efficiency of the operational engineering sections of all Commands and Organizations. As a matter of fact, with the advent of the supersonic era it would probably be advantageous to have all Air Force pilots trained

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along some of the lines of study presented to the test pilots.

Summary

The final step in analyizing the test pilot has disclosed that specialized training is necessary if a pilot is to succeed as a test pilot. The three test pilot schools that provide this training were presented and compared as to length of course, curriculum, and manner of selection of students. It was established that the Air Force Test Pilots School is important and that graduates of this school are highly regarded in the aviation industry. The weakness of the Air Force student selection method was pointed out and compared with the more efficient selection method used by the Royal Air Force and the United States Navy.

NOTES FOR SECTION IV

[1]R. M. Stanley, Chief Engineer, Bell Aircraft Corp., Flight Testing Conventional and Jet Propelled Aircraft by Benson Hamlin (New York: The MacMillan Co., 1946), p. V.

[2]Air Ministry Orders A.499, The Empire Test Pilots School (England: Air Ministry, Royal Air Force, 7 July, 1949), p. 8.

[3]Indoctrination and Training of Naval Test Pilots, a letter of information from Commander Naval Air Test Center to Commander Naval Div. AC&SS (Patuxent River, Maryland, 29 September, 1949), p. 1, para. 1.

[4]Flight Test Division - Directorate, Research & Development, a briefing given to USAF Air Inspectors' Field Team by FTD Staff Officers (Dayton: Headquarters AMC, not dated), p. 7.

[5]Beech Aircraft Corp., "Want Ad Section," Aviation Week (14 March, 1949), p. 46.

* [6]Indoctrination and Training of Naval Test Pilots, a letter of information from Commander Naval Air Test Center to Commander Naval Div. AC&SS (Patuxent River, Maryland, 29 September, 1949), Endosure A.
Lt. Col. Leo C. Moon, Chief AMC Flight Test Division Performance and Stability School, "Curriculum of School and Qualities of Test Pilot," a letter of information (Dayton: Flight Test Division, 5 September, 1949).

[7]Capt. D. A. Grubaugh, "Information on Empire Test Pilots School," a personal letter presenting information on curriculum, 5 September, 1949.

[8]Lt. Col. Leo. C. Moon, Chief AMC Flight Test Division Performance and Stability School, "Curriculum of School and Qualities of Test Pilot," a letter of information (Dayton: Flight Test Division, 5 September, 1949).

[9]Flight Test Division - Directorate, Research & Development, a briefing given to USAF Air Inspectors' Field Team by FTD Staff Officers (Dayton: Headquarters AMC, not dated), p. 3.

[10]Air Ministry Orders A.499, The Empire Test Pilots School (England: Air Ministry, Royal Air Force, 7 July, 1949), p. 9.

[11] Indoctrination and Training of Naval Test Pilots, a letter of information from Commander Naval Air Test Center to Commander Naval Div. ACASS (Patuxent River, Maryland, 29 September, 1949), p. 1, para. 2.

[12] Rear Admiral Apollo Soucek, Commandant U. S. Naval Test Center, "The Story of Patuxent," Aero Digest, (December, 1948), p. 34, para. 4d.

SECTION V

CONCLUSIONS AND RECOMMENDATIONS

The purpose and importance of exact scientific flight testing was established in order that an intelligent discussion of the problem might be presented. It was further established that the experimental test pilot was the instrument with which flight testing was accomplished - the quality of flight testing and the final product being proportional to the quality and capabilities of the test pilot. An analysis of the test pilot, his duties, qualifications and training disclosed four points that should be considered as weak spots in an otherwise sound training and utilization program.

The Need for Accurate Classification

Conclusion

No MOS now authorized accurately identifies the duties of an experimental test pilot. In consideration of the lengthy indoctrination and training period of from 12 to 15 months required to qualify these pilots, and the tremendous responsibilities involved in the duty assignment, it is considered essential that this high level of ability and experience be accurately classified. This should be done in order to prevent all of the present disadvantages which are accruing due to faulty classification, and to achieve the objective of correct classification as described in paragraph two if AF Manual 35-0-1. The MOS presently in use to classify these duties, Design and Development Officer (Experimental Test Pilot), SSN 7050, is desirable in the absence of a more specific designation, however, the field encompassed by that SSN is so broad that the identification of the specialized abilities developed by experimental test pilots is apt to be obscured in generalizations.

Recommendation

That Headquarters USAF establish a Military Occupational Specialty which will accurately identify the experimental test pilot.

Tour of Duty for Test Pilots

Conclusion

Flight Test Division personnel records indicate that the average tour of duty for officers assigned to that Division is approximately 17 months. During one twelve month period a loss of 60 was experienced out of an average strength of 117 officers. This represents a turnover of approximately 51%. Since the indoctrination and training period takes from 12 to 15 months, an assignment of 17 months is so brief that it must adversely affect the overall operation of the Flight Test Division. Personal experience has indicated that it takes almost two years for a pilot to mature into a useful experimental test pilot.

Recommendation

That a study be initiated to investigate the causes for this rapid turnover, and that if at all possible the tour of duty of experimental test pilots be definitely established at five years. The establishment of a five year tour of duty being based on the fact that the first two years are devoted to developing a successful test pilot.

Medical Supervision

Conclusion

It has been established that there is a high degree of correlation between physical fitness and successful performance as a test pilot. Another factor to consider is that loss of interest in test flying on the part of the test pilot who is still forced to continue, either due to personal pride or necessity, will result in mental disturbances which will adversely affect his performance of duty. An annual physical examination is not considered as sufficient. Due to existing regulations, it will be two years since the Air Force test pilot was last examined. There is an uncompromising need for close and continuous medical supervision in order to prevent future loss of life and valuable experimental aircraft.

Recommendations

That Flight Test Division personnel authorization include a Flight Surgeon and the necessary assistants to provide a close and continuous physical and mental check of all Division test pilots.

That the Division Flight Surgeon assist in the selection of pilots for test pilot training, and make recommendations to the Division commander with regards to the selection of test pilots for flight test assignments.

The Training Program and Selection of Students

Conclusion

The degree of training and the quality of the instruction presented in the Performance and Stability Test Pilots School is, beyond a doubt, of the highest quality obtainable. However, student selection for the school is at present limited to only those pilots assigned to the Flight Test Division.. This procedure narrows the field of selection quite considerably. When a pilot is assigned to the Division there are only three alternatives. First, he may be exceptional materiel and will be a successful test pilot upon graduation. Secondly, he may graduate, but due to lack of interest or other causes will be a mediocre test pilot. The third consideration is that the pilot will not be acceptable as a student and in that case must be transferred from the Division or kept as a functional pilot. The last two alternatives are not compatible with the Mission of the Flight Test Division.

Recommendations

That the Air Force issue a periodic call to all Commands and Organizations for recommendations of pilots for test pilot training.

That a selection board be established within the Flight Test Division for the purpose of interviewing and screening applicants.

That successful applicants be detached directly to the school and not charged against the authorized personnel strength of the Division.

That only the top graduates be assigned to the Flight Test Division, as needed, and the other graduates be returned to their respective Commands and Organizations. This would assure the Flight Test Division of the best talent available, and the Air Force would derive benefit from the graduates who returned to their organizations better equipped to understand and solve operational engineering problems.

APPENDIX A

CURRICULUM OF THE AIR MATERIEL COMMAND

EXPERIMENTAL TEST PILOTS SCHOOL

I. PERFORMANCE COURSE

A. Military Instructor Pilot.

B. Civilian Instructor (P-3 or P-4)

C. Aircraft presently used:
   C-45s -2
   T-6s -2
   F-51s -4
   F-80s -3

D. Duration of Course - 3-4 months
   1. Practice tests flown.
   2. Test data reduced by student completely.

E. Tests.
   1. C-45 tests.
      a. Demonstration of sawtooth climbs, power required points, airspeed calibration over speed course, altimeter and free air temperature gauge calibration.
      b. Students fly all of the following tests as teams of two students per team:
         (1) Airspeed calibration - speed course method.
         (2) Altitude and FAT calibration - fly by power method.
         (3) Sawtooth climbs.
         (4) Check climbs.
         (5) Power required.
         (6) Speed points at several altitudes.
         (7) Cooling sawtooth and drag flights - cowl flaps.
         (8) Fuel flow.

      They reduce engineering data; become familiar with tests, methods, areas, speed courses; and get used to taking all test readings.
   2. T-6 tests.
      a. The students fly each of the above tests in the T-6, the first aircraft flown, requiring that students take all data unaided. Additional test: Stability and control observation with maximum rearward (safe) C.G.
   3. F-51 tests.
      a. Each student must first write up a test program he will fly and emphasis is placed upon the importance of a well thought-out flight program as a major part of the supervisory duty of the test pilot.
      b. Tests are to include the following:
         (1) Airspeed calibration - pacer method.
         (2) Altitude and FAT calibration - pacer method.
         (3) Power required in both blower configurations.
         (4) Speed points to obtain power required curves at all altitudes.
         (5) Sawtooths in both blowers.
         (6) Coolant shutter and oil shutter: cooling-drag and sawtooth runs.
         (7) Two check climbs.

4. F-80 tests.
   a. Sterotyped tests set up by instructors as follows:
      (1) Airspeed, altitude and FAT calibration, pacer method.
      (2) Sawtooths.
      (3) Check climbs.
      (4) Power required and fuel flow.

F. Data reduction; memorandum reports on pilot's observation; test programs.
   1. Each student does complete data reduction of all tests he flys.
   2. A complete test program is written by each student on the F-51 only as it requires the most complicated program and also since he should be fairly familiar with the rudiments of test flying by this time. This is done to impress the student with the importance of each detail of planning to save time and secure the most in test data.
   3. Memorandum reports are required on all aircraft. This is considered the most important part of his work and it actually the end result of test flying. These reports are graded carefully for form, grammer, and content. Also serves as a final examination.
   4. Accident prevention, cost of test vehicles in time and money, and necessity for using each minute of flight in test data gathering is continually emphasized.

G. All aircraft in school are equipped with photo recorders and students install barographs for each flight.

II. STABILITY AND CONTROL COURSE

A. Military Instructor Pilot.

B. Civilian Instructor (F-4)

C. Aircraft used:
   2 - B-25s
   1 - B-25 on loan to Princeton
   1 - New B-25 being instrumented
   1 - New B-26 being instrumented

D. Duration of course - 4 months.

E. Tests are flown and data completely reduced by students.

F. Tests are as follows:
   1. Unaccelerated and accelerated stalls.
   2. Longitudinal static.
   3. Accelerated longitudinal.
   4. Longitudinal dynamic
   5. Directional dynamic.
   6. Lateral dynamic
   7. C_n Maximum landing, full stall, full elevator.
   8. Trim changes.
   9. Side slip characteristics.
   10. Asymmetric power.
   11. Aileron rools and adverse yaw.
      a. 25 tests are flown in all at approximately C.G.'s of from 16% to 34%.

G. Aircraft are instrumented with force measuring devices on all controls, position indicators for all controls and trim tabs, photo recorders, and usual performance sensitive instruments.

H. A memorandum report is written at the end of the tests following standard requirements for stability and control test reports with regard to form, content, grammar and observations.