THE AIRLINE PILOT: A SURVEY OF THE CRITICAL REQUIREMENTS OF HIS JOB AND OF PILOT EVALUATION AND SELECTION PROCEDURES

by

Thomas Gordon

Report of a survey conducted at the American Institute for Research, Incorporated, Pittsburgh, Pennsylvania, under the auspices of the National Research Council Committee on Aviation Psychology, with funds provided by the Civil Aeronautics Administration.

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Committee on Aviation Psychology

Executive Subcommittee

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LETTER OF TRANSMITTAL

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2101 Constitution Avenue, Washington, D. C.
Division of Anthropology and Psychology

Committee on Aviation Psychology

November 4, 1947

Dr. Dean R. Brimhall
Assistant to the Administrator
for Research
Civil Aeronautics Administration
Room 5217, Commerce Building
Washington 25, D. C.

Dear Dr. Brimhall:

The attached report, entitled The Airline Pilot: A Survey of the Critical Requirements of his Job and of Pilot Evaluation and Selection Procedures, by Thomas Gordon, is submitted by the Committee on Aviation Psychology with the recommendation that it be included in the series of Technical Reports of the Division of Research, Civil Aeronautics Administration.

The investigation described in this report represents definite progress in the direction of increasing air safety, since it provides information concerning the nature of flight situations and flight equipment, and the characteristics of pilots which contribute towards unsafe flying. The continued occurrence of airline accidents underlines the necessity for conducting this type of research and the importance of complete cooperation of pilots, company and union officials, and the personnel of the Civil Aeronautics Administration in the conduct of such research. The survey described in the report has established the basis for the next step which calls for the development of improved practical procedures for the examination of flight proficiency of airline pilots.

Cordially yours,

M. S. Viteles

Morris S. Viteles, Chairman
Committee on Aviation Psychology
National Research Council

MSV:rm

ACKNOWLEDGMENTS

The survey described in this report was conducted at the request of the National Research Council Committee on Aviation Psychology. The members of this committee contributed valuable suggestions at all stages of the project. The original planning of the survey was done by John C. Flanagan in cooperation with several members of the Committee on Aviation Psychology. The project was supervised by the writer, who is Director of the Aviation Branch of the American Institute for Research. Acknowledgments are due to the members of his staff for their wholehearted cooperation and effort. L. C. Steckle contributed valuable assistance in contacting a number of the airline companies and in helping to organize the field activities during the early stages of the project.

This survey would not have been possible without the cooperation of the airline pilots and Civil Aeronautics Administration Air Carrier Inspectors who generously furnished information based upon their first-hand experiences. Acknowledgment is made to the following airline companies with whom arrangements were made for examination of their personnel files or for interviewing their pilots:

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October 22, 1947

Thomas Gordon
Director, Aviation Branch
American Institute for Research

EDITORIAL FOREWORD

At the request of the Civil Aeronautics Administration, the National Research Council Committee on Aviation Psychology is conducting an investigation designed to reveal the critical requirements of the job of airline pilot, with particular reference to those aspects of pilot performance which may contribute to accidents during flight, and with the view of developing improved practical procedures for upgrading, selection, and certification of airline pilots.

The first phase of this investigation, involving an analysis of CAA records on airline transport pilots, was described in a report entitled "Analysis of CAA Records on Airline Transport Pilots," by H. O. Preston, published as Report No. 72, Division of Research, Civil Aeronautics Administration.

The second step in this investigation has included interviews with pilots, CAA inspectors, and company check flight personnel, as well as an examination of airline company personnel records. This survey throws considerable light upon critical situations in which airline pilots become involved; pilot characteristics; operating conditions; aspects of equipment design; and other factors which appear to contribute to accidents during flight.

The results of this analysis support the opinion that the improvement of practical flight test procedures for evaluating pilot proficiency represents a promising approach towards increasing flying safety. During the past few months progress has been made in initiating the next phase of the research program, which is concerned with the development of more objective and more adequately standardized flight test procedures for checking flight proficiency of air transport pilots. Steps have been taken to enlist the active support and interest of the Air Line Pilots Association as well as of individual companies in order to make use of the wealth of practical experience and practical judgment which the representatives of such organizations can supply.

The research program described in this report was conducted by the American Institute for Research under the general direction of Dr. John C. Flanagan and under the immediate supervision of Thomas Gordon. Detailed acknowledgments to many individuals and organizations who cooperated in the project are found on pages v and vi of this report.

November 4, 1947

Morris S. Viteles, Chairman
Committee on Aviation Psychology

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SUMMARY

This study was undertaken for the purpose of making a comprehensive survey of present procedures for evaluating the airline pilot and identifying the critical requirements of his job. The principal objectives of the study were to obtain information concerning the critical requirements of the airline pilot's job, the methods of selecting airline pilots, the methods of evaluating airline pilots, the critical situations in airline flying and their causes, and pilot fatigue.

Various sources of information were utilized in making this survey. These included interviews with airline pilots, Civil Aeronautics Administration Inspectors and airline company check-pilots. Information was also obtained from the Civil Aeronautics Board records of airline accidents, and from a study of airline company personnel files.

In arriving at the critical requirements of the job of airline pilot, content analyses were made of all critical incidents reported by pilots, inspectors and check-pilots in the interviews and of the airline accidents obtained from the Civil Aeronautics Board records. These analyses produced 787 examples of pilot behavior, which were grouped into 21 different job components. The most critical component of the pilot's job, as determined from all sources, is that involving the skills of establishing and maintaining a proper angle of glide, rate of descent and speed of glide on the approach. Failure to perform this part of the job adequately was found to result in three times as many accidents as does failure to perform any other part of the job. The next most critical component is that involving the operation of controls and switches. Errors in this component contribute to near-accidents with a high frequency. Navigating and orienting proved to be the third most critical component of the pilot's job.

In order to determine if airline company selection requirements for pilot applicants were critical requirements, matched groups of applicants who were later eliminated and applicants who successfully completed training were compared as to age, education and flying hours at time of employment, as to scores on standardized intelligence and personality tests and as to performance in ground and flying training. Data from this comparison suggest that present airline company selection requirements are not critical requirements, inasmuch as in general they do not predict later success or failure during training. Achievement on flight checks, however, does predict later success or failure.

Other evidence as to the components of the pilot's job which are critical was obtained from content analyses of the opinions of Civil Aeronautics Administration Inspectors and company check pilots and from an analysis of unfavorable comments made by captains on the flight performance of the eliminated group of trainees. There is some evidence that Civil Aeronautics Administration Inspectors, check-pilots and captains put greater emphasis upon components of the job which seldom contribute to critical situations actually experienced by airline pilots.

In order to view the critical requirements of the airline pilot's job in relation to other factors contributing to the difficulty of the job, data were collected which bear on the problem of what factors outside of the pilot contribute to critical situations. In the majority of situations made critical by some unsafe condition, weather was a contributing factor. Unsafe conditions of the airplane and of airports contributed to the next highest number of critical situations. A content analysis of 1,241 comments as to causes of unsafe airline flying revealed that pilots, inspectors and check-pilots feel that inadequate communication and navigational equipment, unsafe conditions of airports, unsafe conditions of aircraft, company policies and procedures and CAA and CAB policies and procedures are the most important factors contributing to unsafe airline flying.

Although only limited information was obtained on pilot fatigue, there is evidence that pilot fatigue may affect pilot behavior in almost all of the components of his job and in almost all phases and conditions of flight. Additional studies of this aspect of the pilot's job are needed, using larger samples of pilots and more refined research techniques.

This survey provides a foundation upon which to develop improved selection, more appropriate training and more objective evaluations of airline pilots. The knowledge of what the critical requirements of the job are is of great potential value for further work in improving these three areas.

THE AIRLINE PILOT: A SURVEY OF THE CRITICAL REQUIREMENTS OF HIS JOB AND OF PILOT EVALUATION AND SELECTION PROCEDURES

INTRODUCTION

At the request of the Committee on Aviation Psychology of the National Research Council, the American Institute for Research has conducted an extensive survey of procedures for evaluating the airline pilot and the requirements of his job. The funds for this project were supplied to the National Research Council by the Civil Aeronautics Administration.

The first objective of the study was to survey all of the important sources of information pertaining to the requirements for the job of the effective airline pilot. The study was intended as a preliminary job-analysis of the position of airline pilot, with special emphasis upon determining the most critical requirements of the job. By critical requirements is meant those specific skills, information, aptitudes and personality traits which characterize the safe and effective airline pilot. The survey was an attempt to supply a partial answer to the question, "What does it take to be a safe and effective airline pilot?"

A second objective of the study was to survey sources of information pertaining to present methods of selecting airline pilots. This aspect of the project was intended to provide a partial answer to the question, "Are present methods of selecting airline pilots adequate from the standpoint of differentiating between those who are most likely to become successful airline pilots and those who are most likely to fail?"

A third objective of the study was to survey sources of information pertaining to present methods of evaluating airline pilots, with special emphasis on the present instrument check. In this aspect of the study, the main sources of information pertaining to methods of evaluation were the attitudes and opinions of pilots themselves including those pilots whose job it is to evaluate airline pilots. This aspect of the study was intended to throw light on the question, "How could present methods of evaluation be improved?"

A fourth objective of the study was to survey sources of information pertaining to the conditions and factors which contribute to making the pilot's job more difficult and hence make airline flying less safe. The purpose of this aspect of the study was to provide a partial answer to the question, "What are the factors which produce critical situations in airline flying and what is the nature of such critical situations?"

A fifth objective of the study was to survey airline pilots for the purpose of obtaining information pertaining to the causes of pilot fatigue and the way in which fatigue affects the performance of the pilot.

This survey, then, was initiated for the purpose of obtaining information in these five areas:

1. The critical requirements of the job of airline pilot
2. The methods of selecting airline pilots

3. The methods of evaluating airline pilots
4. The critical situations in airline flying and their causes
5. Pilot fatigue

METHOD AND PROCEDURE

General Plan of Project

The plans for the survey called for obtaining information from five principal sources. First, an examination was made of the pilot records of the Civil Aeronautics Administration. This study was conceived as somewhat separate from the one herein described, and its methods and results have been described in a separate report. The second source of information was an extensive program of interviews with airline pilots. A third source of information was interviews with pilots responsible for the evaluation of the flight performance of airline pilots -- Civil Aeronautics Administration Air Carrier Inspectors and airline company check pilots. A fourth source was airline accident reports kept on file by the Civil Aeronautics Board. The fifth and final source was certain information in airline company personnel files on pilots who had been eliminated by the company and on pilots who had successfully completed their training for the job of airline pilot.

Originally it was intended that information be solicited from control tower operators and supervisors of pilot training and company operations. A preliminary investigation and some try-out interviews with a small number of control tower operators indicated that this was not a promising source of information pertaining to the job of the airline pilot. It had been the opinion of the president of the Air Line Pilots Association that this was not a promising source of information. Contacts were made, however, with the supervisors of pilot training and company procedures, but they were primarily for the purpose of explaining the project and obtaining their permission to interview their pilots and examine their personnel files.

It was originally intended that the survey be conducted over a four-months period. This was later extended to a six-months period -- March, 1947, through August, 1947. An initial period of approximately one month was used as a try-out period during which proposed procedures were field tested. Preliminary interviews, some electrically recorded, were conducted with airline pilots, control tower operators and Civil Aeronautics Administration Air Carrier Inspectors. A preliminary study of the personnel files of one airline was made for the purpose of learning about the nature of the records and trying out methods and procedures. A preliminary study was made of the accident reports of the Civil Aeronautics Board after which standardized procedures were established for processing these records.

The Pilot Interview Phase

1. Aims. The interviews with airline pilots were expected to provide valuable information which would assist in accomplishing several of the main objectives of the study. First, it was intended that the interviews with pilots would be a rich source of information pertaining to the critical requirements of

the airline pilot. One of the aims, then, was to obtain from the pilots themselves examples of actual critical incidents in their airline flying experience and their behavior in those situations. The assumption underlying the "critical-incident technique" is that the critical requirements of the superior airline pilot are much more likely to be determined from an analysis of pilot behavior in critical situations in airline flying rather than in the more commonplace and everyday situations. In other words, significant differences between pilots probably are revealed more by their differential behavior in critical situations, and, contrariwise, smaller differences are revealed in normal, uneventful situations. A second purpose of the pilot interview was to obtain the opinions and attitudes of airline pilots towards present methods of evaluation and to obtain their suggestions for improving them. Thirdly, it was hoped that in an interview pilots would express their opinions as to what factors or conditions contribute to making the pilot's job more difficult and, hence, make airline flying less safe. Finally, the interview was used to obtain information pertaining to pilot fatigue.

2. Questions and Forms. On the basis of a few preliminary interviews during which different kinds of questions were tested out on several airline pilots and Civil Aeronautics Administration Inspectors, the following nine questions were devised for the standardized interviews with airline pilots:

QUESTION #1: "Probably all pilots who have flown a lot have done something at one time or another that got them into an uncomfortable situation or even a near accident. We would like to get from each pilot several examples of such things that he has done. First, could you describe the more recent situation in which you did something like this and tell me just what you did?"

Alternative Question (Alt. #1): "Well, perhaps you could recall the most recent incident where you observed some other pilot do something that got him in such a spot."

QUESTION #2 (Captains): "Now, I would like for you to recall the last time you had to take over the controls from a co-pilot because you felt the situation was pretty critical. Could you describe that situation and tell me just what the co-pilot did or might have done if you hadn't taken over?"

(Co-pilots): "Now, I would like for you to recall the last time the captain you were flying with took over the controls from you because he felt the situation was pretty critical. Could you describe this situation and tell me just what you did or what he thought you might have done if he hadn't taken over?"

Alternative Question (Alt. #2)(Captains): "Well, then, perhaps you could tell me about the last time that you felt that the situation was so critical that you would not have wanted the average co-pilot to fly the airplane. Could you describe that situation and tell me what unsafe act an average co-pilot might have done in that situation?"

Alternative Question (Alt. #2)(Co-pilots): "Well, then, perhaps you could tell me about the last time that you felt that the situation was so critical that you preferred that the captain fly the airplane. Could you describe that situation and tell me what you might have done in that situation?"

QUESTION #3: "In addition to these specific incidents which you have described, we are anxious to get your opinions on causes of unsafe airline flying in general. Obviously, there are a great number of causes, but I would like to hear what you feel are some of the most important. What are the important causes of unsafe airline flying?"

QUESTION #4: "If you ran an airline and had the problem of keeping check on whether captains were doing a good job, how would you do it?"

QUESTION #5: "What characteristics, traits or abilities which differentiate the good airline captain from the poor are not being evaluated adequately by present methods of evaluation?"

QUESTION #6: "How would you change the present instrument check so that more of these desirable characteristics, traits, and abilities of the good airline pilot could be evaluated?"

QUESTION #7: "We are also interested in determining to what extent pilot fatigue may be a factor in airline accidents. Can you recall a situation where fatigue in any way might have contributed to an accident or a near accident? Would you describe that situation and tell me just what the pilot did as a result of his fatigue?"

QUESTION #8: "I would like to get more of your ideas about this problem of fatigue. What causes pilot fatigue for the most part? What are important fatigue-producing factors in airline flying?"

QUESTION #9: "Well, I've asked you a lot of questions and you have given me some very good ideas. Now, perhaps you have something further to say on these problems which you haven't mentioned already. If you do, I would like very much to get some of your other ideas."

These questions were reproduced on an 8-1/2 by 11 inch heavy card for use by the interviewers during the interviews. Below each question was listed the essential information which the interviewer was to obtain by the question. The contents of this card, called the "Interviewers' Guide," are reproduced as Appendix 1. In addition to the "Interviewers' Guide," the interviewers were given a booklet containing a fuller explanation of each question, its purpose, the information which the question was intended to elicit and examples of satisfactory answers taken from recorded preliminary interviews. Comments as to the adequacy of the interviewers' techniques were added following the sample answers. This booklet, called "Questions for the Airline Pilot Interview," is presented as Appendix 2.

Each interviewer was given a manual which contained a description of the project; a description of the general plan of the interviewing program; an explanation of the nature of the type of interview desired; comments as to desirable attitudes for a skilled interviewer; a discussion of interviewing techniques, such as ways of initiating an interview, introducing the questions, responding to the interviewee, note-taking and handling various problems which frequently arise during an interview; an explanation of how to arrange the interviews; and instructions for reporting the interview data in the booklets specially prepared for this purpose. The "Manual for Interviewers" is presented as Appendix 3.

The form to be used for reporting the information obtained in the pilot interviews was called the "Pilot Interview Summary Form." This is presented as Appendix 4. These forms served the function of having the interview information reported by all the interviewers in a standardized way. Information given in response to each question of the interview was thus reported on a page designated for that information. This greatly facilitated the processing of this information.

Each interviewer was asked to keep a record of every contact established with pilots, indicating whether or not the pilot was interviewed and, if not, the reason. A form was prepared for these records and is presented as Appendix 5. These records provided an indication of the number of pilots contacted but not interviewed, thus revealing something concerning the representativeness of the sample of pilots actually interviewed.

In order to accomplish the objectives of the interview, it was decided to use a relatively informal, semi-structured and non-directive interview. Some structure was provided by the standardized questions which defined the areas in which discussion was to take place. Nevertheless, interviewers were instructed to use techniques which would encourage interviewees to feel free to express any attitudes, opinions, or feelings. An effort was made to foster in the interviewers certain basic attitudes which have been found to be desirable in this type of interviewing by such statements in the manual as:

1. The interviewer should consider the interviewee as an individual rather than as a statistic or as just another source of data. Because the interviewee is an individual, he will have feelings, he will want to feel important, he will cherish his own ideas and beliefs, he will defend those ideas if he feels they are not accepted, he will be cautious and at times even suspicious.

2. The interviewer should assume the role of a neutral person. He has nothing to defend, no preconceived ideas as to what is correct or incorrect. He is not a judge.

3. The interviewer should take the attitude that he is not the expert -- the expert is the interviewee. It is the interviewee who knows his field and the interviewer must rely on the expertness of the interviewee in order to obtain the data for this study. It is a mistake for an interviewer to attempt to show how much about flying he knows. "A little knowledge is a dangerous thing" is even more applicable in an interview with someone with years of accumulated knowledge.

4. The interviewer should be willing to let the interviewee take the responsibility for carrying on the interview. His attitude should be one that says, "You know more what to tell me than I do." The interviewer only decides the area by asking his questions, then directs his efforts at encouraging responses to the questions.

Interviewers were instructed to begin the interview by informing the pilots of the following:

1. That the interviewer represents the A.I.R. which has been authorized by the C.A.A. to carry out this investigation, and that the project has been discussed with the Air Line Pilots Association, which has informed all council chairmen and officers of the project.

2. That the purpose of the study is to get as complete an understanding as possible of the job of airline pilots in order to determine what specific qualities and characteristics good airline pilots have which differentiate them from poor airline pilots.

3. That such an understanding is necessary in order later to determine fair and accurate ways of selecting and certifying airline pilots.

4. That the investigators feel that pilots (or CAA examiners, check-pilots, etc.) are in an excellent position to give help on this problem.

5. That in this study we are not dealing with the individual pilot but only with pilots in general. Similarly we are not using the names of the particular persons contributing their opinions and ideas to this investigation.

Interviewers were instructed to take notes during the interview, being cautioned that when interviewing is done in a field with which interviewers are not too familiar gross misinterpretations occur when interviewers take insufficient notes and rely too heavily on their memory. It was suggested, too, that interviewers obtain some verbatim statements which they felt would make good examples to include in reports of the program.

3. Establishing the Interviewing Program in the Field. Eighteen cities were selected as places for interviewing. These particular cities were selected because of both the availability of pilots and the availability of psychologists who could supervise the program at each locale. Each supervisor was assigned a quota of pilots to be interviewed based upon estimates of the number of pilots available in his city. Supervisors were asked to assume the responsibility for selecting and training interviewers. They were encouraged, however, to select men with experience in interviewing as well as some familiarity with flying. A large number of the interviewers fulfilled these requirements, although it became apparent that a few of them lacked either sufficient interviewing skill or familiarity with pilot jargon. A small number of interviewers were ex-pilots. Almost all of the interviewers were graduate students in psychology or related

fields. Supervisors were requested to ascertain that their interviewers became thoroughly familiar with the information prepared for them by the central office staff and the procedures for carrying out the program. Supervisors also were requested to conduct training sessions during which these matters were discussed. Supervisors were asked to have each interviewer conduct an early interview in the presence of either the supervisor or another interviewer, following which each would fill out an Interview Summary Form independently. The two forms were to be compared, and the techniques of the interviewer discussed. These two forms were to furnish data for a rough check on the reliability with which interview information was recorded and reported. Plans were made to have some of these interviews electrically recorded, but this was made impossible when the interviewing was prematurely suspended.

Continuous communication with supervisors was effected through a series of frequent memoranda from the central office. These served to keep field representatives informed as to changes in the procedures and the status of the project.

Contacts with all of the airline companies whose pilots were to be interviewed were established by central office staff. Supervisors established contacts with regional or local airline company officials before contacting their pilots. In most of the cities, the supervisors also contacted the local chairmen of the Air Line Pilots Association. Prior to the initiation of the entire project, the president of the Air Line Pilots Association and officers of the Air Transport Association had been informed personally about the project, its objectives and the manner in which it would be carried on. Each of these organizations informed its members of the project by letter, enclosing a copy of a write-up of the proposed project.

4. The Data Collected. The total number of airline pilot interviews conducted was 270. Most of these were with pilots of scheduled domestic airlines, although approximately 25% were with pilots of non-scheduled domestic airlines. The latter group was included in the sample after interviews with the scheduled airline pilots were discontinued midway in the project, pending further clarification of the project for the Air Line Pilots Association. Of the total sample of airline pilots interviewed, 70% were captains and 30% were co-pilots. Fifteen interviews were conducted by two interviewers or by a supervisor and an interviewer, each of whom reported the results independently.

Civil Aeronautics Administration Examiner and Company Check-Pilot Interviews

1. Aims. This aspect of the project was intended primarily to supply information concerning the critical requirements of the effective airline pilot, for it was felt that the examiners and company check-pilots were in a position to furnish specific information about the particular skills, traits or characteristics which they felt differentiated the pilots whom they fail and those whom they pass on the instrument flight check. Furthermore, it was expected that they could relate specific critical incidents which they had experienced during flight checks -- incidents in which the pilot being checked behaved in such a way that a critical situation developed. Secondly, it was felt that examiners and check-pilots would have valuable comments and suggestions to make concerning the present methods of evaluating airline pilots and conducting the flight check.

2. Questions and Forms. On the basis of the preliminary try-out of different questions with a number of Civil Aeronautics Administration Examiners (Air Carrier Inspectors), the following six questions were devised for the standardized interview with this group:

QUESTION #1: "First, we would like to draw on your experience as a check-pilot to get examples of what pilots do on check rides. Would you think back on the last pilot you failed on a check ride and tell me exactly what he did which caused you do fail him?"

QUESTION #2: "Now, I would like for you to recall the last time you had to take over the controls from a pilot you were checking because you felt the situation was pretty critical. Could you describe the situation and tell me just what the pilot did or might have done if you hadn't taken over?"

QUESTION #3: "When you check a pilot, what are the things you particularly look for which you feel differentiate a good airline pilot from a poor one?"

QUESTION #4: "If you ran an airline and had the problem of keeping check on whether captains were doing a good job, how would you do it?"

QUESTION #5: "What characteristics, traits or abilities which differentiate the good airline captain from the poor are not being evaluated adequately by present methods of evaluation?"

QUESTION #6: "How would you change the present instrument check so that more of these desirable characteristics, traits and abilities of the good airline pilot could be evaluated?"

A "Interviewers' Guide" for use by the interviewers during the Company Check-Pilot and Civil Aeronautics Examiner interviews was prepared and sent out to each interviewer. This is reproduced as Appendix 6. A booklet was also prepared which explained the purpose of each question and the type of information desired from each question. This booklet, called "Questions for the Company Check-Pilot and Civil Aeronautics Examiner Interviews" is reproduced as Appendix 7. Standardized forms for recording the information obtained from these interviews were prepared. These were called "Company Check-Pilot and Civil Aeronautics Administration Examiner Interview Summary Forms," one of which is reproduced as Appendix 8.

3. Establishing the Interviewing in the Field. The same interviewers who conducted the pilot interviews carried on the interviews with Civil Aeronautics Administration Examiners and Company Check-Pilots. The supervisors in those cities where such interviewees were available were furnished with copies of a circular letter sent out to all Civil Aeronautics Administration Regional Administrators by an official of the Washington offices of the Civil Aeronautics Administration. This letter briefly explained the project and requested that the Regional Administrator notify each examiner (or inspector) that he would be interviewed and requested that he instruct each to cooperate with the interviewers.

No special training program for interviewers was recommended, inasmuch as by the time this aspect of the project was initiated, the interviewers already had received instruction and experience in interviewing the airline pilots.

Fourteen cities were selected for these interviews. All of these cities were in the group of cities in which the airline pilot interviews were conducted. This made it possible to utilize the same supervisors and interviewers for both interview programs. The fourteen cities selected contained about three-fourths of all currently employed Civil Aeronautics Administration Air Carrier Inspectors. In addition, these cities contained the main offices of almost all scheduled airline companies plus almost all of the regional offices of these companies. The selection of these cities made it possible for interviewers to contact a large percentage of the airline company check-pilots.

4. The Data Collected. The total number of Civil Aeronautics Administration Examiner Interviews conducted was 42. This represents approximately two-thirds of all Civil Aeronautics Administration Air Carrier Inspectors. The number of Company Check-Pilot Interviews conducted was 16, representing only a very small percentage of all company check-pilots. The small size of this sample is due to discontinuing the interviewing of airline pilots who are members of the Air Line Pilots Association midway in the project. Most check-pilots are members of this association.

The information obtained from the examiners and that obtained from the check-pilots were processed together inasmuch as both groups are check-pilots, one group being employed by the Civil Aeronautics Administration, the other by the airline companies. Consequently, it was decided to treat the data from both groups as similar data. The same initial procedures were employed for processing these data as for the data from the pilot interviews.

The Civil Aeronautics Board Accident Reports

1. Aims. It was intended that an analysis of the behavior of airline pilots in situations which resulted in accidents would be a rich source of information about the critical requirements of the airline pilot. Accidents, being obvious critical situations, frequently should reveal the kind of pilot behavior which is not desirable on the part of a safe and effective airline pilot. Furthermore, accident data should throw light on the conditions and factors which contribute to undesirable pilot behavior. For these reasons, it was decided to examine records of a number of airline accidents.

2. Nature of the Records. The Civil Aeronautics Board is responsible for maintaining records of all commercial airline accidents, as well as private aircraft accidents. The plans for the project called for an examination of these files for pertinent information about airline pilot behavior in critical situations. After a preliminary examination of these files it was decided to make a more thorough study of the records of all domestic accidents of the scheduled commercial airlines, for the period of 1938 through 1946, in which the behavior of the pilot was judged to be a contributing factor in the

accident. This latter judgment had been made by accident analysts of the Civil Aeronautics Board on each accident, and their judgment was accepted as the criterion for inclusion of an accident report in the sample used in this study. The following data were extracted from the accident reports:

1. Type of plane
2. Time of accident (day or night)
3. Flight reference (instrument, contact or simulated instrument)
4. Phase of flight at time of accident
5. Description of the circumstances leading up to or surrounding the accident
6. Description of the behavior of the pilot prior to or during the accident

Not all of the accident reports contained all of the above information, although in general it was possible to obtain it from most of the reports. Where an accident report contained insufficient data or when it was apparent that not enough evidence had been gathered to determine what the role of the pilot had been, such records were not used in this study.

3. The Data Collected. A total of 185 domestic accidents of scheduled commercial airline pilots were extracted from the Civil Aeronautics Board files. Of these 64 were discarded because of insufficient data or insufficient evidence pertaining to the behavior of the pilot, leaving a total of 121 accidents which were used.

The Study of Airline Company Personnel Files

1. Aims. A thorough analysis of the records maintained by the airline companies on their pilots was thought to be another source of information which would help accomplish several of the main objectives of the project. First, more could be learned about the critical requirements of the airline pilot through analysis of reasons for the elimination of airline pilot trainees and through a comparison of the records of eliminated and successful airline pilots. In addition, present methods of selecting pilot applicants could be evaluated from the standpoint of the degree to which the established company requirements for applicants predicted the successful completion of their training. Finally, present methods of evaluation could be studied from the standpoint of the degree to which they differentiated the superior pilots from those not as proficient.

2. Procedures Used. Each airline company maintains some kind of personnel record for each pilot presently employed and for each pilot hired and subsequently eliminated. From one company, permission was obtained to make a preliminary investigation of their files and to carry out a pilot study of the materials contained in these records. From this study it was learned what records were kept and how they were kept. On the basis of what was learned, standardized procedures were developed for extending this study to other airlines. A standardized form was prepared on which the desired company file data were to be recorded. This form, called the "Company File Report Form," is reproduced as Appendix 9. The following kinds of information were extracted from the files of each pilot:

1. Date of birth
2. Marital status
3. Education
4. Date of employment
5. Date of termination (eliminated pilots)
6. Reasons for termination (eliminated pilots)
7. Previous ground training
8. Previous flying hours
9. Scores on standard tests
10. Scores, ratings and comments on achievement in ground training and flight training with the company

The method employed at each of the companies whose files were examined was to obtain the records of all pilots eliminated from the company during the period between initial hiring and time of checking out as an airline captain. All pilots eliminated in the past three to five years were to be included in the sample. This group of eliminated pilots constituted the experimental group (E-group). Then the files were obtained on a group made up of an equal number of pilots presently employed as co-pilots or captains and matched with the E-group on the basis of approximate date of employment with the company. These pilots constituted the successful or the control group (C-group). The same information was extracted from the files of both of the groups. The names of the pilots whose records were examined were not used, and extreme caution was taken to delete any identifying information. All of the work of recording the information from the files was done in the offices of the airlines, and no materials were removed from these offices.

3. Data Collected. The records of 432 pilots from five different airlines were examined and recorded. Of these, 288 were eliminated pilots. Records could be obtained for only 144 controls. This was due to the reluctance of local company chairmen of the Air Line Pilots Association to having the files of presently employed pilots examined by individuals outside of the company pending negotiations for further clarification of the project.

ANALYSIS OF RESULTS

The Critical Requirements of the Job of Airline Pilot

Information pertaining to the critical requirements of the airline pilot's job was obtained from the interviews with pilots and check-pilots, from the analysis of the Civil Aeronautics Board accident records and from the study of the pilots' personnel files. This information will be presented under three separate headings: (1) critical components of the job of airline pilot and critical pilot behavior, (2) critical pilot traits and characteristics, and (3) critical selection requirements.

1. Critical Components of the Job of Airline Pilot and Critical Pilot Behavior. Questions #1 and #2 of the pilot interview provided specific examples of critical incidents and the behavior of pilots in those situations. The following examples of such critical incidents will illustrate the kind of material obtained from pilots in response to these questions:

"Flying at 6,000 feet between Newark and Pittsburgh in a DC-3A. It was winter and there was moderate snow. We were on instruments. The outside temperature was -5° C. The manifold pressure dropped and the airspeed fell from 160 to 120 M.P.H. We held 120 M.P.H. and began losing altitude. The left engine got rough and misfired. There was almost a complete loss of power and we dropped to 4,500 feet. Then the right engine began to misfire. We applied carburetor heat and alcohol at the same time. We went down to 3,800 feet before we got enough power to climb. Other planes reported moderate carburetor ice and loss of power. One of them almost went down. With an outside temperature of -5° C., we should have had carburetor heat on at all times. The error was in not knowing what should have been done."

"I was flying a DC-3 and was making a landing at Grand Island. It was very gusty and I didn't have the technique for landing in gusty conditions. As I was landing I pulled the power off, which I shouldn't have done. In the Army I had experience flying B-17's and B-29's, which were heavier planes, and you can do this with them without getting into trouble. A gust hit the ship when the power was off and the wing dropped. We could have groundlooped and almost did."

A total of 519 such incidents was collected from the 270 pilot interviews. A preliminary examination of these incidents revealed a total of 333 which satisfied the criteria established for the inclusion of incidents in this study. It was decided that only those incidents would be used which satisfied the following requirements: (1) they should be situations brought on wholly or in part by some behavior on the part of the pilot, (2) they should contain a rather detailed description of the situation and the circumstances surrounding the situation, (3) they should be incidents which occurred in scheduled or non-scheduled airline flying, passenger or transport operations. (Included were a very small number of Air Transport Command and Navy Air Transport Service incidents in which either DC-3's or DC-4's were being flown by airline pilots.)

These incidents were analyzed for the purpose of extracting the various kinds of pilot behavior reported in the incidents. The 333 incidents yielded 401 examples of pilot acts, all of which contributed towards making the incidents critical. The manner in which the pilot acts were extracted can be illustrated on the two sample critical incidents previously given. In the first example, the pilot act contributing to the incident would be "demonstrated lack of knowledge about the de-icing equipment." In the second incident, it would be "making a type of landing inappropriate to the type of plane being flown."

When all of the pilot acts were extracted from the incidents, it was found that they could be placed into groups or clusters on the basis of their similarity. These clusters of pilot acts actually defined the various aspects or components of the pilot's job. For example, from the critical incidents there were extracted four particular kinds of pilot acts which could be grouped together logically: (1) confused two controls or switches, (2) made improper adjustment or moved control or switch to wrong position, (3) forgot to operate a control, (4) inadvertently operated a control. This cluster of four different pilot acts

defines a critical component of the pilot's job, namely, operating the various handles, knobs, dials, controls and switches found in the airplane cockpit. Just how critical this component of his job is can be partially determined by the frequency with which errors of operating controls and switches have contributed to critical situations in airline flying.

The classification of all the extracted pilot acts produced 21 such clusters or groups, each of which define a critical component of the pilot's job. These 21 critical components are presented in Table 1 in the order of the frequency with which pilot errors in each component were reported by airline pilots as contributing to critical situations. Table 1 presents data which indicate how critical each of the components of a pilot's job are, based upon the content analysis of the critical incidents reported by airline pilots themselves. A similar content analysis was made of 137 critical incidents reported by Civil Aeronautics Administration Examiners and Company Check-Pilots in response to Questions #1 and #2 of their interview. A third content analysis was made of the material extracted from the 121 Civil Aeronautics Board accident reports. Finally, a content analysis was made of 61 critical incidents reported by airline pilots in which pilot fatigue was a contributing factor. Each of these analyses provides an additional indication of how critical each component of the pilot's job is. Furthermore, they provide an additional component of the pilot's job. The results of these three analyses are presented in Table 2.

Table 3 shows the critical components of the pilot's job in the order of frequency of pilot acts in each component as determined from the analysis of the critical incidents obtained from all sources -- a total of 652 critical incidents in which 787 pilot acts were reported. This table, the classification of the combined data from all sources, probably gives the best estimate of how critical each component of the airline pilot's job is.

The specific pilot acts in each of the critical job components provide additional information about the critical requirements of the job of airline pilot. Table 4 presents a breakdown of the job components into their specific pilot acts and gives the frequency with which each act was reported in the critical incidents obtained from pilots and check-pilots, from the accident reports and from the fatigue incidents.

Additional information pertaining to critical behavior of airline pilots was obtained from a content analysis of 1,214 unfavorable comments by captains and check-pilots on the flight performance of 288 eliminated pilots from five airline companies. These comments were extracted from the records of flight checks, route checks and captains' routine reports found in the personnel files of the trainee pilots. A total of 265 of the 1,214 comments was related to the actual behavior of the pilots. Table 5 shows how these comments were distributed and the nature of the comments. It is apparent that captains judge as critical some of the same kinds of behavior as were found to be critical in the analyses of critical incidents. Captains do seem, however, to consider "general handling of controls" and "Precision flying" as more critical than was shown by the analyses of critical incidents (Table 4). Furthermore, some kinds of pilot behavior which seemed most critical from the analyses of actual critical incidents are never commented upon by the airline captains, such as "Maintaining Safe Airspeed and Attitude," "Attending, Remaining Alert, Maintaining Lookout," "Establishing and Maintaining Angle of Glide, Rate of Descent and Gliding Speed on Approach and Landing."

TABLE 1

CRITICAL COMPONENTS OF THE JOB OF THE AIRLINE PILOT AND THE FREQUENCY WITH WHICH PILOT ACTS CONTRIBUTING TO CRITICAL SITUATIONS IN AIRLINE FLYING WERE REPORTED BY AIRLINE PILOTS IN EACH COMPONENT

Components of the Job	Frequency of Pilot Acts
Operating Controls and Switches	36
Establishing and Maintaining Alignment with Runway on Approach or Takeoff Climb	31
Navigating and Orienting	31
Establishing and Maintaining Angle of Glide, Rate of Descent, and Gliding Speed on Approach to Landing	27
Maintaining Safe Airspeed and Attitude, Recovering from Stalls and Spins	27
Preparing and Planning of Flight	27
Carrying Out Cockpit Procedures	26
Reading, Checking and Observing Instruments, Dials and Gauges	23
Attending, Remaining Alert, Keeping Lookout	22
Judging Type of Landing or Recovering from Missed or Poor Landing	22
Breaking Angle of Glide on Landing	22
Obtaining and Utilising Instructions and Information from Control Personnel	21
Following Instrument Flight Procedures and Observing Instrument Flight Regulations	21
Utilising and Applying Essential Pilot Information	19
Reacting to Unusual or Emergency Situations	16
Operating Plane on Ground	10
Subjecting Plane to Undue Stress	5
General Handling of Controls	5
Operating and Attending to Radio	4
Flying with Precision and Accuracy	4
Taking Safety Precautions	2
TOTAL	401

TABLE 2

CRITICAL COMPONENTS OF THE JOB OF THE AIRLINE PILOT AS DETERMINED BY ANALYSIS OF CRITICAL INCIDENTS REPORTED BY CHECK-PILOTS, ANALYSIS OF ACCIDENT REPORTS AND ANALYSIS OF INCIDENTS INVOLVING PILOT FATIGUE

Critical Components	Frequency of Pilot Acts: Check-Pilots	Accidents	Fatigue
Operating Controls and Switches	33	15	8
Establishing and Maintaining Alignment with Runway on Approach or Takeoff Climb	5	3	0
Navigating and Orienting	19	4	8
Establishing and Maintaining Angle of Glide, Rate of Descent, and Gliding Speed on Approach to Landing	11	47	14
Maintaining Safe Airspeed and Attitude, Recovering from Stalls and Spins	18	11	1
Preparing and Planning of Flight	3	2	0
Carrying Out Cockpit Procedures	4	7	5
Reading, Checking, and Observing Instruments, Dials, and Gauges	7	1	3
Attending, Remaining Alert, Keeping Lookout	1	14	1
Judging Type of Landing or Recovering from Missed or Poor Landing	8	1	1
Breaking Angle of Glide on Landing	5	1	3
Obtaining and Utilizing Instructions and Information from Control Personnel	0	3	0
Following Instrument Flight Procedures and Observing Instrument Flight Regulations	13	5	6
Utilizing and Applying Essential Pilot Information	18	0	0
Reacting to Unusual or Emergency Situations	7	0	1
Operating Plane on Ground	1	7	5
Subjecting Plane to Undue Stress	7	0	0
General Handling of Controls	8	0	1
Operating and Attending to Radio	10	0	3
Flying with Precision and Accuracy	15	0	3
Taking Safety Precautions	4	2	3
TOTALS	197	123	66

TABLE 3

CRITICAL COMPONENTS OF THE JOB OF AIRLINE PILOT AS DETERMINED FROM ALL SOURCES OF CRITICAL INCIDENTS IN WHICH PILOT ACTS WERE CONTRIBUTING FACTORS

Critical Components	Frequency of Pilot Acts
Establishing and Maintaining Angle of Glide, Rate of Descent, and Gliding Speed on Approach to Landing	99
Operating Controls and Switches	92
Navigating and Orienting	62
Maintaining Safe Airspeed and Attitude, Recovering from Stalls and Spins	57
Following Instrument Flight Procedures and Observing Instrument Flight Regulations	45
Carrying Out Cockpit Procedures	42
Establishing and Maintaining Alignment with Runway on Approach or Takeoff Climb	39
Attending, Remaining Alert, Maintaining Lookout	38
Utilizing and Applying Essential Pilot Information	37
Reading, Checking and Observing Instruments, Dials and Gauges	34
Preparing and Planning of Flight	32
Judging Type of Landing or Recovering from Missed or Poor Landing	32
Breaking Angle of Glide on Landing	31
Obtaining and Utilizing Instructions and Information from Control Personnel	24
Reacting to Unusual or Emergency Situations	24
Operating Plane on Ground	23
Flying with Precision and Accuracy	22
Operating and Attending to Radio	17
General Handling of Controls	14
Subjecting Plane to Undue Stress	12
Taking Safety Precautions	11
TOTAL	787

TABLE 4

SPECIFIC PILOT ACTS CONTRIBUTING TO CRITICAL SITUATIONS IN AIRLINE FLYING AND THE FREQUENCY WITH WHICH THEY WERE CONTRIBUTING FACTORS

	Specific Pilot Acts		Frequency
A.	Establishing and Maintaining Angle of Glide, Rate of Descent, and Gliding Speed on Approach to Landing		99
	1. Made approach with improper glide angle and/or with too much airspeed -- overshot	77	
	2. Made approach with improper glide angle and/or too little airspeed -- undershot	22	
B.	Operating Controls and Switches		92
	1. Forgot to operate a control or switch	41	
	2. Confused two controls or switches	31	
	3. Made improper adjustment or moved control or switch to wrong position	14	
	4. Inadvertently operated a control or switch	6	
C.	Navigating and Orienting		62
	1. Became disoriented on instruments	27	
	2. Did not observe or misinterpreted landmarks	8	
	3. Flew incorrect heading to line-up with runway	7	
	4. Flew incorrect heading to intersect, parallel, or fly down beam	7	
	5. Flew incorrect heading to reach destination	6	
	6. Did not make allowances for change of wind velocity or direction in navigating	4	
	7. Did not know or keep track of position on contact flight	3	
D.	Maintaining Safe Airspeed and Attitude, Recovering from Stalls and Spins		57
	1. Allowed airspeed to drop too close to stalling speed or executed maneuver at too low an airspeed	21	
	2. Assumed dangerous attitude or did not correct attitude soon enough	18	
	3. Stalled out in maneuver	14	
	4. Did not recover from stall or near-stall correctly or soon enough	3	
	5. Allowed plane to go into spin	1	
E.	Following Instrument Flight Procedures and Observing Instrument Flight Regulations		45
	1. Made let-down below minimum altitude or when conditions were below minimums or flew to unsafe altitude	22	
	2. Used incorrect orientation, approach or let-down procedures (with knowledge of position)	12	
	3. Flew partially or entirely contact instead of entirely instrument	7	
	4. Attempted flight through clouds or overcast on contact clearance	2	
	5. Did not maintain assigned altitude	2	

TABLE 4 (Cont.)

	Specific Pilot Acts	Frequency
F.	**Carrying Out Cockpit Procedures**	42
	1. Failed to use or incorrectly used cockpit checklist	14
	2. Did not respond, or responded incorrectly to cockpit signal or made response to cockpit signal prematurely or when no signal was given	12
	3. Demonstrated lack of coordination among crew	11
	4. Executed single-engine sequence incorrectly	3
	5. Gave incorrect cockpit signal	1
	6. Did not make check on ice with flashlight	1
G.	**Establishing and Maintaining Alignment with Runway on Approach or Takeoff Climb**	39
	1. Drifted or failed to align with runway on approach, during round-out, or on takeoff climb	33
	2. Used incorrect method or poor technique to correct for drift on approach, round-out, or takeoff climb	6
H.	**Attending, Remaining Alert, Maintaining Lookout**	38
	1. Did not clear area or observe collision object	24
	2. Did not see edge of runway or taxi strip or observe holes in runway	8
	3. Let attention lapse, fell asleep	5
	4. Did not observe wind tee	1
I.	**Utilising and Applying Essential Pilot Information**	37
	1. Lacked knowledge of navigational techniques	12
	2. Lacked knowledge of equipment of airplane	8
	3. Misjudged weather conditions	6
	4. Lacked knowledge of route, facilities, navigational aids, airport characteristics	6
	5. Lacked knowledge of procedures, rules	5
J.	**Reading, Checking and Observing Instruments, Dials and Gauges**	34
	1. Did not observe readings of instruments or took eyes off instruments	16
	2. Did not cross-check one instrument with another	11
	3. Confused two instruments	5
	4. Misread instrument	2
K.	**Preparing and Planning of Flight**	32
	1. Planned flight or made flight despite knowledge of unsafe conditions	15
	2. Did not carry out necessary inspections or learn of condition of airplane and equipment	12
	3. Did not file or filed incorrect flight plan	3
	4. Did not obtain sufficient weather information	1
	5. Did not obtain sufficient information about route facilities	1

TABLE 4 (Cont.)

	Specific Pilot Acts	Frequency	
L.	Judging Type of Landing or Recovering From Missed or Poor Landing		32
	1. Made type of landing inappropriate to landing conditions or type of airplane	11	
	2. Made type of recovery from poor or missed landing inappropriate to landing conditions or type of plane	10	
	3. Did not go-around after poor approach or missed landing	8	
	4. Attempted go-around under unsafe conditions or when unnecessary	2	
	5. Selected poor or wrong field for landing	1	
M.	Breaking Angle of Glide on Landing		31
	1. Levelled off or reduced angle of glide too high on landing	18	
	2. Did not level off or reduce angle of glide high enough on landing	13	
N.	Obtaining and Utilizing Instructions and Information from Control Personnel		24
	1. Did not obtain necessary information from control personnel	9	
	2. Misinterpreted or disregarded instructions from control personnel	7	
	3. Accepted instructions against own judgment or without thinking of consequences	5	
	4. Taxied without proper clearance	2	
	5. Asked for wrong instructions from control personnel	1	
O.	Reacting to Unusual or Emergency Situations		24
	1. Became excited, tense, confused, disorganized, frozen	17	
	2. Gave up flight controls, stopped flying, "quit"	7	
P.	Operating Plane on Ground		23
	1. Did not maintain directional control on landing or takeoff run	15	
	2. Taxied into or too close to observed collision object	3	
	3. Misused brakes (no loss of directional control)	3	
	4. Taxied too fast	1	
	5. Did not apply sufficient power on takeoff run	1	
Q.	Flying with Precision and Accuracy		22
	1. Lost or gained excessive altitude (not dangerous)	13	
	2. Varied heading or made too large heading corrections	3	
	3. Climbed with improper angle or airspeed	3	
	4. Varied degree of bank, rate of turn, rate of descent	2	
	5. Varied airspeed (not dangerous)	1	

TABLE 4 (Cont.)

	Specific Pilot Acts		Frequency
R.	Operating and Attending to Radio		17
	1. Misinterpreted or responded slowly to radio range signals	14	
	2. Did not maintain listening watch on radio or make radio position check frequently enough	3	
S.	General Handling of Controls		14
	1. Handled plane roughly, overcontrolled	12	
	2. Did not coordinate controls	2	
T.	Subjecting Plane to Undue Stress		12
	1. Executed maneuver at dangerously high airspeed	6	
	2. Flew in turbulence at excessive airspeed	3	
	3. Flew through bad weather instead of around it	2	
	4. Let R.P.M. build up too high	1	
U.	Taking Safety Precautions		11
	1. Landed downwind	5	
	2. Landed too close behind other aircraft	2	
	3. Did not open window on landing	1	
	4. Cut all throttles to check horn instead of only one	1	
	5. Took hands off throttles or controls	1	
	6. Flew at dangerously low altitude	1	
	TOTAL		787

TABLE 5

FREQUENCY OF CAPTAINS' UNFAVORABLE COMMENTS ON THE PILOT BEHAVIOR OF 288 ELIMINATED AIRLINE PILOTS

	Pilot Behavior		Frequency
A.	Poor General Handling of Controls		89
	1. Handles plane roughly, overcontrols	64	
	2. Flies mechanically	15	
	3. Does not coordinate controls	10	
B.	Demonstrated Lack of Essential Pilot Information		50
	1. Procedures, rules	21	
	2. Route, facilities, navigational aids, airports	16	
	3. Meteorology	9	
	4. Navigational techniques	3	
	5. Equipment of airplane	1	
C.	Demonstrated Inconsistent or Erratic Flying		27
D.	Demonstrated Lack of Precision and Accuracy		26
E.	Operated Controls and Switches Incorrectly		16
	1. Forgot to operate a control	14	
	2. Confused two controls	1	
	3. Made improper adjustment of a control	1	
F.	Demonstrated Poor Navigating and Orienting		11
	1. Flew incorrect heading to intersect, parallel or fly down beam	7	
	2. Flew incorrect heading to reach destination	2	
	3. Becomes disoriented on instrument flight	1	
	4. Did not know or keep track of position on contact flight	1	
G.	Poor Operating of Radio or Lack of Attending to Radio		10
	1. Did not speak distinctly on radio	5	
	2. Misinterpreted or failed to hear range signals	3	
	3. Did not maintain listening watch on radio	1	
	4. Improperly tuned or controlled volume of radio	1	
H.	Poor Cockpit Procedures		8
	1. Failed to use or incorrectly used checklist	4	
	2. Executed single-engine sequence incorrectly	4	
I.	Poor in Establishing and Maintaining Alignment with Runway		5
J.	Poor in Reading, Checking and Observing Instruments, Dials and Gauges		4
K.	Poor Judgment of Type of Landing and Recovery from Missed Landing		4
L.	Miscellaneous		15
	TOTAL		265

A content analysis of the answers of Civil Aeronautics Administration Examiners and Company Check-Pilots to the question, "When you check a pilot, what are the things you particularly look for which you feel differentiate a good airline pilot from a poor one?", produced 234 specific things which they said they particularly looked for. Of these, only 74, or 34%, had to do with pilot behavior which was previously found to be most critical from the standpoint of contributing to critical situations and accidents. This is shown in Table 6. The four most frequently mentioned kinds of behavior which they look for, representing 80% of all those mentioned, are kinds of behavior which are not even among the first eight most critical components of the pilot's job, as determined from the analyses of critical incidents and accidents (see Table 3).

When the airline pilots were asked what were the factors contributing to making airline flying less safe than it should be, some of them felt that poor piloting was an important factor. Of 1,241 comments of airline pilots as to causes of unsafe airline flying, 9%, or 115 comments, were related to poor pilot behavior. Table 7 shows how these 115 comments were distributed in categories of poor pilot behavior. Many of the kinds of behavior are similar to those previously found to be contributing to critical situations and accidents. Nevertheless, the most critical job component, as determined from the analyses of critical incidents and accidents, was mentioned by only one pilot; the next most critical was not mentioned by a single pilot.

Additional information pertaining to critical pilot behavior and knowledge was obtained from the study of the personnel files of eliminated pilots and their controls. A comparison was made between matched pairs of the E-group and C-group pilots as to ratings of pilot behavior on certain phases of the last recorded flight check administered to each experimental pilot before elimination and an identical flight check administered to his matched control pilot within plus or minus two months of the other check. Most of the paired pilots had received ratings on a three-point scale corresponding to "Above Average," "Average," and "Below Average." A few had received ratings on a four-point scale: "Excellent," "Good," "Fair," and "Poor." After an examination of the distribution of ratings on the four-point scale, it was decided to convert these ratings to the three-point scale as follows: "Excellent" and "Good" ratings were considered "Above Average," "Fair" ratings were considered "Average," and "Poor" ratings were considered "Below Average." A score of 3 was assigned to "Above Average" ratings, 2 to "Average" ratings, and 1 to "Below Average" ratings. The Mean differences between ratings of the matched pairs on each category of pilot behavior is shown in Table 8. This table shows which of the various job components differentiate the E-group from the C-group, hence are critical components of the airline pilot's job. All of these components with the exception of "Knowledge of Mechanical Details" differentiate between the two groups significantly. When an average grade was computed for each pilot in both groups on all of the items rated on these flight checks, it, too, was found to differentiate the E-group from the C-group at the 1% level of significance ($t = 7.014$ with 82 degrees of freedom). Included with the items shown in Table 8 were six items relating to pilot traits, all of which went into making up this average flight check score. These six items relating to traits will be discussed subsequently in the section on critical pilot traits and characteristics. Nevertheless, it can be concluded that the average flight check score and also practically all of the components

TABLE 6

FREQUENCY OF COMMENTS OF CIVIL AERONAUTICS ADMINISTRATION EXAMINERS AND COMPANY CHECK-PILOTS CONCERNING KINDS OF PILOT BEHAVIOR WHICH THEY CONSIDER DIFFERENTIATE GOOD AIRLINE PILOTS FROM AVERAGE ONES

Kinds of Pilot Behavior	Frequency
General Handling of Controls	18
Thoroughness in Obtaining Information, Cross-checks Sources	17
Plans and Prepares for Flight	16
Plans Ahead, Visualizes Flight Course, Stays "Ahead of Airplane"	8
Good Takeoff, Approach and Landing Procedures	4
Uses Checklist at All Times	3
No "S-Turns" on Approaches	1
Keeps Constant Airspeed	1
Taxies Carefully	1
Selects Correct Runway on Takeoffs and Landings as Regards Wind Direction	1
Keeps Directional Control on Landing Run	1
Good A.D.F. Procedure	1
Does Good Job of Orienting	1
Good Technique Under All Conditions	1
TOTAL	74

TABLE 7

FREQUENCY WITH WHICH KINDS OF PILOT BEHAVIOR WERE MENTIONED BY AIRLINE PILOTS AS CONTRIBUTING TO UNSAFE AIRLINE FLYING

Pilot Behavior	Frequency
Letting Down Below Authorized Minimums	22
Violating Policies and Procedures in General	18
Attempting to Fly Partially or Wholly Contact in Instrument Weather	16
Poor Navigating or Orienting	8
Failure to Use Checklist	7
Both Pilots Attending to Things in Cockpit	5
Disobeying Instructions from Airway Traffic Control	5
Demonstrating Lack of Essential Pilot Information	4
Insufficient Planning: Not Boarding Enough Fuel	3
Violating C.F.R. Ceiling and Visibility Minimums	2
Misidentifying Landmarks	2
Not Cross-checking One Instrument with Another	2
Making Type of Landing Inappropriate to Weather Conditions	2
Flying I.F.R. in C.F.R. Weather	2
Making Approach with Too Much Airspeed, Overshooting	1
Not Staying on Radio Range on Instruments	1
Others (not specific)	15
TOTAL	115

TABLE 8

MEAN DIFFERENCES BETWEEN RATINGS OF MATCHED PAIRS OF ELIMINATED PILOTS AND THEIR SUCCESSFUL CONTROL PILOTS ON CERTAIN PILOT BEHAVIOR EVALUATED BY CAPTAINS ON IDENTICAL FLIGHT CHECKS

Pilot Behavior	Number of Pilots in each group	Number Ratings on each group	Mean Difference (C-E)	S.E. of Mean Difference	t-ratio	Level of Significance
Contact Flying Ability	85	107	.64	.101	6.337	1%
Flight Performance Navigation Enroute Flying Ability Air Work Execution of Flight						
Instrument Flying Ability	85	363	2.89	.688	4.201	1%
General Instrument Work Let-down and Approach Use of Navigational Aids Smoothness and Accuracy Beam Orientation						
Approach and Landing (Contact)	28	148	3.11	.611	5.090	1%
Takeoff and Climb (Contact)	28	201	1.73	.352	4.915	1%
Flight Planning and Analysis	57	97	.66	.131	5.038	1%
Demonstration of Route Knowledge	57	57	.43	.089	4.831	1%
Demonstration of Knowledge of Mechanical Details	42	42	.04	.065	.615	not significant
Observance and Knowledge of Regulations	77	154	.60	.161	3.727	1%
General Progress in Comparison with Others	51	51	.78	.105	7.414	1%

relating to pilot behavior which are evaluated on a sample flight check actually differentiate below pilots who eventually were eliminated and those who eventually became successful airline pilots.

Some additional information as to the importance of various kinds of pilot behavior was obtained from an analysis of the ratings obtained by 176 eliminated pilots on all flight checks recorded in their personnel files. For these pilots, the percentage of all ratings which were below average was computed for each of 20 categories of pilot behavior. The total number of ratings on the 176 eliminated pilots was 17,974. Of these, 4,077, or 22.7%, were below-average ratings. The percentage of below-average ratings for each category of pilot behavior is shown in Table 9. Although it was not possible to match these 176 eliminated pilots with successful pilot controls, these comparative percentages of below-average grades for the various components of the pilot's job give some indication of the extent to which they differentiate the eliminated pilot from the successful. In Table 8 it was shown that ratings on many of these components significantly differentiated between eliminated and successful pilots. Furthermore, these below-average ratings represent scores which are below the standards established by the airlines for an average pilot. Consequently, those kinds of pilot behavior receiving the largest number of below-average ratings are probably some of the most critical pilot behavior requirements for the job of airline pilot. One thing which is apparent from observation of the job components being rated on these checks is the fact that they do not correspond with the job components determined from the analysis of critical incidents obtained from the interviews. It appears that the airlines for purposes of checking and evaluating pilots have broken down the job into phases of flight or maneuvers, whereas the content analysis of critical incidents and accidents gives a breakdown of the job into components made up of similar kinds of pilot acts.

One further indication of what kinds of behavior are critical was obtained from an analysis of the percentage of below-average ratings on 35 eliminated pilots who had been given ratings on an "Instrument Approach Report." These pilots had ratings on very specific parts of the instrument approach. Some indication of what aspects of this particular component of the job are critical is obtained from this analysis, presented in Table 10.

2. Critical Pilot Traits and Characteristics. This survey provided a considerable amount of information pertaining to pilot traits and characteristics which are critical in differentiating superior airline pilots from the average or poor airline pilots. Information of this nature was obtained from the following three sources and will be discussed under these headings: (1) information from the pilot interviews, (2) information from the Civil Aeronautics Administration Examiner and Company Check-Pilot Interviews, (3) information from the company personnel files.

In response to Question #3 of the pilot interview, which asked for causes of unsafe airline flying, the pilots made 224 comments indicating that certain traits or characteristics of airline pilots were causes of unsafe airline flying. A classification of these comments is presented in Table 11.

Pilots, check-pilots and Civil Aeronautics Administration Examiners expressed 466 opinions as to the traits and characteristics which they felt differentiated the good airline pilot from the average one but were not being evaluated by present methods of evaluation. These opinions are classified in Table 12.

TABLE 9

PERCENTAGE OF ALL RATINGS WHICH WERE BELOW AVERAGE ON VARIOUS KINDS OF PILOT BEHAVIOR RATED BY CAPTAINS ON ALL FLIGHT CHECKS ON RECORD FOR 176 ELIMINATED PILOTS

Pilot Behavior	Total Number of Ratings	Number of Below Average Ratings	Percent of Below Average Ratings
Unusual Maneuvers	22	10	45.5
Navigation: Dead Reckoning	210	84	40.0
Takeoff, Climb (Contact)	1,134	437	38.5
Approach, Landing, Go-around	1,178	394	33.4
Control of Airspeed and Heading (On Instruments)	478	139	29.1
Radio Technique	459	117	25.5
Instrument Approach	3,681	939	25.5
Slow Flight and Stalls	417	103	24.7
General Instrument Flying and Orientation Procedures	793	195	24.6
Single-Engine Operation	647	157	24.3
Ability to Progress	813	187	23.0
Ground Operation of Plane	1,072	209	19.5
Knowledge of Equipment, Procedures, Regulations and Route Facilities	2,615	509	19.5
Banks and Turns	659	118	17.9
Overall Flying Ability	764	127	16.6
General Ability to Handle Plane	123	19	15.4
Descent and Climb: Spirals	562	85	15.1
Takeoff, Climb (Instrument)	306	44	14.4
General Competency	74	8	10.8
Pre- and Post-Flight Procedures	1,967	196	10.0
	17,714	4,077	

TABLE 10

PERCENTAGE OF BELOW AVERAGE RATINGS BY 35 ELIMINATED PILOTS ON VARIOUS PARTS OF THE INSTRUMENT APPROACH PROCEDURE

Parts of the Instrument Approach Procedure	Total Number of Ratings Received	Number of Below Average Ratings	Percentage of Below Average Ratings
Maintaining Altitude on Return to Station	88	47	53.4
Maintaining Altitude on Procedure Turn (In)	90	42	46.7
Maintaining Altitude Prior to Procedure Turn	91	40	44.0
Maintaining Heading in Return to Station	86	29	33.7
Maintaining Altitude over Field	86	24	27.9
Maintaining Heading on Procedure Turn (In)	87	23	26.4
Maintaining Heading from Station to Field	83	20	24.1
Maintaining Heading on Initial Approach	82	18	22.0
Maintaining Heading on Procedure Turn (Out)	85	19	22.4
Maintaining Altitude over Station	86	18	20.9
Maintaining Constant Rate of Descent	84	18	21.4
Maintaining Altitude on Initial Approach	88	17	19.3
Ability to Detect Station on Final Approach	84	15	17.9
Maintaining Constant Airspeed	86	15	17.4
Timing (Station to Pull Out)	84	14	16.7
Pull Out	85	8	9.4
Ability to Detect Station on Initial Approach	88	8	9.1
Knowledge of Procedure	84	7	8.3
Range Signal Reaction	84	6	7.1
Control of Signal Volume	85	5	5.9

TABLE 11

FREQUENCY WITH WHICH TRAITS AND CHARACTERISTICS OF AIRLINE PILOTS WERE MENTIONED BY PILOTS AS CAUSES OF UNSAFE AIRLINE FLYING

Traits and Characteristics		Frequency
A. Thinking and Learning Capacities		52
1. Poor judgment	21	
2. Failure to anticipate or plan ahead	11	
3. Inadequate ability to make decisions as fast as necessary	9	
4. Misinterpretation of instruction	3	
5. Inability to coordinate many factors into one plan	3	
6. Inadequate memory	3	
7. Inadequate intelligence, thinking	2	
B. Carelessness or Tendency to Err Frequently		46
C. Attitude		39
1. Overconfidence	23	
2. Professional pride	8	
3. Undesirable attitude in general	8	
D. Attending, Remaining Alert		36
1. Fatigue	29	
2. Lack of alertness	7	
E. Nervousness		23
1. Nervous behavior under routine conditions	17	
2. Nervous behavior under stress or pressure	6	
F. Feelings of Insecurity		12
G. Tendency to Prevaricate About Position to A.T.C.		5
H. Lack of Industry in Keeping Up with New Developments		5
I. Tendency to Reject Advice from Control Personnel		2
J. Poor Physical Condition, Illness		2
K. Unsatisfactory Family Life		2
TOTAL		224

TABLE 12

FREQUENCY WITH WHICH CERTAIN TRAITS AND CHARACTERISTICS WERE MENTIONED BY PILOTS, CIVIL AERONAUTICS ADMINISTRATION EXAMINERS AND CHECK-PILOTS AS DIFFERENTIATING THE GOOD AIRLINE PILOT FROM THE POOR PILOT

Traits and Characteristics	Frequency
Lack of Nervous Behavior	116
Intelligence -- Ability to Learn	66
Ability to Get Along with People	54
Knowledge and Information	44
Attitude and Interest	36
Attention and Alertness	31
Self-confidence	31
Sense of Responsibility -- Conscientiousness	27
Obedience to Rules, Directions, Regulations, etc.	17
Industry and Effort	15
Mechanical Aptitude	7
Cautiousness	6
Forcefulness	5
Physical Condition	5
Rapid Reaction -- Time	2
Coordination	2
Individualistic Tendencies	1
Experience	1
TOTAL	466

From the captains' unfavorable comments on the 388 eliminated pilots from five airline companies, additional information was obtained pertaining to critical traits and characteristics. Of the 1,214 comments, 949 comments, or approximately 78%, were related to unfavorable traits and characteristics of the eliminated group. The results of a content analysis of these 949 comments is presented in Table 13.

Further information pertaining to the critical traits and characteristics of the airline pilot's job was obtained from the comparison of ratings received by the E-group and the matched C-group on flight check reports or on reports submitted by captains on their co-pilots, both of which types of reports provided evaluations of the traits, abilities or characteristics of the pilots in each group. Comparative ratings were obtained on the following: judgment, alertness and speed of reactions, appearance and bearing, personality, industry, and cooperativeness. A below-average rating on each trait, ability or characteristic was assigned a value of 1, an average rating a value of 2, an above-average rating a value of 3. Generally, the judgment of whether a trait was above-average, average or below-average was made by the captains themselves. In a few instances their judgments were made on a slightly different three-point scale, such as "Below Standard," "Standard" and "Above Standard." It was assumed that this scale was identical to the other. In a few other cases their judgments were made on a four-point scale: "Excellent," "Good," "Fair," and "Poor." After a careful examination of the distribution of ratings over the four-point scale, it was decided that both "Excellent" and "Good" ratings would be considered as Above-Average, "Fair" ratings as Average and "Poor" ratings as Below-Average. The comparison of the E-group and C-group on these qualities is presented in Table 14.

Several traits, characteristics or abilities are consistently judged as more critical than others by both pilots themselves and by the Civil Aeronautics Administration Examiners and Company Check-Pilots. These are:

1. Intelligence, Thinking, Learning Capacity
2. Lack of Nervous Behavior
3. Ability to Get Along with Others
4. Favorable Attitude, Interest
5. Attending, Remaining Alert
6. Initiative, Aggressiveness, Forcefulness
7. Industry and Effort

3. Critical Selection Requirements. From the study of the company personnel records data were obtained which enabled a determination of the degree to which established company requirements for the selection of pilot applicants predict successful completion of training. Data were available from the files of a number of the pilots in the E-group and C-group on the following:

1. Age at time of hiring
2. Previous education
3. Otis I.Q. scores
4. Bennett Test of Mechanical Comprehension (Form AA) scores
5. Minnesota Multiphasic Personality Inventory scores
6. Previous flying hours
7. Marital status
8. Previous ground training in aeronautics

TABLE 7?

FREQUENCY OF UNFAVORABLE COMMENTS BY CAPTAINS RELATED TO TRAITS, ABILITIES AND CHARACTERISTICS OF 288 ELIMINATED TRAINEE PILOTS

Traits, Abilities and Characteristics	Frequency
Inadequate Thinking and Learning	232
Inability to Get Along with People	105
Nervous Behavior	96
Unfavorable Attitude and Interest	82
Inability to Attend or Remain Alert	57
Lack of Initiative, Aggressiveness, Forcefulness	55
Lack of Industry, Effort	52
Slow Reaction	39
Carelessness and Tendency to Err Frequently	37
Overconcern for Obtaining Favorable Evaluation	29
Irresponsible, Unreliable, Undependable, Insincere	29
Poor Pilot Aptitude	27
Poor First Impression, Poor Appearance	23
Lack of Pep and Vitality	19
Tendency to Become Confused	17
Lack of Confidence	14
Inability to Divide Attention	14
Lack of Coordination Between Pilot Knowledge and Skills	14
Lack of Adequate Motor Coordination	6
Poor Speech, Unpleasant Voice	2
TOTAL	949

TABLE 14

MEAN DIFFERENCES BETWEEN RATINGS OF MATCHED PAIRS OF ELIMINATED PILOTS AND SUCCESSFUL PILOTS ON CERTAIN TRAITS EVALUATED BY CAPTAINS ON FLIGHT CHECKS

Traits or Characteristics	Number of Pilots in Each Group	Number of Ratings on Each Group	Mean Difference (C - E)	Standard Error of Mean Difference	t-ratio	Level of Significance
Judgment	57	57	.61	.086	7.093	1%
Alertness and Speed of Reactions	55	97	1.16	.189	6.110	1%
Appearance	59	59	.31	.069	4.493	1%
Personality	56	87	.76	.133	5.736	1%
Industry	58	58	.59	.111	5.315	1%
Cooperativeness	60	64	.37	.079	4.684	1%

These eight requirements represent the kinds of selection requirements generally established by airline companies for their pilot applicants. An attempt was made to determine if these requirements are critical ones -- that is, do they differentiate between pilots who were eliminated and those who successfully completed their training.

Table 15 shows the results of a comparison of E-group pilots and C-group pilots on the basis of their ages at time of employment. The difference between the ages of the two groups of pilots is not statistically significant. In other words, the ages of pilot applicants do not predict their success or failure much greater than expected by chance.

A comparison of the amount of previous education of the eliminated and successful pilots is shown in Table 16. One point was given for each year of formal education. It is apparent that within this range the amount of education is not a critical requirement for successful completion of training as an airline pilot.

Otis I.Q. scores were available for 63 pilots who were eliminated and 63 pilots who were successful. Table 17 presents a comparison of these scores. The difference in mean I.Q. between the two groups is too small to be statistically significant at the 5% level of significance.

Scores on the Bennett Test of Mechanical Comprehension (Form AA) were available for 14 eliminated and 14 successful pilots. These scores were in the form of percentiles. The difference between the two groups was very small as shown in Table 18. The t-ratio obtained indicates that the differences between the matched pairs are not statistically significant at the 5% level of significance. It can not be said with confidence that larger groups with a wider range of scores would not show a greater difference, but for the sample tested it can be said that the difference obtained is too small to reject the hypothesis that there is no difference between the two groups.

A few of the pilots in each group had received scores on the Minnesota Multiphasic Personality Inventory. A comparison of the scores of each group on each of eleven parts of the test is presented in Table 19. It can be seen that on all of the parts of this test the differences between the two groups are not statistically significant at the 5% level.

The number of previous flying hours was available for 165 eliminated and 171 successful pilots. Table 20 shows that previous flying hours do not discriminate between the two groups at the level of statistical significance established.

In order to determine if marital status discriminates between eliminated and successful pilots, the percentages of each group of pilots who were married and single were calculated. The comparison of the two groups gave a difference which is so small as to be practically insignificant, as shown below:

	Number Married	Number Single
Eliminated Pilots	117 (68.8%)	53 (31.2%)
Control Pilots	119 (70.8%)	49 (29.2%)

TABLE 15

COMPARISON OF AGES AT TIME OF EMPLOYMENT OF ELIMINATED PILOTS AND SUCCESSFUL CONTROLS

Age	Number of Eliminated Pilots	Number of Control Pilots
Over 34	7	3
30 - 34	37	34
25 - 29	86	78
20 - 24	39	50
Under 20	0	1
TOTAL	169	166

Mean difference (Control minus Eliminated)	-.65
S.E. diff.	.501
t-ratio	1.297 (not significant at the 5% level)

TABLE 16

COMPARISON OF AMOUNT OF EDUCATION OF ELIMINATED PILOTS AND SUCCESSFUL CONTROLS

Education	Number of Eliminated Pilots	Number of Control Pilots
Over 2 years college	53	43
1 - 2 years college	61	67
High school only	56	59
TOTAL	170	169

Mean difference (C - E)	.177 (1 year equals 1 point)
S.E. diff.	.240
t-ratio	.736 (not significant at the 5% level)

TABLE 17

COMPARISON OF OTIS I.Q.'S OF MATCHED PAIRS OF ELIMINATED PILOTS AND SUCCESSFUL CONTROLS

I.Q.	Number of Eliminated Pilots	Number of Control Pilots
130 and above	3	6
125 - 129	10	5
120 - 124	10	15
115 - 119	13	19
110 - 114	10	13
105 - 109	15	4
100 - 104	1	1
95 - 99		
90 - 94	1	
TOTAL	63	63

Mean difference (C - E) 2.4
S.E. diff. 1.362
t-ratio 1.762 (not significant at the 5% level)

TABLE 18

COMPARISON OF SCORES OF MATCHED PAIRS OF ELIMINATED PILOTS AND SUCCESSFUL CONTROLS ON THE BENNETT TEST OF MECHANICAL COMPREHENSION

Percentiles	Number of Eliminated Pilots	Number of Control Pilots
95 - 99	5	5
90 - 94	1	3
85 - 89	3	1
80 - 84	2	3
75 - 79	1	
70 - 74	1	
65 - 69	1	2
Under 65	1	
TOTAL	14	14

Mean difference (C - E) 6.14
S.E. diff. 7.24
t-ratio .848 (not significant at the 5% level)

TABLE 19

COMPARISON OF SCORES OF MATCHED PAIRS OF ELIMINATED PILOTS AND SUCCESSFUL CONTROLS ON THE MINNESOTA MULTIPHASTIC PERSONALITY INVENTORY

Scales	Number of Pilots In Each Group	Mean Difference (C - E)	S.E. diff.	t-ratio*
Lie Scale	16	1.00	1.77	.566
Validity Scale	15	.33	1.13	.294
Hypochondriasis Scale	15	.33	1.49	.222
Agression Scale	16	-1.50	2.91	.514
Hysteria Scale	18	1.00	1.81	.553
Psychopathic Deviate Scale	15	3.47	3.07	1.130
Interest Scale	17	-1.71	3.03	.564
Paranoia Scale	17	1.29	1.65	.780
Psychasthenia Scale	15	.00	2.29	.000
Schizophrenia Scale	15	- .87	1.60	.544
Hypomania Scale	16	2.81	1.44	1.957

*All not statistically significant at the 5% level of significance

TABLE 20

COMPARISON OF ELIMINATED AIRLINE PILOTS AND SUCCESSFUL CONTROLS ON NUMBER OF PREVIOUS FLYING HOURS AT TIME OF EMPLOYMENT

Flying Hours	Number of Eliminated Pilots	Number of Control Pilots
Over 4,500	2	4
4,000 - 4,500	3	3
3,500 - 4,000	1	3
3,000 - 3,500	3	6
2,500 - 3,000	13	8
2,000 - 2,500	33	16
1,500 - 2,000	21	28
1,000 - 1,500	31	38
500 - 1,000	29	36
Under 500	29	29
TOTAL	165	171

Mean difference (C - E)	14.66
S.E. diff.	128.92
t-ratio	.113 (not significant at the 5% level)

Similarly, the percentages of eliminated and successful pilots who had received some previous aeronautical ground training were identical, as shown below:

	Number Having Ground Training	Number Having No Ground Training
Eliminated Pilots	134	80
Control Pilots	134	80

Previous ground training differed somewhat from the ground training received with the company in this respect. A comparison of the eliminated and control groups on the basis of average ground school grades indicated that achievement in ground school differentiates the two groups. This difference was in favor of the control group and yielded a t-ratio of 3.053, which is significant at the 1% level with 64 degrees of freedom.

This study of selection requirements provided results which indicate rather conclusively that present requirements established by airline companies for selection of applicants are not adequate for predicting later success or failure with much confidence.

Methods of Evaluating Airline Pilots

Information pertaining to methods of evaluating airline pilots was obtained in this survey from three main sources: (1) from the study of the personnel file records of the eliminated pilots and their controls; (2) from certain questions from the pilot interview; and (3) from certain questions from the Civil Aeronautics Administration Examiner and Company Check-Pilot Interview. It was not the purpose of this study to make an exhaustive survey of methods of evaluation but only to learn what methods are being used and to obtain an estimate of the extent to which these methods evaluate the behavior, traits, characteristics and abilities which are most critical for the job of airline pilot. Furthermore, an attempt was made to learn the attitudes toward present methods of evaluation of both those who make evaluations and those who are evaluated.

1. Flight-Check Forms in the Personnel Files. The examination of the pilots' personnel files in five airline companies gave an opportunity to make some observations as to the kinds of evaluation methods which are presently used. To evaluate the pilots' flying skills and proficiency on scheduled flights, the companies use three principal kinds of checks. One is a routine captain's report of a scheduled flight on which ratings are made on quite general components of the job, such as "Flying Ability," "Judgment," "Instrument Flying," "Route Knowledge," "Knowledge of Regulations," "Progress," "Industry," etc. Ratings are usually assigned on a scale, such as "Excellent," "Good," "Fair," and "Poor." Some ratings are made on a two-point scale, such as "Standard" and "Sub-standard." Comments may be added on this form. The second type of check in general use is a captain's report of a scheduled flight on which ratings are made on somewhat more specific components of the pilot's job, such as "Duties Prior to Takeoff," "Takeoff and Climb," "Instrument Approach," "Landing," etc. Usually each is rated on a two-, three- or four-point scale. A third type of routing flight check is one on which ratings are made on even more specific components of the job, such as:

Preparation of the Flight Plan

1. Discussion of flight with dispatcher
2. Discussion of flight with meteorologist
3. Discussion of flight with co-pilot
4. Selection of cruising altitude
5. Choice of alternates
6. Fuel requirements

Individual airline companies show great variation as concerns the items which are to be rated on these forms and the type of scale on which ratings are made.

Almost all of the airlines have a check-flight form which is used either for practice hooded flights or for the six-months instrument flight. This type of check-flight breaks down the components of the job into very small units, such as:

Instrument Takeoff

1. Proper application of power
2. Direction held during takeoff
3. Timing proper takeoff -- fast -- slow -- proper
4. Initial climb out -- direction -- angle -- establishment of proper air speed

Ratings are usually made on a two-, three- or four-point scale on each item.

Only one of the airlines had in the pilots' records a flight check which could be called objective. Almost all of the ratings received by the pilots, consequently, depend to a great extent upon the judgment of the check-pilot. Seldom were there records of the actual performance of a pilot such as how many degrees he varied in heading or how many feet he varied in altitude -- instead, there were only ratings of his performance, such as "Average," "Standard," etc.

Another observation was made in regard to the ratings given on these checks. Even when captains use a check form which breaks down components of the job into specific units, it is seldom that there will be different ratings given on each unit -- that is, all the units of a particular component invariably have the same score, indicating the "halo effect" is operating strongly on such forms.

It was also observed that there was a great amount of variation between airline companies as to the adequacy of the personnel records themselves. Some of the companies had records of many flight-checks, captains' reports and other evaluations. Others had records of only a few such evaluations. Some of the files for a single pilot had no record of any flight checks.

2. Attitudes Towards Present Methods of Evaluation. Information pertaining to methods of evaluation was obtained from a content analysis of the attitudes of pilots, Civil Aeronautics Administration Examiners and Company Check-pilots towards presently employed methods. Table 21 presents a classification of all their suggestions for improving the present instrument check. It may be

TABLE 21

SUGGESTIONS OF AIRLINE PILOTS, CIVIL AERONAUTICS ADMINISTRATION EXAMINERS AND COMPANY CHECK-PILOTS FOR IMPROVING THE PRESENT INSTRUMENT CHECK

	Suggestions	Frequency
A.	Factors Omitted from the Present Check Which Should be Included	55
1.	Psychological characteristics	22
2.	Test of knowledge of new facilities, equipment, developments, etc.	12
3.	New maneuvers (no specific ones mentioned)	5
4.	Radio procedures on let-down, under adverse conditions, on unfamiliar range stations	4
5.	A check on the crew as well as the captain	3
6.	Smoothness of flight	3
7.	Night check at low altitude under restricted conditions including forced landing	3
8.	Weather interpretation	2
9.	An evaluation of the pilot's flying record as a supplement to check	2
10.	C.C.A. procedures	1
11.	Simulated landing at a closed field	1
12.	Simulated radio failure	1
B.	More Opportunity for Practice and Training on Skills Required on Instrument Check	51
C.	Factors Included in the Present Check Which Should be Omitted	40
1.	Stalls and obsolete procedures	17
2.	Pilot's mental hazard in the check	12
3.	Personality factor	5
4.	Union pressure (not a member, won't pass check)	4
5.	Details of little importance	2
D.	Check Under Actual Conditions of Instrument Flying	33
E.	Personnel Conducting Check	20
1.	Should be better selection of check-pilots	10
2.	Should do a complete job of checking	3
3.	Should be an independent group	2
4.	Should establish favorable relationship with those whom they check	1
5.	Should not question pilot during check	1
6.	Should be versed in the limitations of the check plane	1
7.	Should know a lot -- not necessarily be a veteran pilot	1
8.	Should note the conditions under which landings are made	1

TABLE VI (Cont.)

	Suggestions	Frequency
F.	Factors Deserving More Emphasis in the Check	18
	1. Instrument approach and let-down	6
	2. Safety	2
	3. Minimum speed maneuvers	1
	4. Single engine maneuvers	1
	5. Simulated emergencies	1
	6. A.D.F. work	1
	7. Pilot's automatic response to instruments	1
	8. Needle, ball and airspeed flying	1
	9. Performance in vicinity of the airport	1
	10. Headwork of the pilot should be near perfect	1
	11. Raise requirements for radio-instrument flying	1
	12. Gyro instruments	1
G.	Checks Should be Changed Occasionally	8
H.	Checks and Checking Should be Standardized	8
I.	Frequency of Checks	7
	1. Checks should be given more frequently	6
	2. Checks should be given less frequently	1
J.	Factors Deserving Less Emphasis in the Present Check	7
	1. Tolerances	3
	2. Needle, ball and airspeed flying	2
	3. Holding work while on instruments	2
K.	Give Route Check in Normal Conditions of Flight	5
L.	Check in the Largest or Heaviest Plane the Pilot Flies	3
M.	Standards of the Present Check Should be Raised	3
N.	Eliminate the Instrument Check Entirely	2
O.	Pilots Should be Checked by More Than One Check Pilot	1
	TOTAL	261

concluded that both the pilots in charge of evaluation and the pilots being evaluated feel that the check could be improved by the addition and deletion of certain items, by standardizing the method of administration, by providing more opportunity for practice and training on maneuvers required by the check and by effecting certain changes in regard to the personnel administering the check.

Critical Situations in Airline Flying

Although the main objectives of this survey were to obtain information pertaining to the critical requirements of the job of the airline pilot, it was realized that it would be necessary to look at the pilot's job in relation to other factors contributing to making his job more difficult, and hence airline flying less safe. Consequently, information has been obtained which bears on the problem of what contributes to critical situations in airline flying.

It will be recalled that in response to Question #3 of the pilot interview, pilots made 1,241 comments as to causes of unsafe airline flying. A total of 902 of these comments, or 72.7%, were related to factors other than the pilot, such as unsafe conditions of airplanes, airports, weather, etc. These comments attributed unsafe airline flying to causes which fell into the following categories: (Comments related to the pilot as a cause are excluded.)

	Percentage of Comments
Communication and Navigational Equipment	20.0
Airports	19.1
Aircraft	16.7
Airline Companies' Policies and Procedures	14.4
C.A.A. and C.A.R. Policies and Procedures	13.3
Weather	8.5
Traffic Control	7.8
Other	.2
TOTAL	100.0%

Each of these categories has been broken down into the specific causes mentioned by the pilots and is presented in Table 22. These data provide valuable information as to existing conditions which pilots feel are making their job more difficult. Of particular significance to all agencies interested in flying safety are the 15 most frequently mentioned specific causes of unsafe airline flying. Each of the following 15 items was mentioned by at least 20 pilots:

Inadequate Approach System
Inadequate Lighting at Airports
Non-commercial Airplanes in Traffic
Too much Government Interference
Airway Traffic Control Inadequate
Radio Static
Lack of V.H.F.
Lack of High Intensity Approach and Runway Lights
Short Runways
Inadequate Airports for Amount of Traffic
Cockpits not Standardized
De-icing Equipment Inadequate
Inadequate Training for New Equipment
Inaccurate Weather Reports

TABLE 22

FREQUENCY OF VARIOUS FACTORS MENTIONED BY AIRLINE PILOTS AS CAUSES OF UNSAFE AIRLINE FLYING

Causes of Unsafe Airline Flying		Frequency	
A.	Communication and Navigation Equipment		180
1.	Approach Systems	67	
a.	Lack of I.L.S.	33	
b.	Inadequate G.C.A.	27	
c.	Lack of the new radar equipment	6	
d.	I.L.S. not reliable	1	
2.	Communication Equipment	50	
a.	Radio static	26	
b.	Poor Communications in General	9	
c.	Radio failures	9	
d.	Inefficient radios	6	
3.	Radio Ranges	49	
a.	V.H.F. ranges needed	26	
b.	Radio ranges not lined up with runways	7	
c.	Adcock ranges should replace loop type	5	
d.	Inadequate range stations	3	
e.	Radio ranges too close to airport	2	
f.	More than one range station on one frequency	1	
g.	Radio range not suitable for faster planes	1	
h.	V.H.F. changes without notice	1	
i.	More fan markers needed	1	
j.	Radio ranges too far from station	1	
k.	Poor radio range maintenance	1	
4.	Others	14	
a.	Inadequate navigational aids, in general	4	
b.	Radio facilities poor, in general	4	
c.	Lack of radio altimeters	3	
d.	Improper placement of navigational aids	1	
e.	Lack of airborne radar	1	
f.	Lack of gyro or flux-gate compasses	1	
B.	Airports		172
1.	Inadequacies of Airport Lighting	80	
a.	Inadequate lighting	38	
b.	High intensity approach lights needed	21	
c.	High visibility contact lights needed along runway	20	
d.	Insufficient lights indicating pattern	1	
2.	Runways	37	
a.	Short runways	24	
b.	Runways not free of ice, snow, or water	8	
c.	Rough runways	3	
d.	Runways not in enough directions	2	

TABLE 22 (Cont.)

Causes of Unsafe Airline Flying			Frequency
3.	Airports Inadequate for Present Heavy Traffic		26
4.	Airports with No Radio Equipped Control Tower		10
5.	Obstructions On and Around Airport		10
6.	Obsolete or Unstandardized Conditions of the Airport		8
7.	Lack of Fog Dispersal at Airports		1
C.	Aircraft		151
1.	Aircraft Cockpit Design		59
	a. Non-standardized cockpits and instruments	26	
	b. Inadequate cockpit lighting	15	
	c. Windshields not tinted	12	
	d. Windshields too small	2	
	e. Maps that aren't easily securable in the cockpit	1	
	f. Unnecessary gadgets in the cockpit	1	
	g. Radio hard to get at	1	
	h. Windshields too thin, not bird-proof	1	
2.	Structural and/or Equipment Failures or Deficiencies of Aircraft		44
	a. De-icing equipment inadequate	29	
	b. Structural failures	4	
	c. Too much error in altimeters	4	
	d. Inferior equipment	3	
	e. Lights on plane too dim for landing	2	
	f. Aircraft without blinking lights	1	
	g. Flat tires	1	
3.	Mechanical Failures and/or Deficiencies		34
	a. Mechanical difficulties and failures	25	
	b. Two engine planes	7	
	c. Props which won't feather	1	
	d. Constellations mechanically deficient	1	
4.	Fire Hazards		10
	a. Places on plane not available to crew	4	
	b. Paint not fireproof	3	
	c. Engines have inadequate fire-fighting equipment	2	
	d. DC-4 gas tanks	1	
5.	Old Planes		3
6.	Water in Gas		1

TABLE 22 (Cont.)

Causes of Unsafe Airline Flying		Frequency	
D.	**Airline Companies' Policies and Procedures**		130
1.	**Airline Company Training Programs**	58	
a.	Inadequate training when pilots assigned to new plane or equipment	23	
b.	Lack of practice of procedures seldom used in route area	10	
c.	Inadequate knowledge of type of plane being flown	5	
d.	Training is too fast to be complete -- inadequate training	4	
e.	Insufficient training of radio operators	3	
f.	Flying more than one type of plane	3	
g.	Large aircraft too much for some pilots	2	
h.	Insufficient checking on the job	2	
i.	Insufficient practice for emergency situations	2	
j.	Co-pilots should be trained to assume half responsibility	1	
k.	Some captains are poor teachers	1	
l.	Co-pilots lack previous instruction	1	
m.	Too lax in qualifying pilot to fly a route	1	
2.	**Airline Company Personnel Policies**	45	
a.	Shouldn't pay pilots on hourly basis	8	
b.	Shouldn't pay pilots on trip basis	5	
c.	Irregular hours for pilots	5	
d.	Physical training program is needed	4	
e.	Inadequate pay	4	
f.	Best men not being selected	4	
g.	Co-pilot salary too low to attract best men	4	
h.	Retirement plan needed	4	
i.	Deadheading between terminals	2	
j.	Ground personnel not having flying experience	1	
k.	Co-pilots rotated too fast	1	
l.	Personality conflict - captain and co-pilot	1	
m.	Time off shouldn't be interrupted	1	
n.	Should have Sr. Captain, Jr. Captain, and Co-pilot on each trip	1	
3.	**Airline Company Maintenance of Aircraft**	13	
a.	Inadequate maintenance of aircraft	10	
b.	Planes should be checked on each turn-around	2	
c.	Planes should be checked after each thunderstorm	1	
4.	**Airline Company Operations**	14	
a.	Long unanticipated delays	4	
b.	Too much paper work during the flight	3	
c.	Layovers should be about 16 hours, or jump to 32 -- 24 hour layover very bad	2	

TABLE 22 (Cont.)

Causes of Unsafe Airline Flying		Frequency	
d.	Pilot should have final say whether to take off in questionable weather	1	
e.	Closely spaced flights for a pilot	1	
f.	Company allows too much cargo and too little gas	1	
g.	Keeping a man on a run too long	1	
h.	Inadequate loading information	1	
E.	C.A.A. and/or C.A.B. Policy and Procedure		120
1.	Non-commercial traffic - a hazard	36	
2.	Pilots and companies should have more responsibility and authority to make decisions; too much interference	31	
3.	Too many Regulations or Too Many Changes in Regulations	19	
4.	Legal Flying Not Always Safe Flying. Minimums Too Low	10	
5.	Accidents being investigated by a Political Board	4	
6.	Eliminate Minimums - Each Pilot would set his own according to his ability	3	
7.	C.A.A. Physical Should be Standardized	3	
8.	Pilots fear Legality	3	
9.	C.A.B. Regulations Not Being Enforced	2	
10.	C.A.A. Failure to Approve New Equipment	2	
11.	C.A.A. Publications Delayed Beyond Reason	2	
12.	There are No C.A.A. Take-off Minimums	1	
13.	Not Strict Enough on Pilot's Ability to Fly Instruments	1	
14.	C.A.B. puts Too Much Blame on Pilot	1	
15.	Should be Separation of Legislative, Executive, and Judicial Departments	1	
16.	C.A.A. Inspectors Not Qualified	1	
F.	Weather		77
1.	Reports of Weather	52	
a.	Inaccurate weather reports	27	
b.	Late weather reports	12	
c.	No reports between stations	7	
d.	Insufficient weather information	5	
e.	Ceilings not being considered between stations	1	
2.	Weather Conditions	25	
a.	Too bad to fly	9	
b.	Turbulence	8	
c.	Thunderstorms	7	
d.	Unpredictable storms	1	

TABLE 22 (Cont.)

Causes of Unsafe Airline Flying			Frequency
G.	Traffic Control		70
1.	Airway Traffic Control		42
a.	A.T.C. inadequate	32	
b.	A.T.C. inadequate when flying instruments	5	
c.	A.T.C. procedures should be standardized	2	
d.	Flying C.F.R. potentially dangerous	1	
e.	Traffic control in one center should give traffic in next center	1	
f.	Shouldn't give C.F.R. clearances in borderline weather	1	
2.	Control Zone Traffic Control		15
a.	Inadequate control tower operations	6	
b.	Incorrect information from control tower	5	
c.	All lights should be operated by control tower - runway being used should be the only one lighted	1	
d.	Too much work and responsibility given to control tower operator at busy fields	1	
e.	Poor judgment on part of control tower operators	1	
f.	Straight in approaches sometimes cause accidents	1	
3.	Airways and Control Zone Traffic Control		13
a.	Lack of coordination between ground and flying personnel	7	
b.	Poor quality of control personnel	3	
c.	Incorrect clearances	3	
H.	Others		2
1.	People Evaluate Safety in Dollars		1
2.	Politics Interfere with Safety		1

Another additional source of information pertaining to causes of unsafe airline flying was an analysis of the critical situations experienced by the pilots and reported in the pilot interview. All of the 652 incidents from which examples of pilot behavior were extracted were re-analyzed for the purpose of extracting all the incidents in which some unsafe condition or a combination of unsafe conditions was a contributing factor in making the situation a critical one. Of the 652 incidents in which pilot behavior was involved, there were 351 incidents (54%) in which some unsafe condition was associated with the pilot behavior. The other 46% were incidents which were made critical by the behavior of the pilot alone.

A content analysis of these 351 incidents produced a total of 429 unsafe conditions (factors other than the pilot) contributing to the critical situations. These were classified as follows:

	Percentage of Factors
Weather	57%
Unsafe Condition of the Airplane	16%
Unsafe Condition of Airports	15%
Traffic Conditions	9%
Other	3%
TOTAL	100%

Table 23 shows the specific unsafe conditions within each of these more general categories. It will be noted that an attempt was made to classify the various unsafe weather conditions in terms of the effects they have, rather than in terms of the various elements of the weather.

When an analysis was made of all of the 351 incidents to determine the percentage of incidents in which each kind of unsafe condition was reported, it was found that the effect of weather loomed even larger in comparison with other unsafe conditions. This can be shown as follows:

Unsafe Condition	Percentage of Total Critical Situations in Which Each Condition was Reported *
Weather	70%
Airplane	19%
Airport	18%
Traffic	12%
Other	3%

*Total percentage equals more than 100% because more than one unsafe condition could be present in one critical situation.

TABLE 23

SPECIFIC UNSAFE CONDITIONS CONTRIBUTING TO CRITICAL SITUATIONS IN AIRLINE FLYING

	Unsafe Conditions		Frequency
A.	**Weather**		244
	1. Impairment of flight (cross-winds, downdrafts, gustiness, icing)	83	
	2. Obstruction to visibility (fog, haze, rain, low ceilings, snow, smoke)	82	
	3. Danger of damage to aircraft (turbulence, thunderstorms, hail)	32	
	4. Impairment to ground operations (ice, snow or rain on runway, snow banks)	30	
	5. Impairment to radio reception (electrical storms, antenna icing)	17	
B.	**Unsafe Conditions of Airplane**		68
	1. Engine failure (both actual and simulated)	52	
	2. Instrument failures	4	
	3. Lack of standardization of cockpits	4	
	4. Radio failure	2	
	5. Hydraulic system failure	2	
	6. Flat tire	1	
	7. No oxygen	1	
	8. Engine fire	1	
	9. Locked brakes	1	
C.	**Unsafe Conditions of Airport**		64
	1. Interference by trucks, equipment, other planes	29	
	2. Runway slippery	24	
	3. Runways too short	5	
	4. Rough runway	5	
	5. Poor lighting on airport	1	
D.	**Traffic**		42
	1. Congested traffic, interference by other planes	25	
	2. Inadequacy of information from tower or A.T.C. concerning traffic	14	
	3. Radio ranges inoperative or inadequate	3	
E.	**Other**		11
	1. Presence of mountainous terrain	8	
	2. Improper loading of airplane	2	
	3. Unfamiliar airplane	1	
	TOTAL		429

A final analysis of all of the 652 incidents in which pilot behavior was reported was undertaken for the purpose of determining where most of the critical situations were occurring. This analysis revealed the following:

Phase of Flight in Which Critical Situations Occur	Frequency
Engines Running (not taxiing)	3
Taxiing	27
Takeoff	55
Pattern	12
Final Approach and Landing	319
Go-around	3
Normal Flight	238
Undetermined	11
TOTAL	652

The very high frequency of critical situations occurring during approach and landing suggests that this phase of flight requires more of the pilots' critical skills and traits than other phases of flight, which is supported by the high percentage of pilot errors during execution of the approach and landing (see Table 4).

It can be seen from the preceding analyses that the occurrence of critical situations in airline flying is by no means a function of pilot behavior alone. Consequently, in order to understand the critical requirements of the job of the airline pilot, it becomes necessary to see the job in relation to the conditions under which the pilot must perform and to understand where the pilot is called upon to give the most skilled performance.

Pilot Fatigue

Some information pertaining to the problem of pilot fatigue was obtained in this study. One of the aims of the study was to obtain from pilots examples of critical incidents which have occurred partially or wholly as a result of feelings of fatigue on the part of the pilots. From the interviews with the 240 airline pilots a total of only 70 such incidents was obtained. A large number of the pilots said they could not recall such a situation in their own flying experience. An analysis of the 70 incidents was undertaken, however, to determine some of the factors associated with these situations. Below is shown a breakdown of the incidents with regard to time of flight, day or night, instrument or contact flying, and the phase of flight in which the pilot error occurred.

Day	19	Instrument	35
Night	45	Contact	32
Undetermined	12	Simulated Instruments	5
TOTAL	76*	TOTAL	72*

Engines Running (but not taxiing)	0
Taxiing	3
Takeoff	3
Pattern	1
Final Approach and Landing	34
Go-around	0
Normal Flight	24
Undetermined	6
TOTAL	71*

*Incidents in which two factors were involved are counted twice, thus making totals over 70.

These data can only be interpreted broadly. They suggest that fatigue occurs on both day and night flights, perhaps more frequently at night, although the proportions of all day and night flights are not known. They indicate that fatigue occurs on both contact and instrument flights and may also occur during simulated instrument flight. They also indicate that pilot errors resulting from fatigue seem to occur more frequently on the final approach or landing or during the course of normal flight.

Certain other information relative to each fatigue incident was requested in the interviews in order to determine what factors are associated with the occurrence of fatigue. This information is as follows:

1. Number of consecutive hours which each pilot had flown prior to the incident

2. Number of months the pilot had been assigned to the particular flight

3. Whether or not the incident occurred as a domestic or a foreign flight

4. Whether or not the incident occurred on a long hop or a short hop

An analysis of these data revealed that pilots reporting an incident in which fatigue was a factor had flown on an average of 8.65 consecutive hours prior to the occurrence of the incident, had been assigned to the same flight for an average of 15.48 months. Approximately 70% of the flights were domestic and approximately 55% were long hops. Few interpretations can be made of these percentages, inasmuch as the proportions of all flight which are domestic over foreign and long over short are not known.

Table 3 showed the distribution of pilot acts which were committed as a result of fatigue. The most frequently reported acts were in the job component of "Establishing and Maintaining Angle of Glide, Rate of Descent and Gliding Speed on Approach to Landing." This would agree with the large percentage of fatigue incidents which occurred during approach and landing, as shown on pages 48 and 49.

An Evaluation of the Interview

An attempt was made to obtain a rough estimate of the degree to which the interviewers in this survey reliably recorded information given to them by the airline pilot interviewees. It will be recalled that for the purpose of training the interviewers, supervisors were asked to conduct several interviews in which one interviewer observed another and recorded the information independently. These interviews provided the data for this evaluation. Only 15 such interviews were obtained. The recorded information obtained from those questions asking pilots for examples of critical incidents provided the data upon which was based the comparison of the records of the interviewer and his observer in each of the interviews. The 15 interviewers reported 45 incidents. There were five different kinds of information which interviewers were requested to obtain about each incident: (1) type of plane, (2) time of incident, (3) flight reference (instrument, contact or hooded), (4) phase of flight, and (5) behavior of the pilot. For the 45 incidents, this made a total of 225 items upon which to base a comparison of the reporting of each interviewer and his observer. There were a few incidents which analysis showed were really double incidents. Although these were reported by the interviewers as only one incident, each contained more than five items, i.e., two examples of pilot behavior. These double incidents raised the total number of possible items to 240. The results of the comparison are as follows:

EXTENT TO WHICH INTERVIEWERS WERE
ABLE TO GET THE DESIRED INFORMATION

	No.	%
Items which both interviewer and observer reported	157	(65.4%)
Items which neither interviewer nor observer reported	54	(22.5%)
Items which one reported and the other didn't	29	(12.1%)

EXTENT TO WHICH INTERVIEWERS AGREED
ON INFORMATION REPORTED BY BOTH

	No.	%
Items which both interviewer and observer reported	157	(100%)
With complete agreement	155	(98.7%)
With disagreement	2	(1.3%)

From these results it would appear that interviewers agreed on items which they reported, but that one occasionally failed to record items which another did record. Furthermore, it would appear that the interviewers were only 65% effective in obtaining from the pilots all of the information desired about an incident. This may not be solely the function of the interviewers' techniques or the interview method itself, inasmuch as it was found that some pilots were reluctant to relate incidents which were brought on by some act of their own.

SUMMARY AND CONCLUSIONS

Summary and Discussion of Findings

1. The Critical Requirements of the Job of Airline Pilot. This survey has brought together an extensive amount of information from a number of different sources, but all related to the problem of the critical requirements of the airline pilot's job. The interviews with pilots enabled a more complete job analysis than would have been possible without their first-hand experiences. The employment of the "critical-incident technique" further amplified information of the kind ordinarily obtainable only from analysis of accidents. With such extensive data it was possible to obtain fairly reliable comparative indices of the degree to which specific components of the pilot's job are critical from the standpoint of differentiating between safe and effective airline flying and less safe and effective piloting. These comparative indices of how critical various job components actually are should provide a rich source of data for subsequent improvements of selection procedures, improvements in airline pilot training programs, and improvements in airline pilot evaluation procedures. To the present list of available pilot selection tests can be added new tests which will attempt to measure requirements found to be particularly critical for the airline pilot's job. To present training programs can be added procedures designed to increase the proficiency of pilots in the most critical aspects of their job; emphasis upon less critical components can be decreased. Finally, to present evaluation procedures can be added more refined measures and more appropriate standards of proficiency for these extremely critical components of the pilot's job.

A summary of the findings of this study which pertain to critical requirements first should call attention to the extreme range of kinds of pilot acts which produce critical situations and accidents. The content analysis of the critical incidents produced 87 different kinds of pilot acts, which were grouped into 21 different job components. These data indicate that the most critical part of the pilot's job is that involving the skills of setting up and holding a proper angle of glide, rate of descent and speed of glide on the approach. Failure to perform this part of the job adequately results in three times as many accidents as does failure to perform any other part of the job. Further evidence of its critical nature is that ratings of successful pilots on the "Approach and Landing" part of the flight check were significantly higher than ratings of eliminated pilots. It is significant that pilots themselves do not rate this part of their job as very critical, considering the fact that only 5 out of 265 kinds of unfavorable comments made by captains on the performance of eliminated pilots had to do with this aspect of the job. Similarly, this job component ranked next to the last in the frequency with which kinds of pilot behavior were judged as causes of unsafe airline flying. On the other hand, this component was one on which eliminated pilots received a large percentage of below average ratings on check rides and routine flight reports.

Almost as critical is that component of the pilot's job involving the operation of controls, switches and other "gadgets." Although contributing to fewer accidents than some of the other pilot acts, errors in this component contributed to near-accidents with a high frequency. Again, pilots do not

rate this job component as a critical one, considering the fact that this aspect of the job is not mentioned as contributing to unsafe airline flying and is not rated by many check pilots as being one of the things they particularly look for which differentiate the good from the average airline pilot. Nevertheless, it is apparent that pilots are aware of the handicaps imposed upon them by poor cockpit design as shown in Table 22, page 41. The high frequency of "Forgot to Operate a Control" suggests a need for improvements in warning devices. The high frequency of "Confused Two Controls," "Made Improper Adjustment of a Control" and "Inadvertently Operated a Control" strongly suggests a need for improvement and standardization of cockpit design.

The navigating and orienting component of the pilot's job proved to be critical, as determined from the analyses of critical incidents, the analysis of captains' unfavorable comments on eliminated pilots, from the high percentage of below-average ratings obtained by eliminated pilots on this aspect of their flying and from the frequency with which pilots report poor navigating as a cause of unsafe airline flying. It is apparent from pilots' comments, however, that they are operating with what they feel to be inadequate navigational aids, for they reported this inadequacy as being a cause of unsafe airline flying more frequently than any other unsafe condition.

The above summary demonstrates how the information obtained in this survey can be integrated to point out critical requirements of the pilot's job. Other job components were found to be critical to a lesser extent than these three. The various tables indicate which these are. Data from the survey also indicate what specific pilot acts within each critical job component seem to be most critical. Actual observation of pilots performing these acts may be necessary to furnish clues as to what skills or psychological aptitudes are involved, to suggest refinements in evaluating pilots' performance of these acts, or to discover improved techniques of training pilots to perform these acts more efficiently.

2. Selection Requirements. Data obtained from company files and the subsequent comparison of the pre-employment data of eliminated pilots and successful pilots suggest that present requirements established by companies for selecting applicants may not be altogether adequate for predicting subsequent success or failure during training with any degree of confidence. This survey offered an opportunity for testing the effectiveness of many different requirements used by the various airlines, none of which seems to be sufficiently effective in doing the job for which they are intended. Although the data presented in this report do not offer a solution, they are pertinent to the more general problem of airline pilot selection.

3. Methods of Evaluation. Data obtained in this survey indicate that many of the most critical components of the pilot's job are not considered critical by the captains and Civil Aeronautics Administration Examiners who evaluate other pilots. There is some evidence that these check-pilots emphasize components of the job which seldom contribute to critical situations and accidents. This is understandable when it is remembered that airlines do want pilots with traits and abilities over and above those which insure safe flying. Data from this study can serve to point up critical components which perhaps are not being evaluated as effectively as some of the less critical components.

The results of the comparison of the E-group and C-group on ratings received on a sample flight check indicate that the flight check as a whole and almost every item in the check discriminate between the two groups. This is to be expected, inasmuch as whether or not a pilot will be eliminated depends to a great extent upon ratings on his flight checks. The fact that almost every item on the flight check differentiates the two groups suggests a tendency on the part of check-pilots to assign to a single pilot the same rating on each item. This is confirmed by an examination of the scores on all of the items for each pilot. It was observed many times that a pilot had received all 1's (below average), all 2's (average) or all 3's (above average) on the entire flight check. Only one pilot had received ratings over the entire range of the three-point scale. It is possible, then, that a single flight check as a whole discriminates between eliminated and successful pilots largely because the flight check is an important criterion of pass or fail and that individual items of the flight check discriminate because they correlate so high with the check-pilots' overall judgment.

This survey offered the opportunity to observe the various methods of evaluation being used by different airlines. It was found that these methods lack objectivity -- they are dependent upon the judgments of those administering the checks. The use of more objective methods of evaluation by airlines would lead to improvements in training procedures and would furnish more reliable data upon which to validate selection procedures.

4. The Critical Situations in Airline Flying. The findings of this survey indicate which situations are most critical in airline flying and some of the factors which contribute to making them critical. The most critical phase of flight seems to be the "Final Approach and Landing." Almost half of the critical situations obtained in this study occurred in this phase of flight; over 65% of all accidents used in the study occurred during this phase. Some of the reasons for this phase of flight being critical are apparent from the analysis of comments regarding causes of unsafe airline flying. Pilots very frequently rated "Inadequate Approach Systems," "Poor Airport Lighting," "Short Runways" and "Non-commercial Traffic" as causes of unsafe airline flying.

The factor of weather is an important one in the majority of critical situations. In approximately 7 out of every 10 situations made critical by some unsafe condition, weather was one of the contributing factors. Weather most frequently obstructs the visibility of the pilot or hinders control of the flight of the airplane. Consequently, weather seems to exert its effect "through the pilot." Less frequently does weather operate directly to cause damage to the airplane, impairment to radio equipment, etc.

Unsafe conditions of the airplane contribute to critical situations with the next highest frequency, 19% of all critical situations showing this factor. Approximately 3 out of 4 factors related to the airplane are actual engine failures or simulated engine failures. Apparently, from the standpoint of setting up conditions in which pilots make errors, both actual and simulated engine failures make a situation critical for the pilot. This suggests a need for more practice under such situations. This need also is indicated by the large number of errors in operating controls and switches during actual or simulated engine failure.

Slippery runways were a contributing factor in 24 critical situations, although invariably this condition was associated with pilots overshooting or landing with excessive speed or with runways being too short. Interference by non-commercial aircraft was reported as a contributing factor in 25 critical situations. Likewise, it was the opinion of 36 pilots that this was an important cause of unsafe airline flying.

In general, the analysis of these critical situations revealed one consistent fact -- namely, that unsafe airline flying is a product of a constellation of factors. The total configuration produced by several unsafe conditions, operating at one time or in sequence, is the important ingredient for a critical situation. Removal of any one of the unsafe conditions is likely to change the complexion of the situation from critical to commonplace and ordinary.

5. Pilot Fatigue. The findings of this survey in regard to the causes and effects of pilot fatigue are far from extensive. There is evidence, however, that pilot fatigue may effect pilot behavior in almost all of the components of his job and in almost all phases and conditions of flight. The frequency of the kinds of pilot errors resulting from feelings of fatigue seems to correspond with the frequency of errors resulting from other factors, as shown in Table 2. The small number of critical situations reported by pilots as resulting from fatigue seems to indicate the necessity for a separate investigation of this factor, using larger samples of pilots. It appears from the data obtained that an important factor in fatigue situations is the number of consecutive hours flown by the pilot prior to the incident, the average obtained being 8.65 hours.

Conclusions

In the summary of the findings of this survey, it was suggested that the information pertaining to the critical requirements of the airline pilot's job might be a foundation upon which to develop improved selection, more appropriate training and more objective evaluation of airline pilots. The knowledge of what are the critical requirements of the job is of great potential value, but these requirements must be translated into a coordinated attack upon selection, training and evaluation. Improvements in these three areas are necessarily dependent upon knowing the critical requirements of the job. To the presently available pilot selection tests developed during the war can be added some new tests designed to measure some of the requirements distinctive for the airline pilot's job. To present methods of training can be added new methods which will increase proficiency in the most critical components of the job. Both new selection tests and new training methods, however, need validation. That is, there must be some objective and reliable measure of the proficiency of a pilot in order to test adequately the effectiveness of new selection and training methods. In order to say with confidence that a new selection test will predict which pilots will become more proficient and that some new training procedure will increase pilot proficiency, there should exist an adequate measure of proficiency.

The present survey has indicated that present measures of proficiency are hardly objective and sensitive enough to be used as a suitable criterion against which to validate new selection and training procedures. It is proposed, therefore, that the first step of a program which utilizes the results of this

study is the development of objective and reliable evaluation procedures. It is proposed that the information obtained in this present survey be used as a basis for devising an objective flight check which would accurately and reliably evaluate the degree to which pilots achieve proficiency in the most critical components of their job. Such a program would involve further study of present methods of checking, the devising of new ways of rating critical skills and a period during which the new procedures could be tried out experimentally on a sample of pilots. Any new evaluation procedures developed should be objective rather than be based upon the individual judgment of a check-pilot, they should be practical and usable, and they should be acceptable to the pilots themselves. Such procedures, provided they meet these requirements, would then clear the way for scientific validation of selection and training procedures, thus completing the three-fold program of improving selection, training and evaluation of the airline pilot.

APPENDIX 1

INTERVIEWERS GUIDE FOR USE DURING PILOT INTERVIEW

CAA Project I May 1947

INTERVIEWERS GUIDE

For Use During

PILOT INTERVIEW

QUESTION #1: "Probably all pilots who have flown a lot have done something at one time or another that got them into an uncomfortable situation or even a near accident. We would like to get from each pilot several examples of such things that he has done. First, could you describe the most recent situation in which you did something like this and tell me just what you did?"

DESIRED INFORMATION:
1. Specific behavior of the pilot.
2. Most recent incident.
3. Conditions: location, traffic, weather, instrument or contact, day or night, etc.
4. Type of airplane.
5. Equipment involved in incident.

Alternative Question (Alt. #1): "Well, perhaps you could recall the most recent incident where you observed some other pilot do something that got him in such a spot."

QUESTION #2 (Captains): "Now, I would like for you to recall the last time you had to take over the controls from a copilot because you felt the situation was pretty critical. Could you describe that situation and tell me just what the copilot did or might have done if you hadn't taken over?"

(Copilots): "Now, I would like for you to recall the last time the captain you were flying with took over the controls from you because he felt the situation was pretty critical. Could you describe this situation and tell me just what you did or what he thought you might haye done if he hadn't taken over?"

DESIRED INFORMATION:
1. Specific behavior of the pilot
2. Most recent incident
3. Conditions: location, traffic, weather, instrument or contact, day or night, etc.
4. Type of airplane
5. Equipment involved in incident.

Alternative Question (Alt. #2)(Captains): "Well, then, perhaps you could tell me about the last time that you felt that the situation was so critical that you would not have wanted the average copilot to fly the airplane. Could you describe that situation and tell me what unsafe act an average copilot might have done in that situation?"

Alternative Question (Alt. #2) (Copilots): "Well, then, perhaps you could tell me about the last time that you felt that the situation was so critical that you preferred that the captain fly the airplane. Could you describe that situation and tell me what you might have done in that situation?"

QUESTION #3: "In addition to these specific incidents which you have described, we are anxious to get your opinions on causes of unsafe airline flying in general. Obviously, there are a great number of causes, but I would like to hear what you feel are some of the most important. What are the important causes of unsafe airline flying?"

DESIRED INFORMATION: Specific information is necessary. For example, if the pilot mentions insufficient training, find out what part of training. If he mentions equipment, find out what equipment, etc.

QUESTION #4: "If you ran an airline and had the problem of keeping check on whether captains were doing a good job, how would you do it?"

QUESTION #5: "What characteristics, traits or abilities which differentiate the good airline captain from the poor are not being evaluated adequately by present methods of evaluation?"

QUESTION #6: "How would you change the present instrument check so that more of these desirable characteristics, traits, and abilities of the good airline pilot could be evaluated?"

QUESTION #7: "We are also interested in determining to what extent pilot fatigue may be a factor in airline accidents. Can you recall a situation where fatigue in any way might have contributed to an accident or a near accident? Would you describe that situation and tell me just what the pilot did as a result of his fatigue?"

DESIRED INFORMATION:
1. Type of airplane
2. Consecutive flying hours at time of incident
3. Overseas or domestic, day or night, long hop or a flight with many stops, instrument or contact.

QUESTION #8: "I would like to get more of your ideas about this problem of fatigue. What causes pilot fatigue for the most part? What are important fatigue-producing factors in airline flying?"

QUESTION #9: "Well, I've asked you a lot of questions and you have given me some very good ideas. Now, perhaps you have something further to say on these problems which you haven't mentioned already. If you do, I would like very much to get some of your other ideas."

APPENDIX 2

QUESTIONS FOR THE AIRLINE PILOT INTERVIEW

QUESTIONS FOR THE AIRLINE PILOT INTERVIEW

QUESTION #1

"Probably all pilots who have flown a lot have done something at one time or another that got them into an uncomfortable situation or even a near accident. We would like to get from each pilot several examples of such things that he has done. First, could you describe the most recent situation in which you did something like this and tell me just what you did?"

The purpose of this question is twofold. First, it has been worded in such a way as to obtain an example of specific behavior of a pilot, something which that pilot did. It is essential that the question evoke this type of response. It may be necessary to reword the question and ask it a second time in order that the pilot understands what is wanted. Secondly, the question specifically asks for the most recent example. This is important to assure us that all of the incidents we obtain will represent a fairly random sample of typical things pilots do that get them into dangerous situations. It is important, therefore, that the interviewer obtain the most recent incident. It is expected that from some pilots interviewers may be able to obtain more than one incident. Consequently, after the pilot has given his most recent incident, the interviewer should then ask the pilot if he can recall other such incidents. It would be desirable if interviewers could obtain more than one incident, but the number should not exceed three because of time limitations. It will be left up to the interviewer to judge each example the pilot gives and to determine if secondary questions are necessary in order to obtain what is needed. As a guide for the interviewer, the essential information to be obtained from this question can be summarized as follows:

1. The most recent example of something the pilot did that resulted in a dangerous situation or near accident. What was the unsafe act?
2. Conditions under which the incident occurred: location, traffic, weather, instrument or contact flight, day or night flight, etc.

3. Type of airplane being flown and information about other equipment involved in the incident: engine failure, instruments misread, controls confused, radio inoperative, etc.
4. Pilot's opinion as to reasons for the unsafe act. What were the contributing causes of the unsafe act?

It is expected that some pilots will give incidents which were dangerous but were not brought on by an unsafe act of the pilot. These pilots may find it difficult to admit that they committed an unsafe act. The interviewer might remind the pilot that we want examples of what pilots do rather than examples of situations made unsafe by others. The interviewer also might re-emphasize the fact that we are not interested in particular pilots and that these examples will be treated anonymously. If the interviewer still cannot obtain an adequate response for Question #1, he should try the following Alternative Question:

Alternative Question (Alt. #1): "Well, perhaps you could recall the most recent incident where you observed some other pilot do something that got him in such a spot."

Following is an example of a fairly satisfactory answer to Question #1:

Pilot: "We took off at Washington with about a 700-800 foot ceiling. The visibility was only about 1 mile and there was rain on the windshield. We were only about 400 feet off the ground at the time. There was another pilot riding jump seat and if it hadn't been for the fact that he saw this other plane and yelled we would have hit him sure, That was really a close one."

(Comment: The pilot has given the situation and the conditions under which the incident occurred, but he has not stated what the pilot or copilot did to bring on this situation. Consequently, the interviewer found it necessary to make an additional comment).

Interviewer: "I'm not sure I understand just what you did to bring on this situation."

Pilot: "Well, it was really the control tower operator's fault for clearing us to take-off with another plane in that position in the traffic pattern."

(Comment: The pilot seems to be a bit defensive and puts the blame on the control tower operator. Note next that the interviewer does not ask the pilot if he was at fault in any way but makes a simple reflection of the pilot's statement. The result is that the pilot later tells why he was at fault).

Interviewer: "It was really the control tower operator's error that caused this situation to occur, is that right?"

Pilot: "Yes, It was his error at first. He shouldn't have cleared us. Still we were so busy in the cockpit that we didn't look out for other planes. The copilot was reducing power--that shows how low we were! I was busy getting ready to fly instruments. I would like to emphasize that in the DC-4 you have to do so much you don't have enough time to look around.

(Comment: Simply by showing an interest and by trying to understand him the interviewer skillfully brought out the specific unsafe act of the pilot. In addition he obtained the pilot's opinion as to possible reasons for the unsafe act, namely the complexity of a particular airplane.)

QUESTION #2

(Captains) "Now, I would like for you to recall the last time you had to take over the controls from a copilot because you felt the situation was pretty critical. Could you describe that situation and tell me just what the copilot did or might have done if you hadn't taken over?"

(Copilots) "Now, I would like for you to recall the last time the captain you were flying with took over the controls from you because he felt the situation was pretty critical. Could you describe this situation and tell me just what you did or what he thought you might have done if he hadn't taken over?"

The purpose of this question is to get examples of what less competent pilots do or might do in critical situations in airline flying. The answers to this question should be in terms of behavior of the pilot. What did he do or what might he have done? It is expected that from some pilots interviewers may be able to obtain more than one situation. Consequently, after the pilot has given the most recent situation, the interviewer should then ask the pilot if he can recall other such situations. It would be desirable if interviewers could obtain more than one situation but the number should not exceed three because of time limitations. Because of the nature of the information desired, it is necessary to have somewhat different questions for the captain and the copilot. Here again it is important to get the most recent example. The interviewer should make this clear to the interviewee. It will be left up to the interviewer to judge the pilots' answer to the question and to determine if secondary questions are necessary in order to obtain the needed information about the situation. As a guide for the interviewer, the essential information to be obtained from this question can be summarized as follows:

1. The most recent example of what the copilot did or might have done if allowed to continue flying the plane.
2. Conditions under which the captain took over: location, traffic, weather, instrument or contact flight, day or night flight, etc.

3. Type of airplane being flown and information about other equipment involved in the incident: engine failure, instruments misread, controls confused, radio inoperative, etc.

It is expected that some of the pilots may not be able to give an example of such a situation. If, after giving the pilot sufficient opportunity to answer Question #2, the interviewer does not obtain an example, he should try the following Alternative Questions:

Alternative Question (Alt. #2) (Captains): "Well, then, perhaps you could tell me about the last time that you felt that the situation was so critical that you would not have wanted the average copilot to fly the airplane. Could you describe that situation and tell me what unsafe act an average copilot might have done in that situation?"

Alternative Question (Alt. #2) (Copilots): "Well, then, perhaps you could tell me about the last time that you felt that the situation was so critical that you preferred that the captain fly the airplane. Could you describe that situation and tell me what you might have done in that situation?"

Following is an example of a fairly satisfactory answer to Question #2:

Pilot: "We were landing at Winston-Salem, North Carolina, at night. The runway we had to land on was a very short one. Well, my copilot had been flying the plane so I thought I'd let him land it. As he turned on the approach, I could see he was too high, so I took over and cut off all the power and put my flaps down right away. Even at that we didn't touch until we were about a third of the way down the runway."

(Comment: The pilot has described the situation briefly but has omitted some important information).

Interviewer: "Even with your taking over it was close, huh?"

(Comment: Note that the interviewer does not ask further questions but simply makes a response which shows the pilot that he is listening and is understanding what he is saying).

Pilot: "I'll say. He would have overshot for sure. Those DC-3's float a lot more than the DC-4's. I guess he had been flying the bigger ships quite a bit. Then, too, the weather wasn't too hot--poor visibility, light rain. Course, with the rain, that made it worse because if he had to use a lot of brake at the end of the runway we would have been sunk."

(Comment: Here the pilot voluntarily has filled in the gaps in his original description. By giving the kind of response he gave, the interviewer obtained the additional information he needed: the type of plane, weather conditions, more about what the copilot might have done).

QUESTION #3

"In addition to these specific incidents which you have described, we are anxious to get your opinions on causes of unsafe airline flying in general. Obviously, there are a great number of causes, but I would like to hear what you feel are some of the most important. What are the important causes of unsafe airline flying?"

This question is designed to provide us with the opinions of airline pilots as to the important factors contributing to unsafe airline flying. It is expected that the question will provoke opinions on many different aspects of airline operations, such as training, evaluation, communication, equipment, pilot traits, morale, dispatching, maintenance. Such information will be of value to us in later projects and certainly of value to the airlines themselves. The interviewer may wish to ask additional questions in order to obtain more opinions from the pilots. This, of course, will depend upon the judgment of the interviewer. It should be noted that this question is intended to obtain opinions whereas the previous questions were for obtaining specific incidents and behavior of pilots in those incidents. The interviewer, however, should make certain that he completely understands what the pilot means when he states an opinion on causes of unsafe airline flying. It may be necessary to encourage the pilots to be more specific in order that the interviewer understands what is being stated.

QUESTION #4

"If you ran an airline and had the problem of keeping check on whether captains were doing a good job, how would you do it?"

The purpose of this question is twofold: first, to obtain pilots' attitudes towards present methods of evaluating captains; secondly, to obtain their ideas for improving these methods. The question is worded in such a general way that the pilot may express attitudes or opinions about various evaluation procedures.

QUESTION #5

"What characteristics, traits or abilities which differentiate the good airline captain from the poor are not being evaluated adequately by present methods of evaluation?"

It is expected that this question might produce two things: first, it should tell us what characteristics, traits or abilities pilots feel are possessed by the good airline captain; secondly, it should tell us if they feel these other characteristics, traits or abilities should be evaluated.

QUESTION #6

"How would you change the present instrument check so that more of these desirable characteristics, traits and abilities of the good airline pilot could be evaluated?"

The purpose of this question is to get specific ideas from pilots on ways of improving the instrument check so that it would measure more of the qualities which the good airline captain has.

QUESTION #7

"We are also interested in determining to what extent pilot fatigue may be a factor in airline accidents. Can you recall a situation where fatigue in any way might have contributed to an accident or a near accident? Would you describe that situation and tell me just what the pilot did as a result of his fatigue?"

If a pilot can recall such an incident, the interviewer should obtain from him certain essential information about the situation. The interviewer should first give the pilot opportunity to furnish this information voluntarily, but it may be necessary to ask additional questions. Following is the essential information which the interviewer must get:

1. Type of airplane and how many consecutive hours the pilot had been flying at the time of the incident.
2. Kind of flight: overseas or domestic, day or night, a long hop or a flight with stops, instrument or contact flight.
3. How long pilot had been assigned to flight.

QUESTION #8

"I would like to get more of your ideas about this problem of fatigue. What causes pilot fatigue for the most part? What are important fatigue-producing factors in airline flying?"

It is important that the interviewer encourage the pilot to give specific causes which would be of value to airline companies. If the pilot already has indicated that he felt fatigue was not a problem, this question, of course, would not be asked.

QUESTION #9

"Well, I've asked you a lot of questions and you have given me some very good ideas. Now, perhaps you have something further to say on these problems which you haven't mentioned already. If you do, I would like very much to get some of your other ideas."

The purpose of this question is to get any ideas or attitudes relative to these problems which might not have been expressed in response to the questions. In addition, by allowing the pilot to express himself in this way, the interview is terminated on a good note.

APPENDIX 3

MANUAL FOR INTERVIEWERS

MANUAL FOR INTERVIEWERS

Project on

REQUIREMENTS FOR AIRLINE PILOTS

Under Sponsorship of

Committee on Selection and Training of Aircraft Pilots

of the NATIONAL RESEARCH COUNCIL

and

The Assistant for Research of the

CIVIL AERONAUTICS ADMINISTRATION

May 1947

AMERICAN INSTITUTE FOR RESEARCH
Incorporated

Cathedral of Learning
Pittsburgh 13, Pennsylvania

DESCRIPTION OF THE PROJECT

The Committee on Selection and Training of Aircraft Pilots of the National Research Council has requested the American Institute for Research to make a survey during the next several weeks of procedures for selecting, certifying, and upgrading airline pilots. The funds for this project have been supplied by the Civil Aeronautics Administration. The Civil Aeronautics Board has also expressed an interest in this study.

This study is strictly a research project; and the results of the survey will be presented in statistical form, with recommendations regarding current procedures. It is not the intent of the study to evaluate specific airline pilots or to compare different groups of pilots. No data regarding specified individuals will be presented to either the Civil Aeronautics Administration or any of the airline companies.

The primary objective of the study is to survey all sources of information regarding the requirements for effective work as an airline pilot. It is anticipated that this survey will lead to a more accurate definition of the specific skills, information, types of judgment, aptitudes, and personality and temperament which are essential to insure a long career as a safe airline pilot.

Sources of Information

It is proposed that this survey include all of the promising sources of information regarding the characteristics of safe airline pilots. One of the

primary sources is expected to be the pilots themselves. It is planned that a representative sample of pilots from almost all airline companies and with varying amounts of experience, be interviewed. A systematic tabulation of their analyses of situations involving accidents or near-accidents would be made. Various types of emergency situations would be studied to determine the specific skills, abilities, or information most useful in avoiding a serious accident.

A second source of information will be the airline company check pilots. These men will be requested to provide information regarding the specific types of skill and ability which they regard as most important in examining pilots. They will be especially asked to describe actual incidents illustrating poor judgment, bad habits, or unsuitable temperament on the part of a pilot to whom they have recently given a check flight.

A similar survey would be made of other company employees, in charge of the training and supervision of pilots. This part of the survey would stress especially long-range training procedures, special problems with respect to new equipment, and similar matters.

Another source of information will be the company personnel files. These records are to be examined to obtain information regarding all pilots separated from the company either for failure "on the line" or in captains' school. Again, the examiners of the company files are not concerned with individual pilots and consequently the names of pilots would not be taken from the files. For purposes of comparison, a control group of individuals who are successful would also be studied. It is anticipated that by studying the records for a group of approximately a thousand pilots, half of whom were unsuccessful and separated from the company and half of whom were successful, valuable information regarding requirements for successful work as a pilot can be obtained.

STANDARD PROCEDURES

FOR INTERVIEWING

General Plan of Interviewing Program

The general plan of the program calls for interviewing around 500 airline pilots at approximately twenty large cities throughout the country. This interviewing will be accomplished during the month of May. As soon as this airline pilot interviewing program is underway, the plans call for interviewing approximately 100 C.A.A. flight examiners, 100 airline company check pilots, and 100 other individuals who are in positions where they observe airline pilots. It is proposed that all of these interviews be completed by at least the end of the first week in June.

Interviewers will work under the supervision of a person who has been selected as supervisor of a particular city or area. The supervisor will be responsible for obtaining interviewers and also will assist them in learning the interview methods and procedures. Standard operating procedures for interviewing have been written for the interviewers. These procedures are to be followed closely in order that the interviewing be standardized at all of the interviewing localities. In addition, standard procedures have been prepared to assist interviewers in classifying the interview data and in preparing the reports of their interviews. Again, these procedures must be followed closely to insure accuracy of tabulation of the interview information.

The purpose of the interview program is primarily for obtaining first-hand information on what airline pilots do, how they behave, or what acts they perform in those situations which they themselves judge as being the critical situations in airline flying. This information will be one of the main sources from which to determine the critical requirements for the safe airline pilot. The interview,

A small number of control tower operators and other similar types of ground personnel are to be requested to provide information regarding safe and unsafe pilots. These reports would be similar to those obtained from pilots, but would be concerned more especially with observations with respect to landings and take-offs. The individuals in these groups would be asked to report specific incidents which they believed typified behavior characteristics of safe and unsafe pilots.

CAA inspectors and examiners would be requested to provide a statement of the principal reasons for failing each of the last few men who did not pass an airline transport pilot's examination which they gave. These would be amplified by detailed reports of incidents which confirmed their opinion that the applicant should be failed. The examiner might also be asked if the pilot could have done anything after this incident which would have compensated for this error. Similar reports would be obtained from the inspectors and examiners regarding the things which pleased them most about the best pilots whom they had recently examined.

The last source of information which is proposed to be included in this survey is the CAA record files. These files are to be analyzed with respect to flight examination records, personal records regarding pilots, and accidents.

It is anticipated that this comprehensive survey of sources of information regarding pilot requirements will provide a sound basis for further studies and research on the problem of improving current procedures for selecting, certifying, training and upgrading airline pilots.

The findings of this study will be made available to all of the cooperating organizations. It is believed that this survey will provide valuable information which can be used to the advantage of all concerned.

then, is designed primarily to furnish specific examples of pilot behavior. A secondary function of the interview is to furnish opinions of key personnel as to causes of unsafe airline flying, causes of pilot fatigue and ways of improving methods of evaluation airline pilots.

The Nature of the Interview

In order to accomplish the objectives stated above, the interview has been designed as a relatively informal, semi-structured situation. The informality of the interview will depend largely upon the attitudes and techniques of the interviewer. The structure of the interview is provided by the standardized questions which define the areas in which discussion will take place. Our experiences with attempts to obtain information of the kind desired in this study has convinced us of the importance of two factors which determine the success of an interview: the attitudes of the interviewer and the kinds of responses he makes during the interview.

The Attitudes of the Interviewer

The degree to which an interviewee will express opinions and attitudes or talk freely about his experiences to another person depends upon the "atmosphere" created by the interviewer or the "rapport" established between the interviewer and the interviewee. The most favorable atmosphere is one which is best described as "permissive." In a permissive atmosphere an interviewee feels free to express almost any attitude or opinion. This is because he feels that no matter what he says he will be understood, he feels that no matter what attitudes he expresses they will be accepted by the interviewer, he feels that his ideas are worthwhile and respected. How well an interviewer can create such a permissive atmosphere in an interview depends mostly upon his own attitudes. The interviewer may follow certain rules and be familiar with particular techniques, but neither rules nor techniques will cover up faulty attitudes.

It is difficult to label and describe the desirable attitudes of an interviewer. Nevertheless, an attempt is made at listing certain of these attitudes

1. The interviewer should consider the interviewee as an individual rather than as a statistic or as just another source of data. Because the interviewee is an individual, he will have feelings, he will want to feel important, he will cherish his own ideas and beliefs, he will defend those ideas if he feels they are not accepted, he will be cautious and at times even suspicious.

2. The interviewer should assume the role of a neutral person. He has nothing to defend, no preconceived ideas as to what is correct or incorrect. He is not a judge.

3. The interviewer should take the attitude that he is not the expert--the expert is the interviewee. It is the interviewee who knows his field and the interviewer must rely on the expertness of the interviewee in order to obtain the data for this study. It is a mistake for an interviewer to attempt to show how much about flying he knows. "A little knowledge is a dangerous thing" is even more applicable in an interview with someone with years of accumulated knowledge.

4. The interviewer should be willing to let the interviewee take the responsibility for carrying on the interview. His attitude should be one that says, "You know more what to tell me than I do." The interviewer only decides the area by asking his questions, then directs his efforts at encouraging responses to the questions.

The Techniques of the Interviewer

1. Beginning the Interview. This is usually the phase of the interview which gives an interviewer the most difficulty. This is almost always because of the insecurity of the interviewer--not the interviewee. Often the interviewer feels that he must get the interview going smoothly right away and then feels uncomfortable when it doesn't. Most interviews will develop slowly. This is characteristic of almost any situation in which two people begin to establish a relationship. Consequently, the interviewer should strive to appear at ease himself, thus helping the interviewee to relax. It is important not to create the impression of haste or impatience. Some small talk at the beginning of the interview may be helpful. Also it is important for the interviewer to establish his identity and the purpose of the interview fairly soon after starting the interview. This should be done briefly, however, because a long-winded introduction can detract from the informality which the interviewer will want to create. Exactly how to begin this introduction will depend upon the local situation. For example, in this program it has not been possible for A.I.R. representatives to contact all the people who are to be interviewed. In most

cases, the only contact with an airline will have been a letter to a top executive. Consequently, some of the interviewees may know only a little about the project; others will know nothing. It is essential, then, that the interviewer use his own judgment as to how to begin. There are, however, a few important things which the interviewee should understand. He might know some of these things already, or may have to be told about them by the interviewer. In any event, he should be informed of the following:

1. That the interviewer represents the A.I.R. which has been authorized by the C.A.A. to carry out this investigation, and that the project has been discussed with the Air Line Pilots Association, which has informed all council chairmen and officers of the project.

2. That the purpose of the study is to get as complete an understanding as possible of the job of airline pilots in order to determine what specific qualities and characteristics good airline pilots have which differentiate them from poor airline pilots.

3. That such an understanding is necessary in order later to determine fair and accurate ways of selecting and certifying airline pilots.

4. That the investigators feel that pilots (or CAA examiners, check pilots, etc.) are in an excellent position to give help on this problem.

5. That in this study we are not dealing with the individual pilot but only with pilots in general. Similarly we are not using the names of the particular persons contributing their opinions and ideas to this investigation.

It is expected that as the interview progresses interviewees will ask questions or express attitudes indicating some lack of understanding of the study, even though the introduction has been carefully made. These questions can be handled best simply by answering them when they arise. In other words, interviewers should not expect to settle all issues in the introduction to the interview. Too long an introduction will be as bad as no introduction.

2. <u>The Questions</u>. A certain amount of structure has been given the interview by formulating questions to be asked of the interviewee. These questions are different for each type of person to be interviewed, i.e. pilots, C.A.A. examiners, airline company check pilots, etc. These questions have been designed very carefully and worded in the best possible way to obtain the information

needed in this study. The interviewer should study carefully the questions and their explanations in order that he is very familiar with the wording of the questions and knows exactly the information which each is designed to obtain. This is very important inasmuch as the interviewer will want to ask each question very much as it has been formulated, yet without sounding as if he had memorized it. As an aid to the interviewer we have prepared an "Interviewer's Guide" for use during each interview. This is simply a list of the questions and brief reminders of the essential information to be obtained from each. Interviewers may feel more secure by having this guide during the interview, perhaps making an explanation to the interviewee such as the following:

> "I think I can let you know most clearly the kinds of things we are after if I just ask these questions which I have here."

The purpose of these standard questions is to establish clearly the specific area in which information is desired. It is natural, however, to expect that interviewers may have to repeat questions or elaborate somewhat upon their first statement of the question when it does not produce an adequate response. The standardized questions should touch off the first spark and the interviewee then should begin to respond. The interviewer at this point, however, cannot just sit back and listen. His function now is to encourage the interviewee to elaborate certain points, to give additional details and sometimes even to get back on the subject when he has strayed a little. All of this is accomplished by the responses of the interviewer to the statements of the interviewee.

3. Interviewer's Responses. When an interviewee seems to be responding adequately to a question, the interviewer should need only to display his genuine interest by an occasional "I see" or "Uh-huh." It is most important for an interviewee to feel he is being understood--not just "listened-to." This can be displayed if the interviewer occasionally makes a kind of restatement of the essential aspects of what the interviewee is expressing, such as:

Interviewee: "The way they make you take these darn instrument checks every six months, it's no wonder pilots feel that way. When doctors once get their degree, they're through being examined. Not pilots--they never get through being checked and evaluated."
Interviewer: "It really makes you feel pretty insecure about your job."

These three responses, the simple "I see" or "Uh-huh," the restatement of the essential content and the reflection of feelings, constitute the interviewer's main tools. Experience has shown that with desirable attitudes and the skillful use of these three kinds of responses an interviewer is most successful at encouraging interviewees to express their real feelings and attitudes and to furnish the information desired by the interviewer.

4. Note-taking. An important problem in interviewing is how to record what transpires during the interview. In the absence of electrical recording equipment, it is usually necessary for the interviewer to take notes. The problem then becomes to avoid letting the note-taking destroy the relationship or interfere with the other functions of the interviewer. Studies have demonstrated that the interviewer can recall more if he takes notes during the interview than if he does not, even though he may write up the interview immediately afterwards. Consequently, for the interviewing in this project it is requested that the interviewer take notes during the interview. Then, immediately afterwards, the interviewer will fill out the "Interview Summary Forms," using his interview notes. In this kind of interviewing where specific, and often fairly technical, information is being obtained, note-taking during the interview is probably even more necessary than in other kinds of interviewing. It has been our experience, too, that when interviewing is done in a field with which interviewers are not too familiar, gross misinterpretations of information occur when interviewers take insufficient notes and rely too heavily upon their memory. In addition, there is one other important reason for recommending that interviewers take very complete notes. We feel that this investigation will be made more significant if we can include in the reports of the study a number of direct quotations from interviewees. To accomplish this, we are suggesting that interviewers attempt to

get some verbatim statements which they feel would make good examples to include in reports of the program. Whenever verbatim statements are written in the "Interview Summary Forms," the interviewer should place such statements within quotation marks.

Interviewers will turn in both their interview notes and their "Interview Summary Forms" on each interview at the end of the day on which the interview was conducted. The job of tabulating and analyzing interview data will be facilitated greatly if, as soon as interview notes and summary reports are turned in, supervisors will forward them immediately to The American Institute of Research, Cathedral of Learning, Pittsburgh 13, Pennsylvania. Interview notes should be taken on 8½ x 11" paper to insure a standard size for all notes.

5. Special Problems. It is impossible to foresee all problems which may confront an interviewer. Nevertheless, some problems almost always arise, and it is well for interviewers to have done some thinking about them beforehand. One of these problems is in regard to the length of interviews. Several of the interviews for pilots and the interviews for CAA examiners have been accomplished already. Their lengths varied from one to two hours, the average being around one hour and one-half. The length of a particular interview will depend upon many factors: the amount of time the interviewee can spare, his willingness to cooperate, the richness of his experience, and, of course, the skill of the interviewer. Probably the best interviews are obtained, however, when the interviewer informs the interviewee about how long the interview will take. Each interviewer will learn from experience about how long his own interviews take and can use this as a standard. It follows, of course, that interviewers should not extend the sessions much beyond the amount of time decided upon. Rather, they should conduct their interviews in such a way as to complete the questions in the allotted time.

Another problem is where to conduct the interview. This will depend for the most part upon the local situation. Because of the nature of the information

requested from interviewees, however, every attempt should be made to secure a private or semi-private place for these interviews. In this connection, one other problem will arise. Occasionally, interviewers will find that a captain and his copilot may want to be interviewed together. This probably should be avoided because of the nature of Question #2. It may be possible, however, to interview two or three captains or copilots so long as they aren't mixed. This already has been tried with some of our preliminary interviews. If the interviewer has had training and experience in group interviewing, he may try out this procedure. He could decide himself if it seemed to be a good procedure for this type of interview.

Another problem confronting interviewers is what to do when an interviewee has a tendency to stray from the subject and to get off on topics of his own choosing. Here the interviewer is torn between a desire to get certain information and a reluctance to interrupt the interviewee. This situation may occur when an interviewee seems to have something to get off his chest, when he has not understood a question, and only occasionally when an interviewee is deliberately side-stepping a question. It is seldom that an interviewer should have to interrupt an interviewee. This may completely destroy the rapport of the interview. A better procedure is to help the interviewee "get it off his chest" by reflecting his feelings accurately. Then when he has expressed himself, the interviewer might make some such response as:

> "I can sure understand just how you feel about that. Well, could we return for a minute to these incidents we're after. Could you recall such an incident?"

Or when it appears that the interviewee might have misunderstood the question, the interviewer might simply say:

> "I guess I really didn't make it very clear what I would like to get. Perhaps if I just stated that question again for you it would help."

When an interviewer runs across an interviewee who seems to be uncooperative and who appears to be holding back information, very little can be accomplished by

trying to force the information out of him. The interviewer's only recourse is to try to understand why this person doesn't want to cooperate, accept that reason, and attempt to understand what he is willing to tell you.

Finally, there is the problem of what the interviewer does when there are innumerable "long pauses" during an interview. The pause is frequently a rather unnerving experience for an interviewer. It goes without saying, however, that when an interviewer successfully has transferred the responsibility for carrying the interview to the interviewee, the latter is more inclined to "feel" the pauses and to fill them himself. On the other hand, when an interviewer shows by his attitude that he is "in charge," the interviewee will feel that it's the interviewer's job to keep the conversation going, not his; such an interviewer usually finds it is he who has to keep it going and, consequently, there will be pauses. In general, it might be stated that when long pauses become frequent, the interviewer can try the following, in the order given:

a. Wait out the pause, for the interviewee may only be thinking of what to say next. By waiting out pauses, the interviewer also reinforces the fact that he wants the interviewee to carry the ball.
b. If the pause becomes too long, try and restate the essence of the interviewee's previous comments as follows:
   "If I understand correctly what you have been saying, you think that fatigue is a real problem."
   Such a response invariably stimulates further comment, and, furthermore, it demonstrates that the interviewee is really being understood.
c. It may be necessary to reflect the difficulty which the interviewee is having with some response like the following:
   "It's sort of hard to pull these incidents out of the past in a few minutes, is that right?"
d. Finally, it may be necessary to proceed to the next question after trying one final attempt such as:
   "You've sort of exhausted that topic, as far as you're concerned, eh."

Arranging the Interviews

The responsibility for arranging interviews will have to be assumed by the supervisors of interviewers or in some cases by the interviewers themselves. Some of the larger airline companies will have been contacted by members of the staff of A.I.R. Even where this has been done, however, word of the project may not have gotten down to regional offices or turn-around points for these companies.

Consequently, it will be necessary in most cases for the supervisor to arrange an appointment with the captain in charge of that particular office. In some instances, this person is called a "Regional Chief Pilot," a "Chief Pilot," a "Regional Director of Operations," or a "Regional Director of Transportation." In some instances, the main offices of the airline will be located in the same city where the interviewing is to be done. In this case, it is probably best for the supervisor to contact the "Director of Operations" or the "Director of Transportation" of the airline company.

These persons will undoubtedly indicate to the supervisor the best procedures for actually contacting the pilots. Usually, this will be a chief dispatcher or some such person who has records of all flights and knows when crews would be available. It has been our experience, however, that it is mostly up to the interviewer to make actual arrangements for interviews. He may have to make contact with pilots in several different places: operations, pilot ready rooms, hotels where pilots stay during lay-overs (overnight stops), etc.

It will probably make the interviewer's job easier if the supervisor first has contacted the pilot in charge of operations in that city. Then the interviewer is able to tell the interviewees that this person has been contacted and everything has been cleared through him.

An inevitable response of pilots has been to ask if this project has the approval of the Air Line Pilots Association, the pilots' union. The interviewer should say that this organization has been informed of the project and that Mr. Behnke, the head of the pilots' union, has expressed his personal desire to cooperate and has written to all of the council chairman and officers.

At a particular city, interviewers will find that some pilots are based at that city and others are merely at a turn-around point. The latter means that they have a wait at this city before taking out another flight. These waits vary from about one to eight hours for pilots who don't lay-over (stay overnight). It is important for the interviewer to get pilots who have sufficient time between

flights for an hour or hour-and-a-half interview. This information can be obtained from the operations or dispatching offices. About four hours between the time of arrival and the time of departure will generally be required in order for pilots to squeeze in an interview. Pilots who are based (have their home) at the city may have two or three days off between flights.

The Fatigue Rating Scale

A somewhat separate part of this study is the obtaining of pilots' ratings on factors contributing to fatigue. A rating scale has been constructed for this purpose. It is intended that this scale be administered by the interviewer at the end of the interview. This could be done rather informally, asking the pilots to fill out the scale themselves while the interviewer looks on. The completed rating scale then should be attached to the "Interview Summary Forms" and turned in to the supervisor. The instructions for administering the rating scale are self-explanatory and should be studied carefully by the interviewer before he begins any interviews.

INSTRUCTIONS FOR THE USE OF THE PILOT INTERVIEW SUMMARY FORMS

The Pilot Interview Summary Forms are the final record of data collected during each interview. For this reason it is essential that the material is presented clearly, neatly, and accurately. Use ink, and write legibly. When it is necessary to check items, place the check mark (X) directly on the line next to the word to be checked so that there will be no question about which item was checked. Complete these forms directly from the notes taken during the interview.

On the cover page, write your full name after the word "Interviewer," the date of the interview below, and the approximate length of the interview under the date. Give the name of the city in which the interview takes place in the space following "Location." Check whether the interviewee is a captain or copilot. Below, write the name of the airline employing the pilot interviewee. The space for comments may be used to report such things as the interviewee's reaction to the questions, unusual conditions of the interview, extent of cooperation, or anything which you feel of importance to those who will analyze the interview data. It is also your opportunity to make any suggestions or criticisms of questions, instructions or materials used in the interview.

On Questions #1 and #2, note that you are asked to check whether the interviewee answered the preferred or alternate question. Indicate by quotation marks the statements that are in the pilot's own words. It is important that we have a reasonably complete record of what the interviewee actually said in answer to these questions and we are especially interested in getting direct quotations in the answers to the questions.

Indicate any grouping or separation of ideas, attitudes, causes, etc., by numbering each group or item clearly. When reporting the answers to Questions #3, 4, 5, 6, 8, and 9, keep this in mind. On the Summary Form for Question #7, there are three fill-in items and four pairs of items to be checked. Complete these items as indicated even though they are included in the description of the incident.

If, while answering Question #9, the interviewee makes any comment referring to previous questions in the interview, include these statements under the appropriate question rather than under Question #9.

If an interviewee did not answer a question for some reason or another, indicate this on the Summary Form for that question and state briefly why you think he didn't answer the question.

The Summary Forms for each interview should be completed immediately after the interview. This is very important. Scheduling of interviews should be planned so that there will be time at the end of each to fill out the forms.

When the interviewing schedule for each day is completed, clip the notes for each interview with the completed Interview Summary Forms for that interview. Give all the Summary Forms, together with notes, to your supervisor.

APPENDIX 4

PILOT INTERVIEW SUMMARY FORMS

AMERICAN INSTITUTE FOR RESEARCH

Pittsburgh 13, Pennsylvania

PILOT INTERVIEW SUMMARY FORMS

Interviewer:

Location:

Date:

Interviewee: Captain _____
(Check one) Copilot _____

Length of Interview:

Name of Airline:

Comments:

(Use back of sheet if necessary)

(Do not write in this space)

QUESTION #1: Description of Most Recent Incident

Answered: (Check one) Question #1 _____ Alt. Quest. #1 _____

REMEMBER: Include location, traffic, phase of flight, weather, type of airplane, etc.
Emphasize the specific behavior of the pilot.

(Use back of sheet if necessary)

(Do not write in this space)

QUESTION #1: Description of Second Incident

Answered: (Check one) Question #1 _____
Alt. Quest. #1 _____

REMEMBER: Include location, traffic, phase of flight, weather, type of airplane, etc. Emphasize the specific behavior of the pilot.

(Do not write in this space)

(Use back of sheet if necessary)

QUESTION #1: Description of Third Incident

Answered: (Check one) Question #1 _____ Alt. Quest. #1 _____

REMEMBER: Include location, traffic, phase of flight, weather, type of airplane, etc. Emphasize the specific behavior of the pilot.

(Use back of sheet if necessary)

(Do not write in this space)

QUESTION #2: Description of Most Recent Incident

Answered: (Check one) Question #2 _____ Alt. Quest. #2 _____

REMEMBER: Include Location, traffic, phase of flight, weather, type of airplane, etc. Emphasize the specific behavior of the copilot.

(Use back of sheet if necessary)

(Do not write in this space)

QUESTION #2: Description of Second Incident

Answered: Question #2 _____
(Check one) Alt. Quest. #2 _____

REMEMBER: Include location, traffic, phase of flight, weather, type of airplane, etc. Emphasize the specific behavior of the copilot.

(Use back of sheet if necessary)

(Do not write in this space)

QUESTION #2: Description of Third Incident

Answered: Question #2 _____
(Check one) Alt. Quest. #2 _____

REMEMBER: Include location, traffic, phase of flight, weather, type of airplane, etc.
Emphasize the specific behavior of the copilot.

(Use back of sheet if necessary)

(Do not write in this space)

QUESTION #3: Important Causes of Unsafe Airline Flying

(Number each cause separately).

(Use back of sheet if necessary)

(Do not write in this space)

QUESTION #4: Attitude Toward Present Methods

Ideas for Improving Methods

(Number each idea separately)

(Do not write in this space)

(Use back of sheet if necessary)

QUESTION #5: Characteristics, Traits, or Abilities Possessed by Good Pilots Which Are Not Being Evaluated by Present Methods.

(Number each separately)

How They Might Be Evaluated

(Use back of sheet if necessary)

(Do not write in this space)

QUESTION #6: Suggested Changes in Instrument Check

(Number each suggested change separately)

(Use back of sheet if necessary)

(Do not write in this space)

QUESTION #7: Description of Incident in Which Fatigue was a Factor

Type of Airplane (DC-3, DC-4, etc.) _____

Consecutive Hours Flying _____ Hours

How long assigned to flight _____ Months

Kind of Flight: (Check one in each pair)

Overseas___ Day ___ Instrument ___Long Hop ___
Domestic___ Night ___ Contact _____Flight with stops___

(Use back of sheet if necessary)

(Do not write in this space)

QUESTION #8: Causes of Fatigue

(Number each cause separately)

(Use both sides of sheet if necessary)

(Do not write in this space)

QUESTION #9: Additional General Comments

(If any additional comments are answers to previous questions, include them with the appropriate questions rather than on this page).

(Use back of sheet if necessary)

(Do not write in this space)

APPENDIX 5

INTERVIEWER'S RECORD OF CONTACTS

Interviewer:_____

Supervisor:_____

City:_____

INTERVIEWER'S RECORD OF CONTACTS

Captain or Co-pilot	Name	Airline	Inter-viewed	Not In-terviewed	Reason*

*To be used only when an X has been placed in column marked "not inter-

APPENDIX 6

INTERVIEWERS GUIDE FOR USE DURING COMPANY CHECK PILOT AND CAA EXAMINER INTERVIEWS

CAA Project I May, 1947

INTERVIEWERS GUIDE

For Use During

COMPANY CHECK PILOT and

CAA EXAMINER INTERVIEWS

QUESTION #1: "First, we would like to draw on your experience as a check pilot to get examples of what pilots do on check rides. Would you think back on the last pilot you failed on a check ride and tell me exactly what he did which caused you to fail him."

DESIRED INFORMATION:
1. Specific behavior of the pilot.
2. Most recent incident of pilot failure.
3. Conditions: location, traffic, weather, instrument or contact, day or night, etc.
4. Type of Airplane.
5. Equipment involved in incident.

QUESTION #1a: "With your experience checking so many pilots you probably have thought a lot about why they do such things. In that situation you just told me about, why did that pilot do that?"

DESIRED INFORMATION: 1. Specific reasons for unsafe acts.

QUESTION #2: "Now, I would like for you to recall the last time you had to take over the controls from a pilot you were checking because you felt the situation was pretty critical. Could you describe the situation and tell me just what the pilot did or might have done if you hadn't taken over?"

DESIRED INFORMATION:
1. Specific behavior of pilots.
2. Most recent times he took over controls.
3. Conditions: location, traffic, weather, instrument or contact, day or night, etc.
4. Type of airplane.
5. Equipment involved in incident.

QUESTION #3: "When you check a pilot, what are the things you particularly look for which you feel differentiate a good airline pilot from a poor one?"

DESIRED INFORMATION: Specific information is necessary, since very general information is seldom of value.

QUESTION #4: "If you ran an airline and had the problem of keeping check on whether captains were doing a good job, how would you do it?"

DESIRED INFORMATION:
1. Specific suggestions for improving present methods of captain-evaluation.
2. Attitudes towards present methods of captain-evaluation.

QUESTION #5: "What characteristics, traits or abilities which differentiate the good airline captain from the poor are not being evaluated adequately by present methods of evaluation?"

DESIRED INFORMATION:
1. Specific characteristics, traits or abilities common among good captains.
2. Attitudes toward evaluation of these characteristics traits or abilities.

QUESTION #6: "How would you change the present instrument check so that more of these desirable characteristics, traits and abilities of the good airline pilot could be evaluated?"

DESIRED INFORMATION:
1. Specific suggestions for improving the instrument check.

APPENDIX 7

QUESTIONS FOR THE COMPANY CHECK PILOT AND CAA EXAMINER INTERVIEWS

QUESTIONS FOR THE COMPANY CHECK PILOT AND CAA EXAMINER INTERVIEWS

QUESTION #1

"First, we would like to draw on your experience as a check pilot to get examples of what pilots do on check rides. Would you think back on the last pilot you failed on a check ride and tell me exactly what he did which caused you to fail him."

The purpose of this question is two fold. First, it has been worded in such a way as to obtain an example of what pilots do which cause them to fail check rides. It is important that from this question we obtain examples of specific pilot behavior. Secondly, the question specifically asks that the examiners or check pilots give an example from the most recent check ride on which they failed a pilot. This is for the purpose of obtaining a fairly random sample of typical things that pilots do on check rides which cause them to fail. It is important that the question accomplish these two purposes. It may be necessary for the interviewer to reword the question somewhat and to ask it a second time in order to obtain what is needed. It is extremely important for the interviewer to record exactly what the pilot did and the circumstances surrounding his act. It may be that the examiners or check pilots will recall several things which a particular pilot did, in which case the interviewer should record all of these acts. The interviewer should make certain that he understands exactly what the pilot did so it may be necessary for him to ask secondary questions in order to get this information. The interviewer should remind the interviewee that we are not interested in particular pilots and that these examples will be treated anonymously. The essential information to be obtained from this question can be summarized as follows:

1. An example of something a pilot did which caused him to be failed on his check ride.
2. The conditions under which he behaved as he did: location, traffic, weather, instrument or contact flight, day or night flight, etc.
3. Type of airplane being flown.
4. Any information about equipment involved in the incident.

It is hoped that each examiner or check pilot will be able to recall the last three pilots whom he failed on check rides and give examples of what each did. Consequently, after the interviewee tells about the most recent pilot he failed and answers Question #1a in regard to why this pilot committed these acts, the interviewer will ask him to recall the next-to-the-last pilot he failed. Question #1a then will be repeated to get the reasons for this pilot's behavior. Finally, the interviewer will ask the interviewee to recall the pilot he failed just before the next-to-the-last one. Again, Question #1a will be repeated. The interviewer should note that in the Interview Summary Forms for the examiner and check pilot interviews there is a separate page for each of the three pilots whom they have failed.

QUESTION #1a

"With your experience checking so many pilots you probably have thought a lot about why they do such things. In that situation you just told me about, why did that pilot do that?"

The purpose of this question is to obtain examiners' and check pilots' opinions as to the reasons for the unsafe acts committed by pilots who are failed on check rides. It is expected that some examiners and check pilots will have done a great deal of thinking about why pilots commit unsafe acts. This question is designed to obtain their opinions. Some may give very general reasons such as poor training, laziness, poor judgment, etc. These reasons are so general as to be almost meaningless. Consequently, the interviewer should attempt to get from the interviewees more specific reasons for the unsafe acts. If, in answer to Question #1, the examiners have given more than one example of something which the pilot did, the interviewer should attempt to obtain reasons for each of the unsafe acts.

QUESTION #2

"Now, I would like for you to recall the last time you had to take over the controls from a pilot you were checking because you felt the situation was pretty critical. Could you describe the situation and tell me just what the pilot did or might have done if you hadn't taken over?"

The purpose of this question is to obtain examples of critical situations in airline flying. It is hoped that by asking check pilots for examples of situations where they felt it necessary to take over the controls, we will obtain a fair picture of the critical situations in airline flying. Again, this question has been worded in such a way as to obtain specific behavior of pilots. Consequently, the interviewer should make certain that the interviewee tells him exactly what the pilot did or might have done in the particular situation. Again, it is important to get the last time the interviewee had to take over the controls. It is hoped that each examiner or check pilot will be able to recall the last three times he had to take over the controls from a pilot he was checking. Consequently, after the interviewee has recalled the last time, the interviewer will ask for him to recall the next-to-the-last time, and finally the time before that. Note that in the Interview Summary Report Forms for the examiner and check pilot interviews there is a separate page for each of these three times. As a guide for the interviewer, the essential information to be obtained from this question can be summarized as follows:

1. The most recent example of what the pilot did or might have done if allowed to continue flying the plane.
2. Conditions under which the examiner or check pilot had to take over: location, traffic, weather, instrument or contact flight, day or night flight, etc.
3. Type of airplane being flown.
4. Information about other equipment involved in the incident: engine failure, instruments misread, radio inoperative, etc.

QUESTION #3

"When you check a pilot, what are the things you particularly look for which you feel differentiate a good airline pilot from a poor one?"

The purpose of this question is to obtain examiners' and check pilots' opinions as to what differentiates the good airline pilots from the poor and unsafe airline pilots. It is expected that each examiner and check pilot has particular things which he looks for and considers important in differentiating the good and poor pilots. A large number of these will give us clues as to significant traits or characteristics to measure in selecting airline pilots.

QUESTION #4

"If you ran an airline and had the problem of keeping check on whether captains were doing a good job, how would you do it?"

The purpose of this question is twofold: first, to obtain examiners and check pilots attitudes towards present methods of evaluating captains; secondly, to obtain their ideas for improving these methods. The question is worded in such a general way that the examiners and check pilots may express attitudes or opinions about various evaluation procedures.

QUESTION #5

"What characteristics, traits or abilities which differentiate the good airline captain from the poor are not being evaluated adequately by present methods of evaluation?"

It is expected that this question might produce two things: first, it should tell us what characteristics, traits or abilities examiners and check pilots feel are possessed by the good airline captain; secondly, it should tell us if they feel these other characteristics, traits or abilities should be evaluated.

QUESTION #6

"How would you change the present instrument check so that more of these desirable characteristics, traits and abilities of the good airline pilot could be evaluated?"

The purpose of this question is to get specific ideas from examiners and check pilots on ways of improving the instrument check so that it would measure more of the qualities which the good airline captain has.

APPENDIX 8

COMPANY CHECK PILOT AND CAA EXAMINER INTERVIEW SUMMARY FORMS

AMERICAN INSTITUTE FOR RESEARCH

Pittsburgh 13, Pennsylvania

COMPANY CHECK PILOT AND CAA EXAMINER

INTERVIEW SUMMARY FORMS

Interviewer:

Location:

Date:

Interviewee: CAA Examiner _____
(Check one) Company Check Pilot _____

Length of Interview:

Name of Airline:

Comments:

(Do not write below this line) (Use back of sheet if necessary)

QUESTION #1 Description of Pilot Behavior Resulting in Failure: Most Recent

REMEMBER: What did the pilot do?
Conditions under which he behaved as he did: location, traffic, weather, instrument or contact flight, day or night flight, etc.
Type of airplane.
Equipment involved.

(Do not write below this line)

QUESTION #1a Reasons for Behavior Resulting in Failure

(Write each reason directly opposite the unsafe act to which it refers).

(Use back of sheet if necessary)

QUESTION #1 Description of Pilot Behavior Resulting in Failure: Next Most Recent

REMEMBER: What did the pilot do?
Conditions under which he behaved as he did: location, traffic, weather, instrument or contact flight, day or night flight, etc.
Type of airplane.
Equipment involved.

(Do not write below this line)

QUESTION #1a Reasons for Behavior Resulting in Failure

(Write each reason directly opposite the unsafe act to which it refers).

(Use back of sheet if necessary)

QUESTION #1 Description of Pilot Behavior Resulting in Failure: Third Most Recent

REMEMBER: What did the pilot do?
Conditions under which he behaved as he did: location, traffic, weather, instrument or contact flight, day or night flight, etc.
Type of airplane.
Equipment involved.

(Do not write below this line)

QUESTION #1a Reasons for Behavior Resulting in Failure

(Write each reason directly opposite the unsafe act to which it refers).

(Use back of sheet if necessary)

QUESTION #2 Description of Pilot Behavior in a Critical Situation: Most Recent

REMEMBER: What did the pilot do?
What were the conditions under which he behaved as he did: location, traffic, weather, instrument or contact flight, day or night flight, etc. ?
Type of airplane.
Equipment involved.

(Do not write below this line) (Use back of sheet if necessary)

QUESTION #2 Description of Pilot Behavior in a Critical Situation: Next Most Recent

REMEMBER: What did the pilot do?
What were the conditions under which he behaved as he did: location, traffic, weather, instrument or contact flight, day or night flight, etc.?
Type of airplane.
Equipment involved.

(Do not write below this line) (Use back of sheet if necessary)

QUESTION #2 Description of Pilot Behavior in a Critical Situation: Third Most Recent

REMEMBER: What did the pilot do?
What were the conditions under which he behaved as he did: location, traffic, weather, instrument or contact flight, day or night flight, etc.?
Type of airplane.
Equipment involved.

(Do not write below this line)

(Use back of sheet if necessary)

QUESTION #3 Factors Differentiating Safe Pilots from Unsafe Pilots

(Number each factor separately)

(Do not write below this line) (Use both sides of sheet if necessary)

QUESTION #4: Attitude Toward Present Methods

Ideas for Improving Methods

(Number each idea separately)

(Do not write in this space)

(Use back of sheet if necessary)

QUESTION #5: Characteristics, Traits, or Abilities Possessed by Good Pilots Which Are Not Being Evaluated by Present Methods.

(Number each separately)

How They Might Be Evaluated

(Use back of sheet if necessary)

(Do not write in this space)

QUESTION #6: Suggested Changes in Instrument Check

(Number each suggested change separately)

(Use back of sheet if necessary)

(Do not write in this space)

APPENDIX 9

COMPANY FILE REPORT FORM

ICAN I .11
Incorporated
Cathedral of Learning
Pittsburgh 13, Pennsylvania

CAA Project I

May 28, 1947

COMPANY FILE REPORT FORM

1. Code _____ _____ _____

2. Date of Birth _____
3. Marital Status: Married ____ Single ____
4. Highest School Grade completed _____
5. Attendance in Night or Technical School: ____ Months
6. Date of Employment _____
7. Date of Termination _____
8. Status at termination. Student Copilot _____;
   Copilot ____; Student Captain ____; Captain ____
9. Reason for termination _____

11. Civilian Ground Training:

Type	Months
Total	

12. Flying hours:
    Civilian _____
    Military: Total _____
    S.E. _____
    T.E. _____
    4-E. _____
    Airline _____
    Total _____

0. Standard Tests at time of employment:

Name of Test	Form	Score	Variations or Part-scores

Student First Officer (Student Copilot)
Proficiency Record

13. Ground School grades:

Name of Course	Grade

14. Written tests:

Name	Grade

Explanation of grading system:

5. Routine flight checks:

Date	Name of Check	Form	Results and Comments

6. Special Flight Checks (Check-outs, Equipment checks, etc):

Date	Name of Check	Form	Results and Comments

Student Captain Proficiency Record

1. Ground school grades

Name of Course	Grade

22. Written tests:

Name	Grade

3. Routine flight checks:

Date	Name of check	Form	Results and Comments

. Special Flight Checks:

Date	Name of check	Form	Results and Comments

Captain's Proficiency Record

5. Ground School grades:

Name of Course	Grade

26. Written Tests:

Name	Grade

7. Routine Flight checks:

Date	Name of check	Form	Results and Comments

8. Special Flight checks:

Date	Name of check	Form	Results and Comments