A STUDY OF THE ACCURACY OF RECOGNITION OF THE INCIPIENT STALL IN FAMILIAR AND UNFAMILIAR PLANES

by

P J RULON

A report on research conducted at the Educational Research Corporation, Cambridge, Massachusetts, under the auspices of the National Research Council Committee on Aviation Psychology, with funds provided by the Civil Aeronautics Administration.

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National Research Council

Committee on Aviation Psychology

Executive Subcommittee

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National Research Council

1947

LETTER OF TRANSMITTAL

NATIONAL RESEARCH COUNCIL

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

Committee on Aviation Psychology

November 24, 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:

Attached is a report entitled A Study of the Accuracy of Recognition of the Incipient Stall in Familiar and Unfamiliar Planes, by P. J. Rulon. This report 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.

This report is the first on a series of studies concerned with the problem of the incipient stall which have been undertaken by the Committee on Aviation Psychology because of the fact, demonstrated in CAA accident investigations and research, that the inadvertent stall is an important contributory cause to accidents in private flying.

The study reveals consistent failure on the part of student pilots, private pilots and flight instructors to detect the pre-stall conditions in light aircraft. On the basis of these findings the Committee on Aviation Psychology recommends that regulations be formulated requiring the installation of approved stall warning devices in all private airplanes, providing that field tests demonstrate that available instruments can be adequately maintained and function properly over an extended period.

This recommendation does not imply that the necessity of training in the stall; of improving methods for giving such training; and of directing increased attention to the avoidance of a stall as a basic factor in safe flying can be disregarded. It is the plan of the Committee on Aviation Psychology to continue research in the latter areas.

Cordially yours,

M. S. Viteles

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

MSV:rm

EDITORIAL FOREWORD

Both CAA reports on accidents and systematic studies by D. R. Brimhall and R. Franzen show that many accidents in light aircraft follow an inadvertent stall.[1] The high incidence of such accidents has pointed to the necessity for research directed towards a program for reducing the frequency of inadvertent stalls during flight with light aircraft. The study presented in this report is the first in a series of investigations undertaken by the National Research Council Committee on Aviation Psychology on stall recognition; on the effect of training on stall recognition; on the isolation of cues which are most efficient in giving warning of an impending stall; and on other aspects of the problem.

In the study on the accuracy of recognition of the incipient stall covered in this report, check flights were administered to subjects in specially equipped planes. In each plane, five vanes on the leading edge of the wing were set to "trigger" at different angles of attack. In most maneuvers the fourth vane "triggered" just before the edge of the stall was reached, and the fifth vane "triggered" just as the stall occurred. A panel of lights, visible to the check pilot but not to the subject, was activated by these vanes, providing the check pilot with a measure of the degree to which a "stalling" angle of attack was approached by the subject.[2]

During the execution of "assigned" maneuvers in the check flight, subjects were directed to fly as close as possible to the "edge" of the stall without actually stalling the plane. Their success in approaching the stall, without actually stalling the plane, was employed as a measure of the accuracy of their stall recognition. Thus a pilot who lit four lights when intentionally flying as close as possible to the "edge" was considered a better judge of the incipient stall than was a subject who lit only three lights.

An objection might be raised to this procedure on the ground that a pilot who, was actually able to recognize the pre-stall cues attendant to lighting four indicator lights, might nevertheless not approach the stall more closely because of uncertainty as to his ability to control the plane in flight closer to the stalled condition. With respect to this point of view, it should be emphasized that none of several instructors who flew experimentally with the stall-warner signal lights visible had any difficulty flying the plane in the near stall condition characterized by lighting four lights. Similar findings were evident during flights made by a number of private pilots, and it was the opinion of the check pilots that even student pilots could "light four lights" rather easily providing they were allowed to gauge their approach to the stall

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[1]This research is described in the Proceedings of the Annual Meeting of the Committee on Selection and Training of Aircraft Pilots. Washington, D. C.: CAA Division of Research, June 27, 1947.

[2]The apparatus represented an adaptation of a commercially available "stall warning" indicator.

through reference to the stall-warner lights, rather than through using only the perceptual cues normally available.[3] It appears, therefore, that the objection is not tenable.

One further detail should also be mentioned. As indicated in the report, during execution of steep turns the fifth vane could be "triggered" without a stall occurring immediately,[4] although in this condition, unless the pilot immediately decreased the angle of attack a stall would occur, i.e., "if the pilot didn't do something the airplane would." Reference to the report, in particular Table 12, indicates that the proportion of instructors who lit five lights, but who are credited with not stalling the plane, is markedly lower than is the case among private and student pilots. The experimenters have pointed out that this indication may be erroneous.

This results from the fact that in a nose-high gliding turn the fifth vane triggered just as the stall occurred. It was difficult for the check pilot to judge whether the dropping of the nose coincident with the triggering of the fifth vane (and the lighting of the fifth light) occurred as a result of a stall, or during the recovery by the subject from an intended stall approach. In cases where the subject was an instructor, the check pilot may have given him the benefit of the doubt, and recorded that he merely returned to normal flight from an intended approach to a stall, rather than that he actually stalled the plane. This ambiguity does not, however, alter the conclusions drawn from the investigation.

The results of this study, indicating a marked lack of accuracy among flight instructors, private pilots, and student pilots in recognizing the incipient stall, represent important findings pertinent to regulatory policies and to the improvement of pilot training. Further work on the effect of training on stall recognition is being conducted under the auspices of the Committee on Aviation Psychology.

The present investigation was conducted by the Educational Research Corporation, under the direction of Dr. P. J. Rulon, who also was primarily responsible for formulating the experimental approach to this problem.

Nov. 24, 1947

M. S. Viteles, Chairman
Committee on Aviation Psychology

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[3]Similar comments were made by flight personnel associated with a research project at Ohio State University, in which the stall warner installation was also employed.

[4]Further refinement of the equipment used in research now in progress will resolve this difficulty.

CONTENTS

SUMMARY

The purpose of this study can be expressed in the form of two questions; first: Does the typical pilot succeed pretty well in identifying the incipience of the stall when he consciously tries?, and second: Does the typical pilot frequently depart inadvertently from normal flight in the direction of the stall approach when he has no business doing so? The investigation endeavored to answer these questions with respect to performance of pilots in a light plane with which they were familiar (an Aeronca Champion), and in a light plane with which they were unfamiliar (a Taylorcraft L2M).[1]

Two hundred fifty-four subjects were employed in the investigation of performance in the familiar plane (93 student pilots, 80 private pilots, and 81 flight instructors). For the study involving the unfamiliar plane, 119 subjects were used (39 student pilots, 44 private pilots, and 36 flight instructors). Subjects flying in both familiar and unfamiliar planes were instructed, during the execution of a series of assigned maneuvers, to fly the plane as close as possible to the "edge of the stall" but not to stall the plane. Performance of the subjects was measured by means of an adaptation of a commercial stall warning indicator which indicated to the check pilot flying with the subject the degree to which the stall was approached. Measures of degree of approach to the stall were also taken in "unassigned" maneuvers, during which the subject was instructed to fly normally. The subjects were unaware that their performance during these latter maneuvers was being observed.

The results of the investigation indicated that the answer to the first question was: No; the typical pilot does not succeed in identifying the incipience of the stall when he consciously tries; and that the answer to the second question was: Yes; the typical pilot frequently departs inadvertently from normal flight in the direction of stall approach when he has no business doing so.

During the assigned maneuvers, the subjects who were consciously trying to fly on the edge of the stall actually were for the most part flying well below the point of stall incipience, even in the familiar plane. This tendency was more pronounced in the unfamiliar plane. During the flights of a number of subjects the plane was at best only slightly beyond the normal flight condition even though the subjects thought they were "on the edge."[2] Generally, recognition

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[1]The investigation of performance in the familiar plane was carried out at three research centers, respectively located at Bedford Field, Bedford, Massachusetts; Cumberland Airport, Nashville, Tennessee; and Westchester County Airport, Westchester County, New York. Investigation of performance in the unfamiliar plane was conducted only at the Bedford, Massachusetts, center.

[2]It should be noted, however, that a number of subjects, particularly student pilots, approached too closely to the edge of the stall and actually stalled the plane.

of the stall approach, as indicated by the instructors, was more adequate than that of the private pilots, and the performance of the private pilots was somewhat better than that of the student pilots. However, the performance of the instructors was considered far from adequate, and this inadequacy is probably reflected in the performance of the private and student pilots.

In the unassigned maneuvers the results indicated that pilots do occasionally approach the stall inadvertently and do frequently fly in such a way that their deviation from normal is in the direction of an approach to a stall. Again, performances in the familiar plane were better than were performances in the unfamiliar plane. The unfamiliar plane was actually stalled inadvertently three times while a student pilot was trying to fly normally. Several close approaches to the stall were made inadvertently by all types of pilots.

In considering these findings two facts should be noted. First, many of the inadvertent stalls and approaches to stalls in unassigned maneuvers occurred during recovery from a stall following an assigned maneuver in which the subjects attempting to fly close to the stall actually had stalled the plane. This suggests that many accidents resulting, for example, from buzzing the girl friend's house may occur, not during the buzzing itself, but in the recovery from the maneuver during which the g load on the plane is high.

Second, the "unfamiliar" plane was only slightly unfamiliar, both it and the "familiar" plane being high wing monoplanes, of comparable horsepower, tandem seating, and having similar controls. A pilot, having checked out in the Aeronca would at many airports be allowed to fly the Taylorcraft L2M (the "unfamiliar" plane) without further ado. Therefore the indication of markedly poorer stall recognition in this aircraft has important implications.

The most important finding of the study is the evidence of inadequate recognition of the clues to stall incipience as evidenced by the instructors themselves. This may well explain the inadequacies in the performance of private and student pilots.

INTRODUCTION

This study was undertaken to answer a question which can be divided into two parts. Generally put, the question was Is the stall in private flying a very important matter? The first part of the question was Does the typical pilot succeed pretty well in identifying the incipience of the stall when he consciously tries? and the second part of the question was Does the typical pilot frequently depart inadvertently from normal flight in the direction of the stall approach when he has no business doing so?

Researches conducted under the auspices of the Civil Aeronautics Administration and under the auspices of the National Research Council Committee on Aviation Psychology have already shown that a substantial number of the accidents in private flying are due to inadvertent stalls. In a sense therefore the general question has already been substantially answered. Nevertheless no normative data have been previously compiled showing the answers to either of the sub-questions: the accuracy with which the pilot can recognize the stall when he tries, and the frequency with which he inadvertently departs from normal flying in the direction of a stall approach. It was decided that both these questions should be answered with respect to student pilots, private pilots, and instructors, investigated not only in an airplane entirely familiar to them, but also in an appropriate unfamiliar airplane of the same general type and horsepower classification.

PART I: INVESTIGATION OF PERFORMANCE IN FAMILIAR PLANE

RESEARCH CENTERS

The investigation was carried out at three airports at each of which the standard training plane was the Aeronca Champion, a high-wing tandem trainer of 65 horsepower. The location and other pertinent data concerning each of these centers are as follows:

Bedford Field, Bedford Massachusetts. Operating company, East Coast Aviation Corporation; operations manager, Mr. James Meahion; check pilot, Mr. Philip Sampson; project supervisor, Dr. Leo Lieberman.

Cumberland Airport, Nashville, Tennessee. Operating company, Capitol Airways; operations manager, Mr. Mack H. Rowe; check pilot, Mr. Frank Welburn; project supervisor, Professor Stanford C. Ericksen of Vanderbilt University.

Westchester County Airport, Westchester County, New York. Operating company, North American Airport Corporation; airport manager, Mr. Robert W. Galloway; check pilot, Mr. Walter J. O'Neill; project supervisor, Professor Robert T. Rock, Jr., of Fordham University.

PLANES EMPLOYED

Figures 1 and 2 show front and rear views of the Aeronca Champion used at one of the centers as the "familiar airplane." The same kind of airplane was also flown at the other centers at which examinations were given in a "familiar airplane."

STALL RECORDING APPARATUS

At each center the airplane in which pilots were examined was equipped with five vanes in the leading edge of the left wing, arranged in a ladder formation as shown in Figures 3 and 4. Figure 3 shows the view from in front of the airplane looking slightly downward at the leading edge of the left wing. A scrutiny of the upper edges of the black plates indicates the stair-like arrangement of the vanes installation. Figure 4 is a view looking toward the fuselage and upward toward the leading edge of the left wing. The vanes can be seen to stand in different positions on the leading edge of the wing, and to stand at different angles with reference to the wing chord.[1]

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[1] Each of these vanes is a standard part of the Safe Flight Stall Warning Indicator manufactured by the Safe Flight Instrument Corporation of White Plains, New York. The operation of these vanes has been explained by Dr. Leonard M. Greene, president of the Safe Flight Instrument Corporation, somewhat as follows:

As can be seen in Figures 3 and 4, the five vanes used in this instrumentation were arranged in a series with the outboard vane mounted high on the leading edge and the inboard vane mounted low on the leading edge.

Figure 5 was drawn by tracing a template fitted to the leading edge of the Aeronca Champion at one of the centers, and therefore shows a full-scale portrayal of the airplane wing profile in the neighborhood of the vanes. The positions of the vanes and their lengths are also shown full-scale, with the vanes numbered in the sequence in which they trigger as the stall is approached.

The final positions of the vanes were determined by a series of adjustments each made after flight testing the airplane.

The number 5 vane was so adjusted that when a stall approach was made in a left climbing turn, the vane triggered almost exactly at the same instant that the aircraft started to spin over the top in what would be a spin out of a climbing turn if the pilot did not recover. The vane behaved the same way in the stall approach in a right climbing turn as it did in the stall approach in a left climbing turn.

When the stall approach was made from flight conditions other than climbing turns, the number 5 vane did not trigger just as the stall occurred. It was therefore necessary to standardize the installation on the climbing turn in order to assure that the installations would be approximately the same at all test centers.

When the stall approach was made straight ahead with cruising power, the vane triggered just perceptibly late; that is, the shudder of the stall occurred and the nose just started to drop, and only then did the number 5 vane trigger.

When the stall approach was made straight ahead with power off, the behavior of the vane depended upon the way in which the stall approach was exe-

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1 (Continued) An airplane in flight is sustained by the development and maintenance of positive pressures against the lower surface of the wing, and negative pressures (relative to atmospheric) on the upper surface of the wing. Somewhere on the leading edge of the wing is a zone of zero pressure, below which zone the pressure is positive, and above which the pressure is negative with respect to atmospheric. In accordance with the Bernoulli law connecting pressure and velocity in a moving fluid, the air velocity at the point of zero pressure on the leading edge of the wing is very high, and its direction is parallel to the surface of the leading edge. A vane mounted anywhere above this zone of zero pressure will be blown upward by the air stream, while a vane mounted anywhere below the zone of zero pressure will be blown downward.

As the angle of attack of the aircraft wing is increased in the direction of a stall approach, the point of zero pressure moves down the leading edge of the wing, so that a vane mounted high on the leading edge of the wing and so arranged as to close a circuit when blown upward, would trigger quite early in an approach to a stall, while a vane mounted far down on the leading edge of the wing would trigger very late. If the vane is mounted far enough down on the leading edge of the wing, it will not trigger until the occurrence of the stall.

outset. If the nose was pulled slowly [illegible] a relatively high position by continually increasing back pressure on the stick so that the stall occurred in an extremely nose-high attitude, then the number 5 vane triggered almost exactly at the time the aircraft broke into the stall. On the other hand, if the stall was accomplished by bringing the nose up to the horizon and holding it there by gradually exerting more and more back pressure on the stick, but without raising the nose above the horizon, then the aircraft would stall without triggering the number 5 vane, although the number 5 vane would trigger during the drop of the nose in the stall.

When the stall was approached in a gliding turn, the behavior of the number 5 vane depended again upon how the nose was held. If the nose was brought up quite high before the stall occurred and the stall took place in a nose-high attitude, then the vane triggered just as the stall occurred. If the nose was not brought very high, but was only kept up to the horizon while the stick was gradually brought back to induce the stall, then the stall occurred before the number 5 vane triggered, although the vane triggered during the dropping of the nose in the stall.

In a steep turn at altitude (as employed in the 720° turn in the CAA flight examination) the number 5 vane triggered before there was any imminence of a stall. A reasonably skillful pilot could light all five lights and then make a normal recovery from the turn, instead of a normal recovery from a stall. In an airplane with as little horsepower as the Aeronca Champion, this maneuver involved banking the airplane so steeply that altitude could not be held, so that actually the turn was not literally a "steep turn at altitude," but nevertheless a pilot told to come as close as possible to stalling the airplane in a steep turn, without actually stalling it, could readily trigger the fifth vane without stalling the airplane.

When the stall approach was made straight ahead with climbing power, the number 5 vane behaved the same as it did when the stall approach was made straight ahead with cruising power. That is, the stall took place just perceptibly before the number 5 vane triggered.

In spite of the fact that the number 5 vane did not trigger exactly at the entry into the stall when the approach was made in different flight conditions, its behavior was nevertheless satisfactorily meaningful for the purpose of the study. The conditions in which the vane triggered just perceptibly too late were straight ahead maneuvers with either cruising power or climbing power. In either of these maneuvers the stall actually began, and only then did the vane trigger. The stalling of the airplane was easily and clearly recognizable by the check pilot and its occurrence was just as definite as the triggering of the fifth vane, so that it was relatively harmless for examining purposes to have the vane trigger just perceptibly too late.

In steep turns at altitude the vane triggered without any stall taking place, and the examinee could therefore trigger the vane and still keep the airplane in what might be regarded as a flight maneuver instead of a stall maneuver. However, when the vane triggered, a loss of altitude was being sustained, and a turn was not being made <u>at altitude</u>.

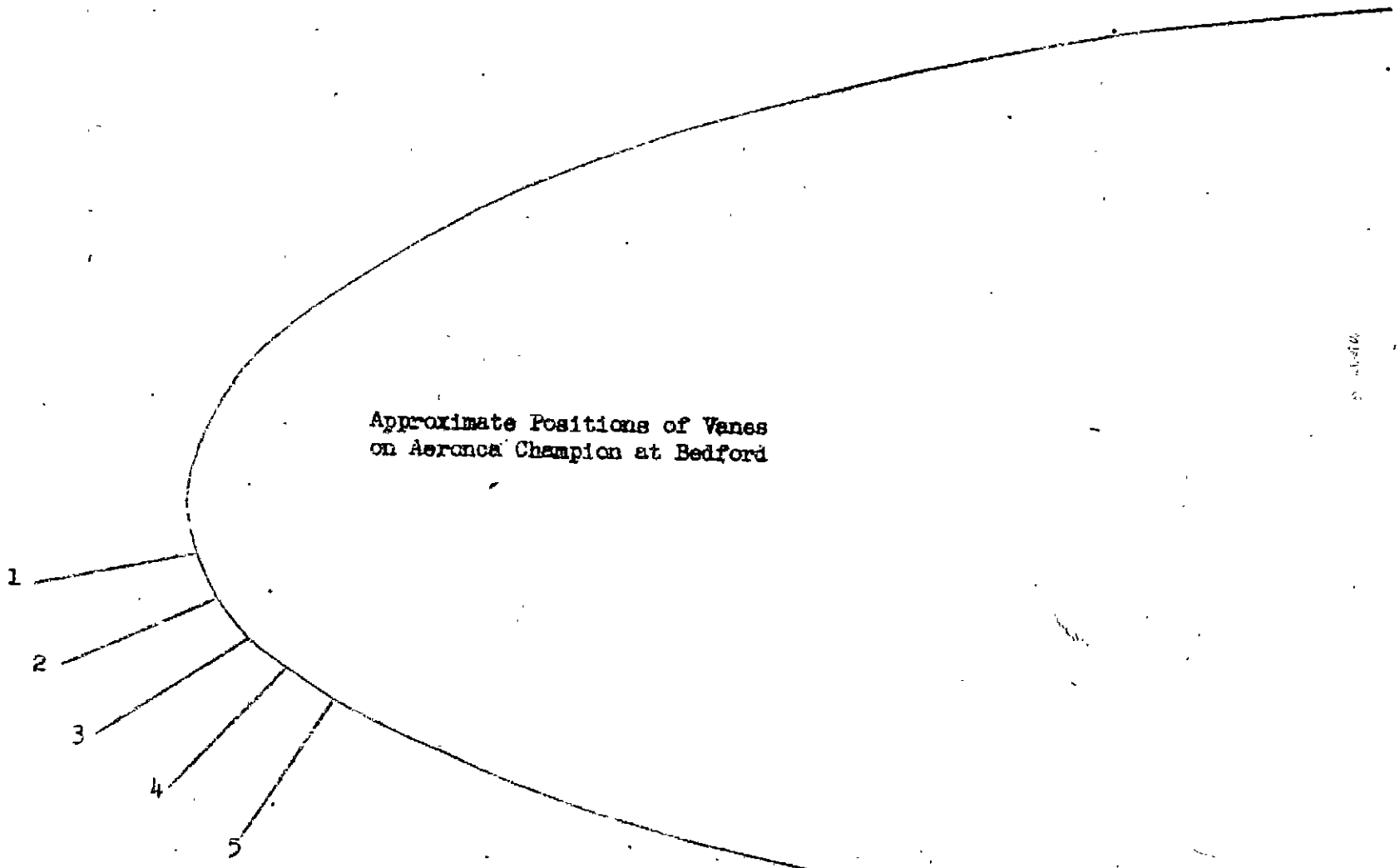

FIGURE 5

SITE PLOYMENT FOR INSTALLATION OF VANES ON LEADING EDGE

FIGURE 1

FRONT VIEW OF THE "FAMILIAR" PLANE (AERONCA CHAMPION)

FIGURE 2

REAR VIEW OF THE "FAMILIAR" PLANE (AERONCA CHAMPION)

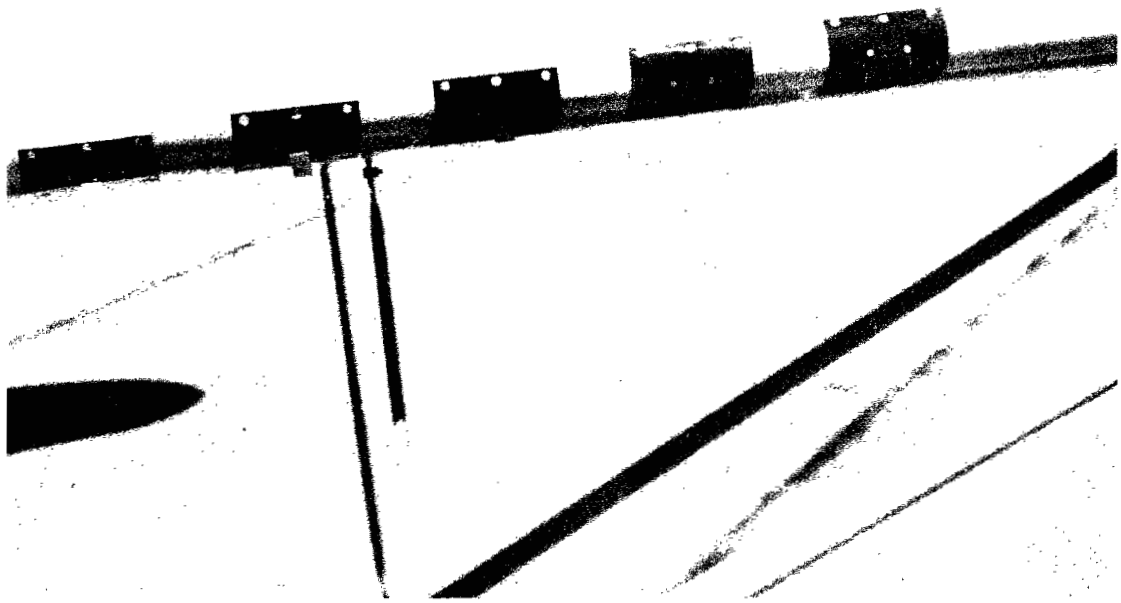

FIGURE 3

FRONT VIEW OF VANE INSTALLATION ON LEADING EDGE OF WING

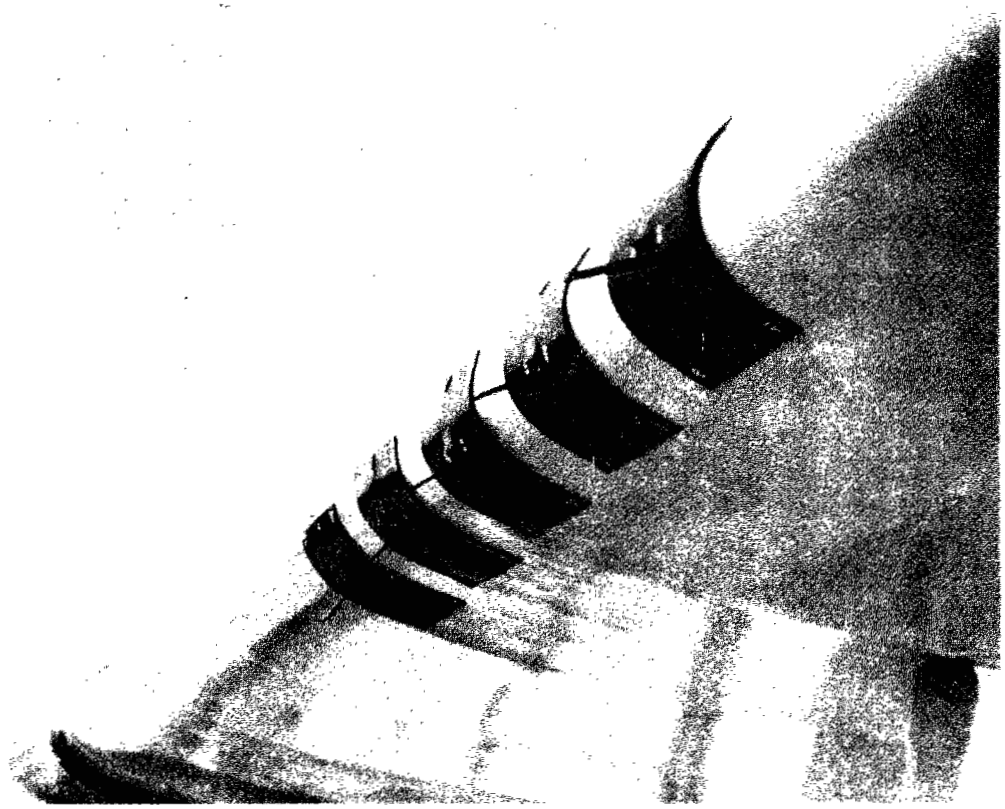

FIGURE 4

VIEW FROM BELOW OF VANE INSTALLATION ON LEADING EDGE OF WING

If violent changes in the angle of bank were brought about by the pilot, the behavior of the vanes was affected. Therefore the above report for the behavior of the number 5 vane does not apply when any pronounced roll is executed along with the designated maneuver. If in a steep left turn at altitude a sudden change of bank is undertaken, the vane will behave differently during the roll which changes the bank. It was therefore suggested to the check pilot that in all turning maneuvers, the bank be established and held during the approach to the stall. It was urged that in any case any very rapid changes of bank be avoided if at all possible. Unhappily nothing very constructive could be suggested in this connection for remedying the inevitable difficulties caused by turbulence, and the necessity for making rapid adjustments in the attitude of the aircraft to overcome the effects of the turbulence.

Vane number 1 was mounted high on the wing so that it would trigger when any significant departure from normal flight increased the angle of attack. It would trigger in a steep climb or in a mushing glide. The setting of vane number 1 was adjusted after flight testing by the check pilot, whose directive was to have vane number 1 so set that whenever it triggered he would be justified in telling the examinee that he was not performing normal flight, but was operating at too high an angle of attack. At the Bedford center the recommended air speed in the normal climb was 60 miles per hour, and vane number 1 was accordingly set so as to trigger in a climb at something under 60 miles per hour, so that in the normal climb the vane would not trigger. The recommended gliding air speed was also 60 miles per hour, so that in the recommended normal glide the number 1 vane did not trigger. The problem, of course, was to get the number 1 vane set so that it would trigger soon enough, but not too soon, when the angle of attack was increased. The setting was left to the check pilot in consultation with the other instructors at the field, with instructions that the vane should trigger soon enough to detect any important deviation from normal flight, but trigger late enough so that the examinee could not claim to be maintaining normal flight when it triggered.

After vanes number 5 and number 1 were adjusted, the position of vane number 3 was determined by a geometrical bisection of the perpendicular distance and angle between numbers 1 and 5, so that number 3 was midway between numbers 1 and 5. Similarly number 2 was midway between numbers 1 and 3, and number 4 was midway between numbers 3 and 5.

The above descriptions of the behavior of the vanes refers of course to their behavior in calm air. When normal flight was maintained through turbulent air, vane number 1 would frequently trigger, and occasionally vane number 2 would trigger as well. This triggering due to turbulence was not regarded as an undesirable feature of the installation, however, since some instructors recommend a flatter climb and a steeper glide in turbulent conditions than in still conditions of air. Since inadvertent stalling can take place in turbulent conditions if the usual gliding speed is employed, some instructors might well recommend a higher air speed in both the climb and the glide when turbulence is encountered. Therefore the more efficient pilots will avoid triggering the early vanes, even when they are flying in conditions of turbulence.

From this row of five vanes a [illegible] was led inboard through the wing to the rear end, thence into the cockpit, and down the left-hand wall of

the cockpit, where it terminated in a cable connector. The check pilot was provided with a specially constructed clipboard from which a cable was led to a similar connector. Front and back views of this clipboard are presented in Figures 6 and 7. The connecting cable can be seen leading off from the upper left of the board in Figure 6 and from the upper right in Figure 7. On the back of the clipboard was mounted a flat six-volt battery which energized the lights when the vanes triggered. As seen from the front, the number 3 light is on the left and the number 5 light is on the right. Thus, as the vanes trigger in sequence during an approach to a stall, the lamps light in sequence from left to right, the first lamp staying lit while the second comes on, both of these staying lit while the third one comes on, and so forth. In order to record the number of triggered vanes, the check pilot had only to put a check mark in the column underneath the farthest light lit.

A new examination sheet was employed for each examinee. A copy of this record sheet constitutes Exhibit I.

PROCEDURE IN CHECK FLIGHT ADMINISTRATION

The check pilot was provided with a supply of instruction sheets so that he could give one to each examinee before the flight. A copy of this instruction sheet is presented as Exhibit II. An examination of this sheet will reveal that the examinee was quietly told several times that he was to fly normally whenever he wasn't told to do anything else. In the fourth paragraph the examinee is told, for example, "If you make the take-off, make a normal take-off, and use a normal climb to altitude. After any maneuver, return to normal cruising flight. When gliding, use the normal glide. In other words, fly just as you have been taught except when told to try the stall business."

Actually not all examinees were supplied with this instruction sheet. The check pilots found that the examinee typically took a good deal of time to read it and the check pilot therefore frequently gave the examinee his instructions orally, occasionally confirming them by supplying a copy of the instruction sheet to be read at the student's convenience. Each check pilot was urged, however, to include in his instructions the admonition for the examinee to use normal flight for all of his flying except in the stall approaches when directed.

Except for the check marks to be placed in the columns, the spaces in the examination record were mostly filled in before the examination flight. At the top of the record was a provision for the examinee's name and his age as of his last birthday. Four letters were provided for indicating the type of certificate held by the examinee: S for student, P for private, C for commercial, and T for transport. The check pilot encircled or underlined the word "Instructor" or "Instrument" if the examinee held either of these ratings, and entered the year of first solo in a space provided for the purpose. Spaces were also provided for recording the total solo hours of experience of the examinee, together with the number of solo hours in the past 90 days, and the number of solo hours in the past 90 days in the make and model of airplane used in the examination.

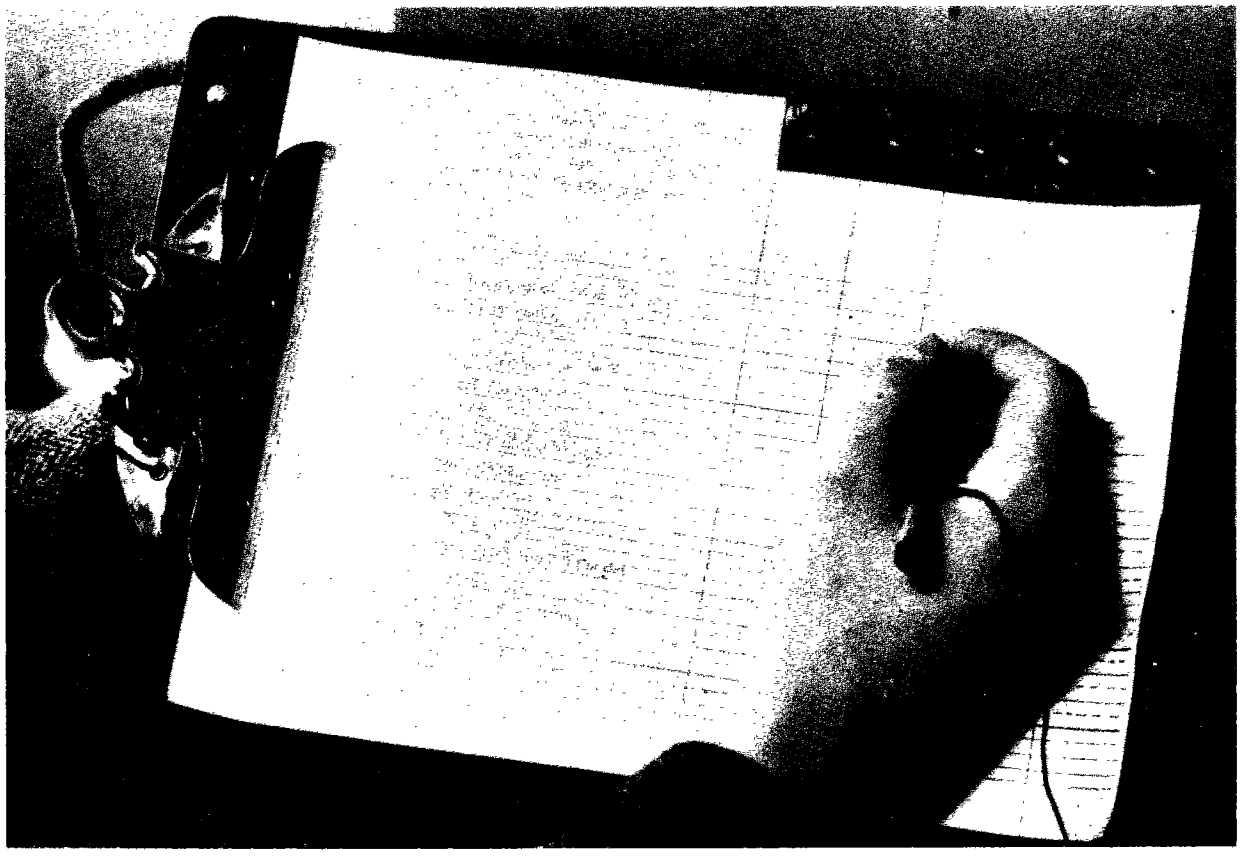

FIGURE 6

CLIPBOARD AND RECORD SHEET EMPLOYED IN INVESTIGATION

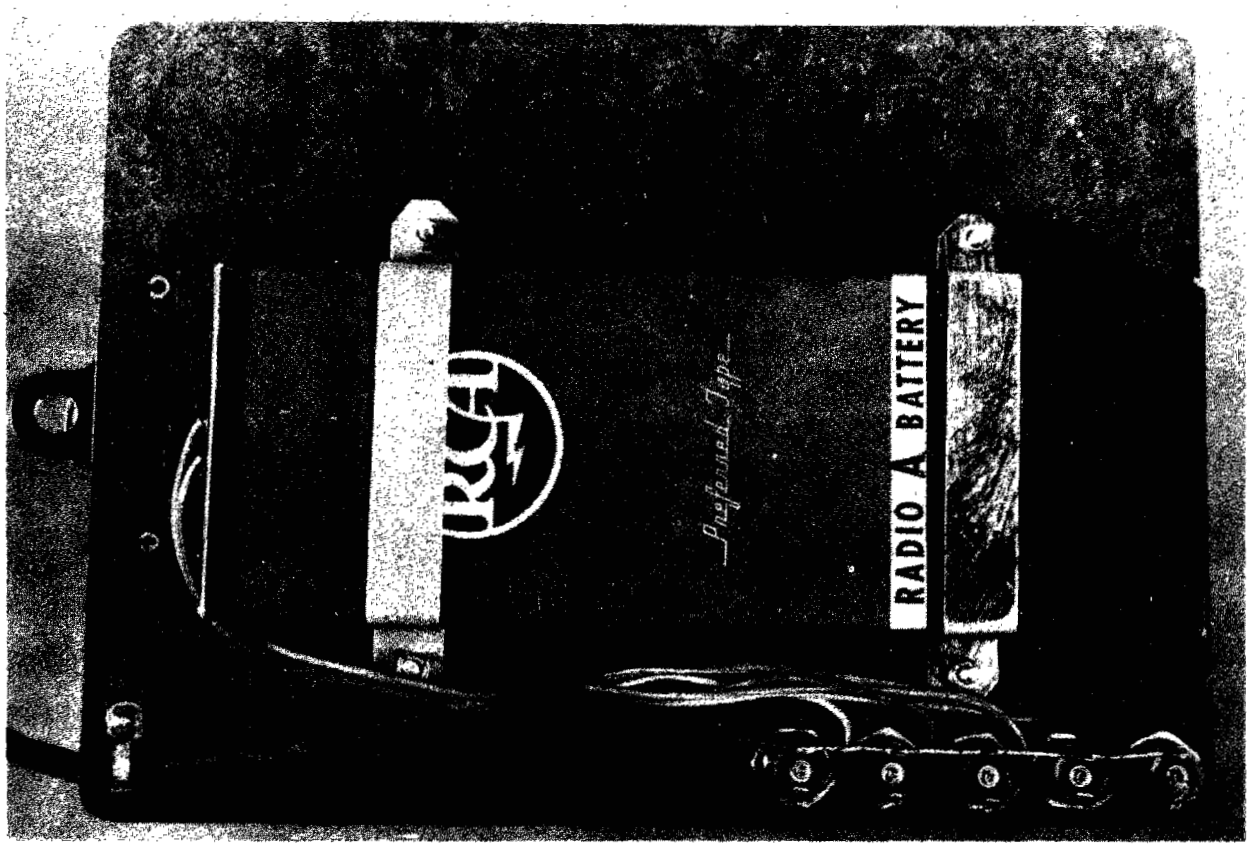

FIGURE 7

BACK OF CLIPBOARD SHOWING BATTERY AND LAMP INSTALLATION

EDUCATIONAL RESEARCH CORPORATION
Cambridge 38, Massachusetts

29 April 1947

Name _____

Age last birthday _____ years. Certificate: S P C T

Ratings: Instructor Instrument Year first solo _____

Total solo _____ hrs. In past 90 days _____ solo hrs.
Solo hrs. in past 90 days in this plane make and model _____ hrs.

Date _____ 1947 Hour _____ a.m. p.m. NC _____

Instructor _____

Climb to altitude					
Clearing turn left					
Clearing turn right					
1. Straight ahead, cruising power					
2. Straight ahead, power off					
Climb to altitude					
Clearing turn left					
Clearing turn right					
3. Left climbing turn					
4. Right gliding turn					
Climb to altitude					
Clearing turn left					
Clearing turn right					
5. Steep left turn at altitude					
6. Right climbing turn					
7. Left gliding turn					
Climb to altitude					
Clearing turn left					
Clearing turn right					
8. Straight ahead, climbing power					
9. Right gliding turn					
10. Steep right turn at altitude					
11. Left gliding turn					
Return to field					

B for

EXHIBIT II

EDUCATIONAL RESEARCH CORPORATION
Cambridge, Massachusetts
40 Quincy Street

8 May 1947

PLEASE

From your flying experience, as well as from your general knowledge of flying, you know how important it is for a pilot to stay out of the trouble which can be caused by stalling the airplane at the wrong time.

Naturally one important thing is, can the pilot tell when he is in danger of a stall? The Civil Aeronautics Administration in Washington has asked the Educational Research Corporation of Cambridge, Massachusetts, to find out how well pilots can tell when the airplane is about to stall.

The check pilot will therefore ask you to come as close to stalling the airplane as you can without actually stalling it. He will ask you to do this several times, first starting with the airplane flying straight ahead with cruising power, then under other conditions, until finally he will ask you to do it after you have started a left gliding turn.

You will not be asked to try the stall in any kind of flying that you haven't already practiced, and you will note that you are to use a ship with which you are already familiar. The check pilot will tell you what to do just as though he were giving you an ordinary flight examination. Whenever he doesn't tell you anything, fly normally. If you make the take-off, make a normal take-off, and use a normal climb to altitude. After any maneuver, return to normal cruising flight. When gliding, use the normal glide. In other words, fly just as you've been taught except when told to try the stall business.

You haven't been told anything much about this study. This is good. The Civil Aeronautics Administration wants to know how well people can tell when the airplane is about to stall, and of course the "people" they want to know about have not been told anything about this study. You are to be one of such people. If we told you very much about this study, you wouldn't be. Therefore the check pilot will only ask you to do things; he won't tell you how well you do them or how well other people have done them.

Of course you are to do the best you can. Each time you are asked, you will come as close to stalling the airplane as you can without actually stalling it. Actually stalling the airplane is not good. Neither is it good to come nowhere near stalling it. So get as close to the stall as you can, but don't stall.

We want to give this flight examination to other pilots on this field. We want them to be more of the "people who fly airplanes." Just people who fly

airplanes haven't been helped by hearing about this examination. Therefore we don't want the other pilots around here to hear about this examination from you.

Of course there is nothing secret about the examination. You can find out anything you want to know about how well you did, as soon as you can be told without hurting the way other pilots take the examination.

All you have to do is write to the Educational Research Corporation, 40 Quincy Street, Cambridge 38, Massachusetts. As soon as all of the examining is finished at this airport--and that won't be long--you can be told all about how well you did.

Until then, you can help by not talking about the examination at all!

Your helping in this way is for the good of private flying.

At the left of the examination record was a space for the date and hour of flight, the NC number of the plane, and the signature of the check pilot. Besides these spaces which were labeled in the printing of the examination record, three other items were also entered. One was the number of minutes the flight took, and the other two were visibility and turbulence conditions. Turbulence was indicated by writing the word None, or Moderate, or Severe, to indicate the degree of turbulence. Visibility was indicated by writing a word to describe the appearance of the horizon; either Distinct, Vague, or Absent.

The check pilot allowed the examinee to watch him fill in the spaces on the examination record, and the check pilot pointed out the purple printing of the numbered maneuvers, referring to them as "the maneuvers you will be scored on." The check pilot made no other remark about the scoring sheet.

The examinee was seated in the seat in which he usually flew this airplane solo. At some airports the Aeronca Champion is soloed from the front seat, and at other airports from the rear seat. The examinee was flown in whichever seat he ordinarily sat in to fly solo.

The check pilot was instructed to be entirely noncommittal during the examination flight. He was instructed not to tell the examinee how well he was doing, how many lights he lit, or even whether he stalled the airplane. The instructions to the check pilot for the conduct of the examination flight are presented in Appendix B.

In the printed matter supplied to the airports there was no mention of scoring the examinee from observations made before, between, or after the assigned maneuvers. Instructions for this scoring were given orally to all check pilots. Reference to the examination sheet presented as Exhibit I shows how the provision was made for recording observations before, between, and after the 11 numbered maneuvers. Several of the lines indicating periods between maneuvers were labeled by red printing which was designed to present the appearance of instructions for carrying out the examination, rather than provisions for making check marks. Actually, observations were made on the lines labeled in red as well as on the lines labeled in purple. The last three lines of the examination record were left blank because it would not have been possible to label them without exposing the plan to score the examinee on these lines. The third line from the bottom of the page was used to record the number of lights lit while the examinee was in the traffic pattern after his return to the field. The next-to-last line was used to record the number of lights lit on the last turn into the field, typically a left gliding turn. The bottom line on the examination record was used to indicate the number of lights lit in the final glide.

Other unlabeled lines appear between the lines for maneuvers 1 and 2, again between 3 and 4, between 5 and 6, between 6 and 7, between 8 and 9, between 9 and 10, and between 10 and 11. These lines were used to indicate the number of lights lit by the pilot between maneuvers. These lights could be lit while the pilot was engaged in intended normal flight between maneuvers, following the instructions he had been given before the flight, or the line

could be used to record the number of lights lit in a bad recovery from a stall if one of the approaches was carried to the point of an actual stall.

The manner of indicating the number of lights lit has already been reported. In case the examinee went so far as actually to stall the airplane, the check pilot entered two check marks in column 5. Such an entry will be tabulated in the tables which follow by referring to it with the digit 6.

SUBJECTS AND CONDITIONS OF ADMINISTRATION

The examinations in the familiar airplane were all given between 7 May and 10 July inclusive. Table 1 shows a distribution of the flight examinations by type of pilot, examining center, and date of flight. As can be seen from this table, there were a total of 93 student pilots, 80 private pilots, and 81 instructors, making a total of 254, of which 124 were flown at Bedford, 49 at Nashville, and 81 at Westchester.

It was intended that the student pilots should have between 10 and 20 hours inclusive of total solo flight experience. As can be seen in Table 2, several of the students had more than this amount of experience. One student flown at Bedford had 21 hours, which was one hour over the limit, but his case was included in the tabulations because it appeared from an examination of his flight record that he was no better than the best other student and no worse than the worst. At Westchester eight students were flown who had more than 20 hours of total flight experience, two of them having as many as 60 hours. All of these cases were included in the tabulations despite their being outside th planned range of solo flight experience, because their performances looked very much like all of the others, and they appeared therefore not to be the possible cause of any significant disturbance in the results. There is reason for supposing that the other centers also flew a number of students who had more than 20 hours of solo flight experience. Bedford reported more students with 20 hours than with any other number, and so did Nashville. It is possible that a substantial number of those reported to have 20 hours actually had more than 20, and the flight examiner put down 20 in order to qualify the candidate, since candidates for the examination were some trouble to find. The table suggests that the principal difference between the Westchester check pilot and the other two was in his honesty, rather than in his adherence to the limits of hi directive.

Private pilots are also distributed in Table 2. The plan was to have private pilots with 40 to 60 hours inclusive of total solo flight experience. Actually there were five pilots who had fewer than 40, and four who had more than 60, as judged by the figures in Table 2. Actually the number outside the prescribed range are probably greater, as is evidenced by the piling up at both ends of the allowable range. Fourteen private pilots are reported to have 40 hours, and 13 are reported to have 60 hours, while the numbers of hours in the neighborhoods of those limits are not occupied by anywhere near that large a number of reports. This behavior of reporters is a well known phenomenon and is exhibited again in the piling up at 50 hours for the private pilots. This piling up at 50 hours is quite likely due to the manner in which the instructions were given. Most private pilots were wanted who had about 50 hours

EXAMINATION FLIGHTS IN THE FAMILIES AIRPLANE DISTRIBUTION BY TYPE OF PILOT, EXAMINING CENTER AND DATE OF FLIGHT

Date	Student Pilots				Private Pilots				Commercial				All Pilots			
	Bedford	Nashville	Westchester	Total	Bedford	Nashville	Westchester	Total	Bedford	Nashville	Westchester	Total	Bedford	Nashville	Westchester	Total
May 9	1			1	1			1					2			2
10																
11																
12	5			5									6			6
13	2			2	1			1	1			1	4			4
14	2			2	1			1					3			3
15									1		1	2	1		1	2
16									2			2	2			2
17	1		1	2	3			3	2		2	4	4	2	3	9
18	1		2	3		1	1	2			2	2	1	1	5	7
19						1		1						1		1
20			1	1							3	3			4	4
21										1	1	2		1	1	2
22									2	1		3	2	1		3
23			2	2		2	2	4								
24	1	1	1	3	3			3	3	1	1	4	7	1	2	10
25									2			2	2			2
26					1			1	1			1	2			2
27							2	1	2		6	8	2		7	9
28			2	2	1			1	2	1		3	3	1	2	6
29			1	1											1	1
30											1	1			1	1
31	1			1	1			1	3		1	4	5		4	9
June 1			1	1			4	4			1	1			6	6
2					2			2	1			1	3		1	4
3																
4	2		2	4	1			1	1			1	4		2	6
5	1			1									1			1
6			2	2	1			1	2			2	3		2	5
7																

TABLE I (Continued)

Date	Student Pilots				Private Pilots				Instructors				All Pilots			
	Bedford	Nashville	Westchester	Total	Bedford	Nashville	Westchester	Total	Bedford	Nashville	Westchester	Total	Bedford	Nashville	Westchester	Total
June 8	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	1
9	2	-	3	5	1	-	1	2	1	-	-	1	2	-	4	6
10	1	-	3	4	-	1	-	1	2	-	-	2	3	1	3	7
11	-	5	-	5	-	1	-	1	-	2	-	2	-	8	-	8
12	1	2	-	3	3	-	-	3	1	-	2	3	5	2	2	9
13	-	-	-	-	-	-	-	-	3	-	-	3	3	-	-	3
14	-	2	-	2	1	-	-	1	1	1	-	2	2	3	-	5
15	2	-	1	3	2	-	-	2	-	-	-	-	4	-	1	5
16	2	-	1	3	2	-	2	4	1	-	-	1	4	-	3	7
17	-	1	-	1	-	-	1	1	-	-	-	-	-	1	1	2
18	1	-	-	1	2	1	-	3	1	-	-	1	4	1	-	5
19	-	-	3	3	1	-	1	2	1	-	1	2	2	-	5	7
20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21	2	-	2	4	1	-	2	3	-	-	-	-	3	-	4	7
22	1	-	1	2	3	-	-	3	1	-	2	3	5	-	3	8
23	-	-	-	-	-	-	2	2	-	-	-	-	-	-	2	2
24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26	2	4	-	6	1	1	-	2	-	-	-	-	3	5	-	8
27	1	2	-	3	1	1	-	2	-	1	-	1	2	4	-	6
28	2	-	-	2	1	2	-	3	1	-	-	1	4	2	-	6
29	1	2	-	3	-	-	-	-	-	-	-	-	1	2	-	3
30	1	-	-	1	1	-	-	1	-	-	-	-	2	-	-	2
July 1	2	1	-	3	1	1	-	2	-	-	-	-	3	2	-	5
2	1	-	-	1	1	-	-	1	-	-	-	-	2	-	-	2
3	-	1	-	1	2	-	-	2	1	-	-	1	3	1	-	4
4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	-	-	-	-	2	-	-	2	2	-	-	2	4	-	-	4
6	2	-	-	2	2	-	-	2	-	-	-	-	2	-	-	2
7	2	-	-	2	1	-	-	1	1	-	-	1	4	-	-	4
8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	1	1	-	-	-	-	-	-	1	1
10	-	1	1	2	-	1	-	1	-	1	-	1	-	3	1	4
Total	38	22	33	93	46	15	19	80	40	12	29	81	124	49	81	254

TABLE 2

PILOTS WHO FLEW TYPE FAMILIAR AIRPLANE DISTRIBUTED BY NUMBER OF TOTAL SOLO HOURS OF FLIGHT EXPERIENCE, TYPE OF PILOT, AND EXAMING CENTER

Solo Hours	Student Pilots				Private Pilots				Instructors				All Pilots			
	Bedford	Nashville	Westchester	Total	Bedford	Nashville	Westchester	Total	Bedford	Nashville	Westchester	Total	Bedford	Nashville	Westchester	Total
9000										1		1		1		1
6800											1	1	1			1
5800									1			1	1			1
5500									1			1	1			1
4800											1	1			1	1
4400											1	1			1	1
4300									1			1	1			1
4200										1		1		1		1
4100										1		1		1		1
4000									2	1	3	6	2	1	3	6
3700											1	1			1	1
3600									1			1	1			1
3500									2	1		3	2	1		3
3100											1	1			1	1
3000									1			1	1			1
2900										1	1	2		1	1	2
2800									1			1	1			1
2700									1		1	2	1		1	2
2600											1	1			1	1
2500									1		2	3	1		2	3
2400											1	1			1	1
2200									1			1	1			1
2100									2		1	3	2		1	3
2000									2		1	3	2		1	3
1700									1			1	1			1
1600									2			2	2			2
1500									2		2	4	2		2	4
1400									1			1	1			1
1300									1			1	1			1
1200									3		2	5	3		2	5

TABLE 2 (Continued) (2)

Solo Hours	Student Pilots				Private Pilots				Instructors				All Pilots			
	Bedford	Nashville	Westchester	Total	Bedford	Nashville	Westchester	Total	Bedford	Nashville	Westchester	Total	Bedford	Nashville	Westchester	Total
1100												2		2		2
1000									2	2	1	5	2	2	1	5
980											1	1			1	1
950									1			1	1			1
930									1			1	1			1
900									1	1		2	1	1		2
800									1			1	1			1
750											1	1			1	1
700									1			1	1			1
650											1	1			1	1
600									1		3	4	1		3	4
550									1			1	1			1
500									1			1	1			1
425									1			1	1			1
400											1	1			1	1
385											1	1			1	1
250									1	1		2	1	1		2
200								1					1			1
190											1	1			1	1
130						1		1						1		1
70						1		1						1		1
62					1			1					1			1
60			2	2	9	2	2	13					9	2	4	15
59					1			1					1			1
58					1		1	2					1		1	2
55					4	2	2	8					4	2	2	8
54					3			3					3			3
53			1	1	1			1					1		1	2
51					1			1					1			1
50					4	4	6	14					4	4	6	14
49							1	1							1	1
48					1			1					1			1
47					1			1					1			1
45					1		1	2					1		1	2
44					3			3					3			3

TABLE 2 (Continued) (3)

Solo Hours	Student Pilots				Private Pilots				Instructors				All Pilots			
	Bedford	Nashville	Westchester	Total	Bedford	Nashville	Westchester	Total	Bedford	Nashville	Westchester	Total	Bedford	Nashville	Westchester	Total
43				1	3			3					3		1	4
42					1			1					1			1
41					1		1	2					1		1	2
40			2	2	8	5	1	14					8	5	3	16
35							1	1							1	1
22							1	1							1	1
21	1		2	3									1		2	3
20	11	10	5	26	1		2	3					12	10	7	29
19	3			3									3			3
18	5		3	8									5		3	8
17	2			2									2			2
16	1		1	2									1		1	2
15	1	1	2	4									1	1	2	4
14			1	1											1	1
13	3		2	5									3		2	5
12		1	3	4										1	3	4
11	5	2	3	10									5	2	3	10
10	6	8	5	19									6	8	5	19
Total	38	22	33	93	46	15	19	80	40	12	29	81	124	49	81	254

of total solo flight experience; specifically private pilots whose solo flight experience was within 10 hours of 50 hours.[2]

No limitation was placed upon the solo flight experience of the instructors, and Table 2 shows no piling up anywhere. The instructors ranged in total solo hours from 190 to 9,000, with a median at 1600 hours.

The student pilots had done most of their solo flying during the 90 days preceding the examination flight. Table 3 shows the distribution of pilots in terms of number of solo hours in the 90 days preceding the date of the examination flight. The students ranged from two to 25 hours of solo flight experience during that period, the private pilots from one to 60 hours, and the instructors from two to 300 hours. The median for student pilots was around 11 hours, for private pilots around 20 hours, and for instructors around 100 hours. The distribution of recent flight experience was approximately the same from center to center except that the private pilots at Westchester seemed to have somewhat fewer recent hours, with a median around 10, as compared to the median of 20 for all private pilots. In fact, the examinees at Westchester seemed to have fewer solo hours in the preceding 90 days in all three categories, students, private pilots, and instructors, and the examinees at Bedford seemed to have more hours in the past 90 days than at either of the other centers, this applying to all types of examinees. The fewer hours of recent solo flight experience at Westchester may or may not be related to the better reported flying conditions as regards turbulence and visibility at Westchester. It is possible that the operating policy at Westchester may be more stringent than at the other centers. This would result in the flying being done on better days, but less flying would be done in any given 90-day period.

The examinees were asked to report the number of solo hours of flight experience in the preceding 90 days in the make and model of airplane used in the flight examination. Table 4 shows how the pilots were distributed with respect to this feature of their flight experience. The median number of hours for student pilots was around 10, for private pilots around 14 or 15, and for instructors around 75. The distributions for student pilots at the various centers are very much like those shown in Table 3 which presented total solo hours in the past 90 days, regardless of make and model of air-

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[2] A private pilot who had 190 total solo hours was flown at Nashville. This pilot was included because he was starting again after an eight-year lay-off, and since starting again had had only 50 solo hours, all in the past 90 days, with 40 of them in the same plane make and model as used in the examination. It was felt that the 70 solo hours he had as long ago as eight years would not be of material assistance to him. An examination of his record bears this out. He was a very typical private pilot, stalling the airplane once in the intended approach straight ahead with climbing power, going too far into the stall in the left gliding turn, lighting only three lights in the approach straight ahead with cruising power, in the first right gliding turn, and also lighting only three lights in the second right gliding turn. He occasionally had lights lit at the time of the unscheduled observations, but generally had none at those times.

TABLE 3

PILOTS WHO FLEW THE FAMILIAR AIRPLANE DISTRIBUTED BY NUMBER OF SOLO HOURS OF FLIGHT EXPERIENCE IN LAST 90 DAYS, TYPE OF PILOT, AND EXAMINING CENTER

Number of Hours	Student Pilots				Private Pilots				Instructors				All Pilots			
	Bedford	Nashville	Westchester	Total	Bedford	Nashville	Westchester	Total	Bedford	Nashville	Westchester	Total	Bedford	Nashville	Westchester	Total
300									2		2	4	2		2	4
250									2		1	3	2		1	3
220									2			2	2			2
210									2			2	2			2
200									2	1	3	6	2	1	3	6
190									1			1	1			1
180									1			1	1			1
170									1			1	1			1
160									1			1	1			1
150									8	2	2	12	8	2	2	12
130									1			1	1			1
120									3			3	3			3
110									1			1	1			1
100									3	6	4	13	3	6	4	13
92									1			1	1			1
75										1	2	3		1	2	3
72									1			1	1			1
70											2	2			2	2
65											1	1			1	1
60					1			3			2	2	1	1	3	5
50					1			1		1	1	2	1	1	1	3
45						1		1						1		1
43					1			1					1			1
41					1			1					1			1
40					6			6	1		1	2	7		1	8
36					1			2					1			1
36					1			1					1			1
35									1		1	2	4		1	5
31													2			2
30									1	1	1	3	5	2	1	8
29					1			1					1			1
28					2			2					2			2
25			1	1	2	1		3	1		1	2	3	1	2	6
24					2			2					2			2
20					1			1					1			1

TABLE 3 (Continued)

Number of Hours	Student Pilots				Private Pilots				Instructors				All Pilots			
	Bedford	Nashville	Westchester	Total	Bedford	Nashville	Westchester	Total	Bedford	Nashville	Westchester	Total	Bedford	Nashville	Westchester	Total
21	1			1	3			3					4			4
20	6	5	3	14	3	4	3	10			1	1	9	9	7	25
19	3			3									3			3
18	5		2	7							1	1	6		2	8
17	2			2									2			2
16		1		1	1			1					1	1		2
15		1	2	3			5	5			2	2		1	9	10
14			1	1	1			1					1		1	2
13	3		1	4		1	1	2					3	1	2	6
12		2	3	5			1	1						2	4	6
11	6	2	1	9			1	1					6	2	2	10
10	7	8	8	23	3	5	2	10			1	2	11	13	11	35
9	2			2			1	1	1			1	3		1	4
8	1	1	2	4			1	1					1	1	3	5
6	2		2	4	2			2			1	1	4		3	7
5		1		1		1	1	2						2	1	3
4		1	2	3	1			1					1	1	2	4
3			4	4	1		1	2					1		5	6
2			1	1			1	1	1		1	1	1		2	3
1					2			2					2			2
Total	38	22	33	93	46	15	19	80	40	12	29	81	124	49	81	254

TABLE 6

PILOTS WHO FLEW THE FAMILIAR AIRPLANE DISTRIBUTED BY TYPE OF PILOT, EXAMINING CENTER, AND NUMBER OF HOURS OF SOLO FLIGHT EXPERIENCE IN PAST 90 DAYS IN A PLANE OF THE SAME MAKE AND MODEL AS THE AIRPLANE USED IN THE FLIGHT EXAMINATION

Number of Hours	Student Pilots				Private Pilots				Instructor				All Pilots			
	Bedford	Nashville	Westchester	Total	Bedford	Nashville	Westchester	Total	Bedford	Nashville	Westchester	Total	Bedford	Nashville	Westchester	Total
300									1		1	2	1		1	2
250									1		1	2	1		1	2
220									1			1	1			1
200									3	1	1	5	3	1	1	5
180									2			2	2			2
170									2			2	2			2
160									1			1	1			1
150									2			2	2			2
140									2			2	2			2
130										1		1		1		1
120									2			2	2			2
110									2			2	2			2
100									6	3	3	12	6	3	3	12
90									1			1	1			1
82									2			2	2			2
80											1	1			1	1
75											1	1			1	1
60											3	3			3	3
52									1			1	1			1
50					1			1	1	3	2	6	2	3	2	7
40					4	1	1	6		1		1	4	2	1	7
36					1			1					1			1
35					2			2					2			2
30					4			4	1	1	1	3	5	1	1	7
29					1			1					1			1
28					1	1		2	1			1	2	1		3
26					2			2					2			2
25			1	1	1			1			1	1	1		2	3
24					2			2					2			2
22					1			1			1	1	1		1	2

TABLE 4 (Continued)

Number of Hours	Student Pilots				Private Pilots				Instructor				All Pilots			
	Bedford	Nashville	Westchester	Total	Bedford	Nashville	Westchester	Total	Bedford	Nashville	Westchester	Total	Bedford	Nashville	Westchester	Total
20	6	2	3	11	1	4	2	7	1	1	1	3	8	7	6	21
19	3			3	2			2					5			5
18	4		2	6	1			1	1			1	6		2	8
17	3			3	1			1					4			4
16	1	1		2	3			3					4	1		5
15		1	2	3	1		3	4	2		4	6	3	1	9	13
14			1	1			1	1							2	2
13	3		1	4	1			1					4		1	5
12		1	3	4	1		2	3					1	1	5	7
11	6	2	1	9			1	1					6	2	2	10
10	6	8	7	21	3	3	2	8	1		5	6	10	11	14	35
9	3			3			1	1					3		1	4
8	1	1	2	4			1	1					1	1	3	5
6	2		2	4	2		1	3			1	1	4		4	8
5		5		5	2	5	1	8					2	10	1	13
4		1	3	4	1			1			1	1	1	1	4	6
3			4	4	2		2	4			1	1	2		7	9
2			1	1		1		1	1			1	1	1	1	3
1					3		1	4					3		1	4
0					2			2	2	1		3	4	1		5
Total	38	22	33	93	46	15	19	80	40	12	29	81	124	49	81	254

craft. The private pilots apparently fly other models and makes of aircraft, and so do the instructors. The distributions in Table 4 are roughly similar from center to center. It is apparent from Table 4 that the pilots were familiar with the airplane used in the flight examination, nearly all of their recent flight experience having been in airplanes of the same make and model.

Most of the pilots had their first solo flight experience in fairly recent times. Table 5 shows how pilots were distributed as regards the calendar year in which their first solo flight occurred. Most of the student pilots first soloed during the calendar year of the examination flight, and except for one case for which there is no record, all the students are reported to have experienced their first solo flight as recently as 1944. All of the students at Bedford and Nashville are included in the range 1946-1947. The private pilots also are of fairly recent origin for the most part, nearly all of them having first soloed in either 1946 or 1947. At the Bedford center there were four examinees who had soloed prior to 1938, but aside from these and a few others at the other centers, the private pilots had their first solo flight experience after the year of Pearl Harbor. The instructors were, of course, the old hands at the flying business, only one having first soloed as recently as 1946, while the rest distributed themselves over all the preceding years back to 1933, one having first soloed as early as 1918.

The students ranged in age from 16 to 55 years (as of their last birthday) with a median of 24. Most of the oldsters among the students came from Nashville and Westchester, the latter accounting for the three oldest, aged 46, 49, and 55. The oldest student flown at Bedford was only 36. Table 6 presents the distribution of examinees by ages as of last birthday.

The private pilots also scattered widely as to age, ranging from 18 to 51 with a median of 26. The scatter of ages was quite pronounced at all centers, although Nashville flew no private pilots older than 37.

The instructors ranged in age from 21 to 51 with a median of 27.

All of the instructors had CAA instructor ratings with either commercial or transport pilot certificates. Thirty-one of the instructors reported that they held instrument ratings. These were nearly all at Bedford and Westchester, only two instructors at Nashville reporting that they held instrument ratings.

Most of the flights were made in the middle of the day or in the afternoon hours, although some were made as early as nine o'clock in the morning (to the nearest hour), as can be seen from Table 7, which shows a distribution of the flights by type of pilot, examining center, and time of day. While some flights were conducted as late as eight o'clock in the evening, the median flight was started between one and two o'clock in the afternoon, so that if conditions of turbulence make a great deal of difference in the performance of subjects taking such an examination, we may expect these flights to show it, since they were nearly all given late in the day, after the turbulence had had a chance to develop.

TABLE 5

PILOTS WHO FLEW THE FAMILIAR AIRPLANE DISTRIBUTED BY TYPE OF PILOT, EXAMINING CENTER, AND CALENDAR YEAR OF FIRST SOLO FLIGHT

Year	Student Pilots				Private Pilots				Instructors				All Pilots			
	Bedford	Nashville	Westchester	Total	Bedford	Nashville	Westchester	Total	Bedford	Nashville	Westchester	Total	Bedford	Nashville	Westchester	Total
1947	33	18	16	67	18	4	4	26					51	22	20	93
1946	5	4	12	21	19	9	6	34		1	1	2	24	14	19	57
1945			2	2	2	1	4	7					2	1	6	9
1944			2	2	1		3	4	1	1	3	5	2	1	8	11
1943									7		7	14	7	-	7	14
1942									9	1	2	12	9	1	2	12
1941					2		1	3	1	2		3	3	2	1	6
1940							1	1	8	1	5	14	8	1	6	15
1939									3	2	2	7	3	2	2	7
1938						1		1	3	1	2	6	3	2	2	7
1937					1			1	1	1	1	3	2	1	1	4
1936					1			1	2		1	3	3	-	1	4
1935											1	1			1	1
1934									1		1	2	1		1	2
1933					1			1	1	1		2	2	1		3
1932																
1931																
1930											2	2			2	2
1929											1	1			1	1
1928																
1927									2			2	2			2
1923					1			1					1			1
1918										1		1		1	-	1
Total	38	22	32	92	46	15	19	80	39	12	29	80	123	49	80	252
No Record	-	-	1	1					1			1	1		1	2

TABLE 6

DISTRIBUTION OF PILOTS WHO FLEW THE FAMILIAR AIRPLANE, BY TYPE OF PILOT, EXAMINING CENTER, AND AGE AS OF LAST PRECEDING BIRTHDAY

Age	Student Pilots				Private Pilots				Instructors				All Pilots			
	Bedford	Nashville	Westchester	Total	Bedford	Nashville	Westchester	Total	Bedford	Nashville	Westchester	Total	Bedford	Nashville	Westchester	Total
55			1	1											1	1
54																
53																
52																
51							1	1		1		1		1	1	2
50																
49			1	1											1	1
48																
47					1			1					1			1
46			1	1											1	1
45									1			1	1			1
44									1		1	2	1		1	2
43		1		1										1		1
42					1			1					1			1
41					1			1					1			1
40							1	1	1		1	1	1		1	2
39			1	1	1			1		1	2	3	1	1	3	5
38			1	1	1			1					1		1	2
37		1		1	1	3		4		1		1	1	5		6
36	1			1	1	1		2	2		2	4	4	1	2	7
35		1		1										1		1
34	1			1	1			1	1		1	2	3		1	4
33	1	1		2	1		1	2	1	1	1	3	3	2	2	7
32	2			2		1	1	2	2			2	4	1	1	6
31		2	1	3	2	1	1	4	1	1	2	4	3	4	4	11
30	1			1		1	1	2	1		2	3	2	1	3	6
29	1	1	3	5	1			1	2		1	3	4	1	4	9
28	3		1	4	5			5	3	2	3	8	11	2	4	17
27	1	1	2	4	2	3	1	6	1	1	2	4	4	5	5	14
26	2	2	2	6	4	1	2	7	4	2	5	11	10	5	9	24

TABLE 6 (Continued)

Age	Student Pilots				Private Pilots				Instructors				All Pilots			
	Bedford	Nashville	Westchester	Total	Bedford	Nashville	Westchester	Total	Bedford	Nashville	Westchester	Total	Bedford	Nashville	Westchester	Total
25	4	-	3	7	3	-	2	5	4	2	-	6	11	2	5	18
24	2	1	2	5	4	-	2	6	6	-	2	8	12	1	6	19
23	6	1	2	9	3	-	-	3	8	-	2	10	17	1	4	22
22	2	1	4	7	4	-	2	6	1	-	1	2	7	2	7	16
21	1	3	5	9	3	-	2	5	-	-	1	1	4	3	8	15
20	5	4	1	9	5	2	1	8	-	-	-	-	10	6	1	17
19	3	2	1	6	-	1	1	2	-	-	-	-	3	3	2	8
18	-	-	1	1	1	-	-	1	-	-	-	-	1	-	1	2
17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16	1	-	1	2	-	-	-	-	-	-	-	-	1	-	1	2
Total	37	22	33	92	46	15	10	80	40	12	28	80	123	49	80	252
No Record	1	-	-	1	-	-	-	-	-	-	1	1	1	-	1	2

FLIGHT EXAMINATIONS IN THE FAMILIAR AIRPLANE DISTRIBUTED BY TYPE OF PILOT, EXAMINING CENTER, AND TIME OF DAY

Hour of Flight*	Student Pilots				Private Pilots				Instructors				All Pilots			
	Bedford	Nashville	Westchester	Total	Bedford	Nashville	Westchester	Total	Bedford	Nashville	Westchester	Total	Bedford	Nashville	Westchester	Total
9	-	3	3	6	-	-	-	-	-	-	3	3	-	3	6	9
10	1	1	5	7	1	-	1	2	1	2	2	5	3	3	8	14
11	6	1	-	7	3	2	1	6	4	2	1	7	13	5	2	20
12	4	1	1	6	7	1	-	8	8	-	2	10	19	2	3	24
13	8	2	3	13	6	2	-	8	8	1	2	11	22	5	5	32
14	8	3	2	13	12	5	3	20	10	4	3	17	31	12	8	51
15	5	5	3	13	8	2	2	12	6	1	3	10	19	8	8	35
16	3	2	2	7	3	3	3	9	2	2	4	8	10	5	9	24
17	1	1	5	7	2	1	1	4	1	-	1	2	4	2	7	13
18	2	3	4	9	1	1	3	5	-	-	3	3	3	4	10	17
19	-	-	4	4	-	-	2	2	-	-	4	4	-	-	10	10
20	-	-	1	1	-	-	3	3	-	-	1	1	-	-	5	5
Total	38	22	33	93	46	15	19	80	40	12	29	81	124	49	81	254

*Hours indicated as on 24-hour clock.

Most of the flights were made under conditions of moderate turbulence. Table 8 shows the 254 flights distributed by type of pilot, examining center, and degree of turbulence reported by the check pilot. As can be seen from this table, the student pilots had somewhat better conditions of turbulence than the other two classes, inasmuch as 25 of the 93 student pilots flew during conditions reported as no turbulence, while a smaller proportion of the private pilots and of the instructors had this advantage. The check pilot at Westchester reported less turbulence than did the check pilots at the other centers, but there does not seem to be enough differences between the centers to warrant a separate tabulation of the examination records, especially since the report of turbulence from Westchester is made by a check pilot different from the ones who made the reports at the other centers, and the apparent difference has not been corrected for any difference of judgment on the part of the reporter as to what is to constitute negligible turbulence, moderate turbulence, or severe turbulence.

Most of the flights were made under visibility conditions which allowed the horizon to be seen, either distinctly or indistinctly. Table 9 presents a tabulation of the reports on this feature of the flight conditions. In 11 cases no report was made of this feature, so that only 243 reports are analyzed in the table. It will be seen that only 24 of the flights, or approximately 10%, were made under conditions of no horizon. It will be observed that the Westchester center reported consistently better conditions of visibility, and since this center also reported better conditions as regards turbulence (see Table 8), the examinees at Westchester might have had a better opportunity to make a good showing than those at other centers. Notwithstanding this possibility, the data were combined for all centers in order to present an over-all picture in the tables which follow.

The flight examinations lasted from 25 minutes to an hour, depending upon conditions which prevailed at the time. Table 10 shows the distribution of examination flights in terms of time taken for each flight, to the nearest five minutes. The median student pilot examination took 35 minutes, and this is also the figure for private pilots, but the median instructor examination lasted only 30 minutes. The Nashville center managed its examinations in somewhat shorter periods of flight than did the other centers, presumably because the Nashville field was relatively small and had relatively little commercial traffic in and out of it, so that it was not necessary to go so far from the field to find a suitable area in which to perform the maneuvers.

RESULTS: FAMILIAR PLANE

Assigned Maneuvers

The total number of lights lit by various classes of pilots in all of the 11 assigned maneuvers[3] is tabulated in Table 11.[4] The "6" at the top of

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[3] The data for the separate maneuvers are given in Table 16, also in Tables 1A through 10A, Appendix A.

[4] All the tabular work in the preparation of this report has been under the direction of Mr. David V. Tiedeman, Teaching Fellow in Education at Harvard University.

TABLE 8

EXAMINATION FLIGHTS IN THE FAMILIAR AIRPLANE DISTRIBUTED BY TYPE OF PILOT, EXAMINING CENTER, AND DEGREE OF TURBULENCE

Degree of Turbulence	Student Pilots				Private Pilots				Instructors				All Pilots			
	Bedford	Nashville	Westchester	Total	Bedford	Nashville	Westchester	Total	Bedford	Nashville	Westchester	Total	Bedford	Nashville	Westchester	Total
----	9	1	-	10	14	-	-	14	14	3	-	17	37	4	-	41
----	26	20	12	58	26	15	10	51	25	8	17	50	77	43	39	159
or no	3	1	21	25	4	-	9	13	1	1	12	14	8	2	42	52
	38	22	33	93	44	15	19	78	40	12	29	81	122	49	81	252
ort	-	-	-	-	2	-	-	2	-	-	-	-	2	-	-	2

TABLE 9

EXAMINATION FLIGHTS IN THE FAMILIAR AIRPLANE DISTRIBUTED BY TYPE OF PILOT, EXAMINING CENTER, AND DISTINCTNESS OF HORIZON

Appearance of Horizon	Student Pilots				Private Pilots				Instructors				All Pilots			
	Bedford	Nashville	Westchester	Total	Bedford	Nashville	Westchester	Total	Bedford	Nashville	Westchester	Total	Bedford	Nashville	Westchester	Total
Absent	5	-	8	13	3	-	3	6	2	1	2	5	10	1	13	24
Vague	13	17	7	37	22	11	4	37	22	5	6	33	57	33	17	107
Distinct	16	5	17	38	15	4	12	31	16	6	21	43	47	15	50	112
Total	34	22	32	88	40	15	19	74	40	12	29	81	114	49	80	243
No Report	4	-	1	5	6	-	-	6	-	-	-	-	10	-	1	11

TABLE 20

DISTRIBUTION OF PILOTS WHO FLEW THE FAMILIAR AIRPLANE, BY TYPE OF PILOT, EXAMINING CENTER, AND NUMBER OF MINUTES OF EXAMINATION TIME

Number of Minutes	Student Pilots				Private Pilots				Instructors				All Pilots			
	Bedford	Nashville	Westchester	Total	Bedford	Nashville	Westchester	Total	Bedford	Nashville	Westchester	Total	Bedford	Nashville	Westchester	Total
60	-	-	-	-	-	-	-	-	-	-	1	1	-	-	1	1
55	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
50	-	-	1	1	-	-	-	-	-	-	-	-	-	-	1	1
45	5	-	5	10	4	-	2	6	1	-	-	1	10	-	7	17
40	15	2	11	28	16	-	7	23	12	2	5	19	45	4	23	72
35	13	6	9	28	13	5	5	23	11	5	2	18	37	16	16	69
30	5	10	6	21	11	8	5	24	13	2	21	36	29	20	32	81
25	-	2	-	2	-	2	-	2	3	2	-	5	3	6	-	9
Total	38	20	32	90	46	15	19	80	40	11	29	80	124	46	80	250
No Record	-	2	1	3	-	-	-	-	-	1	-	1	-	3	1	4

the left-hand column of this table and in succeeding tables is to be read as indicating that the airplane was stalled. There were only five lights in the airplane, so that the digit 6 is used in the table to indicate that the examinee went too far and actually stalled the airplane, contrary to the instructions he had been given, which were to come as close as he could to stalling the airplane, but not to stall it. In 82 cases out of 2,785 observations, the examinee went too far and actually stalled the airplane. This was done mostly by students and privates, only three instructors committing an actual stall. Apparently the instructors are quite successful in avoiding the stall as compared to the students or the private pilots. However, in their intended approaches to the stall, a large number of them (324) stopped at three lights instead of the optimum four or five lights. In some maneuvers the optimum number of lights was four and in some others it was five, but in no case was the optimum number three. Yet three lights is just where the instructors stopped more often than anywhere else, and is also where the privates stopped more often than anywhere else, and also where the students stopped more often than anywhere else. Furthermore, 53 records of instructors' attempts indicate only two lights lit, while in 15 cases only one light was lit when the instructor thought he was on the edge of a stall. These 68 cases of instructors who lit either one or two lights surely do no credit to the instructors' recognition of the stall in the airplane in which he has been giving instruction and in which he has just recently been flying. It will be remembered that the median instructor had flown this very make and model of airplane 75 hours during the 90 days preceding the examination flight. The stall approaches were all made at a safe altitude, so that it cannot be claimed as a defense of these instructors that they were avoiding any hazard in failing to reach the verge of the stall. All these instructors must teach recovery from stalls as a routine matter, and the only penalty for stalling the airplane would have been that the instructor would have been required to make a routine recovery afterward. About the only conclusion that can come out of the instructor column of Table 11 is that instructors by and large do not know where the edge of the stall is, in the very airplane they use every day in teaching students to fly.

The student pilots do just about what the instructors do, but are not so good at it. Eighteen attempts of the students resulted in their lighting no lights at all when the students thought they were on the edge of the stall. Forty-six attempts yielded only one light lit, and 129 only two lights lit. These 193 intended stall approaches can hardly be called stall approaches at all, since one or two lights were commonly lit by the best pilots in normal flight through turbulent air, and the lighting of this number cannot be considered a stall approach. Thus nearly 20% of the students' attempts at a stall approach got practically nowhere, even though these attempts were made in the same make and model of airplane the student had been using for his solo flight, as well as for his flight lessons when flying dual.

The private pilots did a little better than the students, and again did just about what the instructors did, but didn't do it as well. Apparently these private pilots had learned to fly from just about the same kind of instructors as the ones whose performances are tabulated in Table 11, since they follow

along with them very nicely, but aren't quite as skilful as the instructors themselves. Thirty-one of the private pilots went so far as to stall the airplane contrary to the instructions they had received, while at the other end of the scale, 11 private pilots thought they were on the edge of the stall when there were no lights lit whatever. A total of 156 attempted stall approaches by private pilots resulted in lighting no more than two lights, so that more than one-sixth of all of the attempted stall approaches by private pilots got nowhere near the stall.

Table 11 answers one of the questions which the investigation started out to answer, and the answer is no, the typical pilot does not do a good job of recognizing the incipience of the stall, even in the very airplane with which he is familiar through recent experience. And this answer applies not only to student pilots and to private pilots, but to the instructors themselves.

Gliding Turns. A good many of the bad approaches to the stall were made during the gliding turns. Table 12 presents the combined data from all four gliding turns. Thirty-four approach attempts resulted in actually stalling the airplane, and 76 more resulted in lighting five lights, which is a performance regarded as undesirable by all of the check pilots, since in this maneuver only four lights can be lit without incurring at least the beginning of an actual stall, even though five lights can be lit without incurring the necessity for the standard stall recovery. To put it another way, the pilot can return to normal flight after lighting five lights by simply releasing back pressure on the stick, but if he does not do it immediately, the airplane will go into the stall. Or to put it still another way, the airplane cannot be flown with five lights lit. Something must be done. If the pilot doesn't do anything, the airplane will.

In these gliding turns the modal instructor lit only three lights instead of the optimum four. In seven attempts at a stall approach, the instructors actually lit only one light, and in 21 more, only two lights were lit, making a total of 28 attempts out of 324 which must be regarded as more or less completely abortive. Of course the gliding turn is the maneuver used to make the last turn into the field and is the one which has become famous as the prologue to a fatal stall. Yet many instructors' attempts to recognize the stall in a deliberate stall approach during the gliding turn resulted in the instructor's failure to label the stall incipience correctly, even in the very airplane in which he has been giving instruction more or less continuously during the preceding 90 days.

Apparently the students do just what their instructors have shown them to do, except they don't do it quite as uniformly as the instructors do. Twenty-one students' attempts resulted in actually stalling the airplane, and 30 more resulted in lighting five lights, which is a definitely hazardous condition of flight, so that 51 out of 371 attempts resulted in going too far. More students stopped at three lights than at any other number, just as the instructors did, and just about as many (57) failed to light more than two lights as went too far and actually stalled the airplane. The 51 who went too far combined with the 57 who got nowhere near the stall constitute more than one-quarter of all of the students' attempts.

TABLE 11

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS IN ATTEMPTING STALL APPROACHES IN ALL ASSIGNED MANEUVERS

Number of Lights Lit	Type of Pilot			All Pilots
	Student	Private	Instructor	
6*	46	31	3	82
5	151	159	225	535
4	235	223	271	729
3	389	309	324	1022
2	129	94	53	276
1	46	51	15	112
0	18	11	-	29
Total	1016	878	891	2785
No observation	7	2	-	9

* The figure 6 means that the airplane was stalled.

TABLE 12

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS IN ATTEMPTING STALL APPROACHES IN FOUR GLIDING TURNS

Number of Lights Lit	Type of Pilot			All Pilots
	Student	Private	Instructor	
6*	21	12	1	34
5	30	24	22	76
4	97	93	110	300
3	166	144	163	473
2	44	37	21	102
1	10	9	7	26
0	3	1	-	4
Total	371	320	324	1015
No observation	1	-	-	1

* The figure 6 means that the airplane was stalled.

The private pilots are apparently slightly older versions of the same kind of students. More stopped with three lights than with any other number, 12 attempts resulted in stalls, and 24 in lighting five lights, making 36 attempts which were carried too far, or something over 10%. One private pilot's attempt to stall resulted in lighting no lights whatever. A total of 47 attempts resulted in lighting no more than two lights. These, combined with the 36 who went too far, make a total of 83, which again is more than one-quarter of the total number (320) of attempts.

The only conclusion possible from Table 12 is that the typical pilot doesn't know where the stall takes place in the gliding turn, even in the very airplane with which he is familiar, has taken lessons or given instruction, and in which he has had recent flight experience.

The results for the separate gliding turns are very much the same as for the combination of all four gliding turns. Tables showing the results from the gliding turns separately are presented in an appendix.[5]

Climbing Turns. The typical instructor does a great deal better in recognizing the incipience of a stall when it occurs in a climbing turn than he does when it occurs in a gliding turn. Unhappily, however, this typical instructor who does so much better is not very typical. Table 13 shows the results from 508 attempts to approach, but avoid, the stall out of a climbing turn. In these attempts the instructors are visibly better than their students, and better than the private pilots. Since it was possible to light five lights without actually stalling the airplane, we must allow that the 51 instructors who did so were reaching the exact point they were asked to reach, or at least we must admit that they could have interpreted the instructions that way, although actually the airplane wing has already started to lose its lift when the fifth light goes on. Another 58 instructors' attempts resulted in lighting four lights, which must be credited as a good performance as well, making 109 attempts out of 162 for the instructors which must be called good performances. Unhappily, a lot of instructors failed to find the edge of the stall, 38 of them stopping with only three lights and a total of 14 of them failing to light more than two. Two attempts by instructors resulted in having one light lit when the instructor thought he was on the very edge of stalling. Since the stall out of a climbing turn is a deliberate maneuver, obviously at variance with normal flight procedure, there is no good reason which can be adduced to explain even as few as two attempts at stall approaches by instructors which resulted in lighting only one light each time. So it must be concluded from Table 13 that though the instructors are better at recognizing the stall in a climbing turn than in certain other maneuvers, they are still not up to what is commonly expected of instructors, especially by the instructors themselves.

In the climbing turn, the students and private pilots do not follow the instructors as faithfully as was the case for the gliding turns. A total of 52 students either lit five lights or stalled the airplane. The 11 who

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[5]The data for the separate maneuvers are given in Tables 3A, 6A, 8A, and 10A in Appendix A.

TABLE 13

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS IN ATTEMPTING STALL APPROACHES IN TWO CLIMBING TURNS

Number of Lights Lit	Type of Pilot			All Pilots
	Student	Private	Instructor	
6*	11	6	1	18
5	41	35	51	127
4	43	41	58	142
3	58	49	38	145
2	23	20	12	55
1	4	8	2	14
0	6	1	-	7
Total	186	160	162	508

* The figure 6 means that the airplane was stalled

stalled the airplane went demonstrably and obstreperously too far. The 41 who lit five lights went too far in the sense that even with such objective equipment in the airplane, an instructor does not want the student to carry the stall approach as far as lighting five lights indicated in this installation. At the other end of the scale, six attempts by students resulted in lighting no lights at all when the students thought they were just about to break into a stall. Four other attempts resulted in lighting one light, and 23 others resulted in lighting only two. Thus 33 attempts by students resulted in lighting no more than two lights, so that more than one-sixth of all the students' attempts resulted in getting nowhere near the stall. These 33 combined with the 52 who went too far make a total of more than half of the students' attempts, so even if one were to include lighting three lights as an acceptable performance (because of the desirability of the students' staying some little distance off from the actual stall incipience) we could credit less than half of the students' attempts as satisfactory. It must be remembered that these attempts were made in the same airplane the student had taken lessons in and had flown recently in solo flight under the direction of an instructor.

The private pilots did distinguishably better than the student pilots in the climbing turn, but they still did not do well. More of them stopped with three lights than with any other number. Six approach attempts by private pilots resulted in actually stalling the airplane, and 35 more resulted in lighting too many lights. One attempt by a private pilot resulted in lighting no lights at all, eight more resulted in lighting only one light, and 20 more resulted in lighting only two, making a total of 29 attempts which would be regarded as being very feeble indeed. This number is more than one-sixth of the total number (160) of attempts.

Student pilots and private pilots do not do a very good job of recognizing the incipience of a stall in the climbing turn.

Steep Turns. The instructors exhibited still greater superiority over the students and the private pilots when they attempted the stall approach in a steep turn, as is employed in the 720° turn required as a maneuver in the CAA flight examination. Table 14 shows the combined results from stall approaches in two such steep turns, one to the left and one to the right.[6] No instructor stalled the airplane, and more of them lit five lights than lit any other number. The installation was such that in this condition of flight, five lights could be lit by the reasonably skillful pilot, following which he could make a normal recovery from the turn without any necessity for recovering from even a partial stall of the airplane wing. Since this is the case, there is little which can be said for the two instructors' attempts which resulted in lighting only one light each time, and hardly more of a defense can be offered in the case of the eight other attempts which resulted in lighting only two lights. Indeed the 22 attempts which resulted in lighting only three lights must be called sadly deficient as a stall approach, and this makes 32 attempts out of 162, which is more than one-fifth of all the attempts. So again the typical instructor does a very good job of recognising the stall during a steep turn, but the typical instructor is unhappily not very typical.

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[6] The data for the separate maneuvers are given in Tables 4A and 9A in Appendix A.

TABLE 14

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS IN ATTEMPTING STALL APPROACHES IN TWO STEEP TURNS

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	8	6	-	14
5	63	62	102	208
4	35	21	28	84
3	48	25	22	95
2	21	13	8	42
1	16	21	2	41
0	7	9	-	16
Total	180	158	162	500
No observation	6	2	-	8

*The figure 6 means that the airplane was stalled.

The student pilots have apparently not been taught the stall in the steep turn. More of them stop at three lights than go on to light five, which is the optimum number. In the case of seven attempts by students, no lights were lit at all when the student thought he was on the edge of a stall. In 18 more cases, only one light was lit, representing practically normal flight in this maneuver. The total number of instances in which no more t three lights were lit was no less than 94, which is more than half of the total number (180) of attempts.

The private pilots do little better. Six of them went too far and stalled the airplane, although this is rather difficult to do in an airplane of such light wing loading and small horsepower. In the case of nine private pilots' attempts, no lights were lit at all when the pilot thought he was on the verge of stalling. In 21 more cases only one light was lit, and in 13 more cases only two. The total number of cases in which no more than three lights were lit was 68, which is between one-third and one-half of the total number of attempts. The most that could be said for the private pilot is that, like the instructor, the modal pilot performs the stall approach in t steep level turn correctly, but the modal pilot is not very common.

Student pilots and private pilots don't know where the stall occurs in the steep turn.

Table 14 calls attention to an unhappy discovery which was made by the examining pilots. As can be seen in the table, there were eight cases of "no observation," six of these coming from students and two from private pilots. The check pilots had trouble getting the examinees in the student and pri classes to maintain a steep turn at altitude long enough to make an attempted stall approach out of it. Instead of holding the turn and then entering a stall approach, the student pilot would either fail to establish a steep turn or, having barely established it, would go into a tight spiral at excessive air speed. One student at Bedford candidly announced that he did not wish to try a steep turn, and one private pilot, also at Bedford, went into a tight spiral at 125 miles an hour. This same pilot handled the airplane so badly that the check pilot took over after the last turn into the field and made the landing himself. The flight was made under conditions of moderate turbulence and good visibility.

Straight Flight. In attempting the stall approach straight ahead, with cruising power or with climbing power, the private pilots and the ins tors both excelled the student pilots. The data are presented in Table 15, from which it can be seen that all pilots as a whole concentrate at three lights slightly more than at any other number.[7] Most of the instructors lit either four or five lights, the total for these two numbers of lights being 107, or more than one-half the 162 attempts. The case of the instructor who stalled the airplane may be forgiven on the grounds of possibly tur-

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[7]The data for the separate maneuvers are given in Tables 1A and 7A in Appendix A.

TABLE 15

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS IN ATTEMPTING STALL APPROACHES STRAIGHT AHEAD, ONCE WITH CRUISING POWER, AND ONCE WITH CLIMBING POWER

Number of Lights Lit	Type of Pilot			All Pilots
	Student	Private	Instructor	
6*	7	6	1	14
5	34	34	48	116
4	40	51	59	150
3	66	49	46	161
2	26	12	5	43
1	11	8	3	22
0	2	-	-	2
Total	186	160	162	508

* The figure 6 means that the airplane was stalled.

bulent conditions, but hardly any defense of this kind can be advanced for the eight cases of instructors' attempts which yielded no more than two lights lit. Consider, for example, the three cases in which only one light was lit. The stall with power on is one of the standard CAA curriculum maneuvers, and these instructors have been teaching this maneuver in the same make and model of airplane as was used for the examination. They have recent flight experience in this particular make and model of airplane. Turbulence would cause more lights to light, not fewer. It seems therefore practically inexcusable that as many as three attempts by instructors to approach the stall straight ahead with power on should result in lighting only a single lamp out of the five. Hardly more can be said for the five additional cases in which only two lights were lit.

The private pilots did a little better than the student pilots in recognizing the stall when flying straight ahead with power on. The modal private pilot lit four lights, which must be credited as an optimum performance, but unhappily six of them went too far and stalled the airplane, while a total of 20 succeeded in lighting no more than two lights.

In the case of two students' attempts at the stall approach, no lights whatever were lit. In the case of 11 more attempts, only one light was lit, and in the case of 26 more only two lights were lit. This makes a total of 39 (or more than one-fifth of all attempts) in which the stall was nowhere near approached. At the other end of the scale, it must be pointed out that 41 of the students went too far. Seven of them actually stalled the airplane, and 34 of them lit more lights than their instructors want them to light in stall approaches.

It appears that even with a familiar airplane in a familiar maneuver in which the stall is familiarly practiced and included as a standard part of the flight curriculum of the Civil Aeronautics Administration, pilots do not know where the stall occurs.

In the stall approach straight ahead with power off, still more disheartening results are obtained. The data are presented in Table 16. The stall approach straight ahead with power off is a CAA curriculum maneuver. The instructors in this tabulation have been teaching this maneuver in this same make and model of airplane every flyable day in the recent past. And yet the scores in Table 16 indicate no clear superiority for the instructors over either the students or the privates, but indicate instead that the students are doing just what their instructors have shown them, and the privates are doing just what they learned to do when they were students. Nearly three-quarters of all the instructors stopped with only three lights lit, in spite of the fact that two of them have demonstrated in the same series of examinations that five lights can be lit without stalling the airplane. (Even so, this is not regarded as the optimum performance for any other than an instructor-pilot.) This piling up of 73 instructors at the three-lights level is something which simply and undeniably happened. One cannot deny the fact that these instructors simply did not make satisfactory stall approaches, nor that this deficiency was committed in very large numbers.

Can this be the way the stall approach should be taught?

TABLE 16

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS IN ATTEMPTING STALL APPROACH STRAIGHT AHEAD, POWER OFF

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	1	1	-	2
5	3	3	2	8
4	20	17	16	53
3	51	42	55	148
2	15	12	7	34
1	3	5	1	9
0	-	-	-	-
Total	93	80	81	254

* The figure 6 means that the airplane was stalled.

Perhaps the students should be forgiven for following their instructors' demonstrations so slavishly. Still, it is a little disturbing to find three of them lighting only one light when they think they are about to stall the airplane. On the other hand, this is no more disturbing than the single occasion on which an instructor actually had only one light lit when he thought the airplane was about to break into a stall. So perhaps we should dwell not too long on the behavior of the students and the private pilots as exhibited in Table 16, but only point again with dismay at the performance of these purported paragons, the flight instructors, in their own curriculum maneuvers, in their own familiar airplanes!

Unassigned Maneuvers

Table 17 presents a two-way distribution of 5,529 observations on the number of lights lit during the times before and after and the times between the performances of the stall approaches in the 11 assigned maneuvers.[8] It will be seen that most of the observations report no lights lit, and of the remainder most show only one or two lights lit. The installation was such that one or two lights might be lit for short periods in normal flight through turbulent air. It is not reasonable to ascribe the lighting of three lights to turbulence, however, except when the turbulence is combined with improper action of the pilot. Nevertheless there are five occasions on which instructors have as many as three lights lit. There are five other occasions on which students have as many as three lights lit. The private pilots make a still worse showing in this regard, eight occasions appearing in which three lights were lit, and two in which no fewer than four were lit. The installation was such that the lighting of four lights during any of the 23 periods during which these observations were made indicated a very near approach to the stall. We have here, then, two occasions on which private pilots were observed in an inadvertent stall approach. This table answers the second question which this investigation undertook to answer. Pilots do occasionally approach the stall inadvertently and do frequently fly in such a way that their deviation from normal is in the direction of an approach to a stall.

Clearing Turns. Apparently the clearing turn is a relatively safe maneuver. If the turn was a gentle one, four lights could be lit without stalling the airplane, and if the turn was a very tight one at a steep bank with full power, it was possible to light five lights without stalling the airplane. As can be seen in Table 18, no pilot lit more than three lights in his clearing turns,[9] and the big pile-up of pilots in all three classes is in the no-light-lit category. Relatively few pilots lit as many as two lights, and these might be accounted for by turbulent conditions.

Intervening Maneuvers. There were seven pairs of maneuvers between the two members of which observations were made of the number of lights lit. Table 19 presents the results for all seven of these observations.[10] From this

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[8] The data for the separate observations are given in Tables 21 through 25 and Tables 11A through 28A in Appendix A.

[9] The data for the separate observations are given in Tables 11A, 12A, 14A, 15A, 17A, 18A, 20A, and 21A in Appendix A.

[10] The data for the separate observations are given in Tables 22A through 28A in Appendix A.

TABLE 17

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS DURING ALL 23 UNASSIGNED MANEUVERS

Number of Lights Lit	Type of Pilot			All Pilots
	Student	Private	Instructor	
6*	-	-	-	-
5	-	-	-	-
4	-	2	-	2
3	5	8	5	18
2	44	45	20	109
1	393	391	259	1043
0	1577	1308	1472	4357
Total	2019	1754	1756	5529
No observation	120	86	107	313

* The figure 6 means that the airplane was stalled.

TABLE 18

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS DURING EIGHT CLEARING TURNS

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	-	-	-	-
5	-	-	-	-
4	-	-	-	-
3	1	1	1	3
2	13	14	3	30
1	103	109	74	286
0	583	500	540	1628
Total	705	624	618	1947
No observation	39	16	30	85

* The figure 6 means that the airplane was stalled.

TABLE 19

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS DURING SEVEN OBSERVATIONS OF FLIGHT BETWEEN MANEUVERS

Number of Lights Lit	Type of Pilot			All Pilots
	Student	Private	Instructor	
6*	-	-	-	-
5	-	-	-	-
4	-	1	-	1
3	1	2	1	4
2	5	7	2	14
1	47	39	25	111
0	549	476	508	1533
Total	602	525	536	1663
No observation	49	35	31	115

* The figure 6 means that the airplane was stalled.

table it is apparent that one private pilot went so far as to light four lights, indicating that he was on the verge of stalling the airplane. An examination of the record for this pilot indicates that he lit these four lights not while he thought he was flying normally awaiting instructions for the next maneuver, but during his recovery from the stall into which he got himself upon attempting to approach the stall in the preceding scheduled maneuver. Thus this pilot approached a secondary stall at a relatively high speed in the process of his recovery from an inadvertent stall which he committed in attempting to get as near as possible to the stall without actually stalling the airplane.

Four of the pilots lit as many as three lights in a similar way, indicating that the secondary stall which takes place during the recovery from an unusual flight attitude is a definite hazard to the pilot, especially to the student pilot and private pilot.

Some of the many occasions on which either one or two lights were lit seemed to be the result of turbulent conditions, and the others seemed to be the result of the pilot's being slightly disoriented from the preceding maneuver. The instructors appear definitely superior to the other two classes of pilots as regards their recovery from maneuvers, and their intended normal flight while awaiting instructions for the next maneuver. Only three out of 536 observations upon instructors indicated as many as two lights lit. Of the other two classes of pilots, the private seems to be the worst offender, although the difference appearing in our data is perhaps not significant. Nevertheless, in the categories for two, three, and four lights lit, the numbers for private pilots are larger than those for student pilots, even though there is a smaller total number of observations upon private pilots than upon student pilots.

Before maneuvers 3, 5, and 8, the examinee was instructed to climb back up to altitude. This instruction was given whether he had sufficient altitude or not, so that observations could be made upon the number of lights the examinee had lit when he was supposedly engaging in a normal climb. Table 20 presents the data from these observations.[11] From this table it will be seen that a total of six climbs to altitude resulted in lighting as many as three lights at some time during the climb, while 24 more were the occasion for the lighting of two lights. Since the lighting of four lights marked the beginning of stall incipience, it cannot be said that the lighting of three is at all desirable in what is intended as a normal climb. And it is not nice to see the instructors just as guilty of this as the students or private pilots are. The lighting of two lights indicates perfectly safe flight, but it does not indicate the normal climb, and so we have here fairly conclusive evidence that during intended normal climbs all classes of pilots deviate from the normal flight conditions in the direction of a stall approach.

That this is a more or less habitual tendency on the part of these pilots is indicated by the fact that during the climb to altitude preceding the first scheduled maneuver, the pilots behaved in much the same way. This climb was much longer than the other three, since this was the one that followed take-off

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[11] The data for the separate observations are given in Tables 13A, 16A, and 19A in Appendix A.

TABLE 20

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS DURING THREE CLIMBS TO ALTITUDE BETWEEN MANEUVERS

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	-	-	-	-
5	-	-	-	-
4	-	-	-	-
3	2	2	2	6
2	10	9	5	24
1	91	105	68	265
0	158	110	132	400
Total	261	227	207	695
No observation	13	13	36	67

* The figure 6 means that the airplane was stalled.

and was used to gain altitude so that the stall approaches could be safely performed. Table 21 shows a distribution of the numbers of lights lit in this climb. Again the instructors lit practically as many lights as either the students or the private pilots, one instructor having as many as three lights lit during what he was instructed to perform as a normal climb. It has been suggested that the instructors who lit lights during the unscheduled maneuvers must have known what they were doing and more or less deliberately flew in the way they did, but the suggestion contravenes the well known fact that all of these instructors have been giving flight checks as part of their regular jobs, and they are fully aware of what is meant by an examination, especially a flight examination. The instructor who lit three lights on the climb to altitude before the first maneuver was one of those who took the flight examination at Bedford, where the shortest runway is several thousand feet long, and there was no necessity for taking off or climbing at a very high angle of attack, and yet that is just what this instructor did. Much more likely than that the instructor deliberately lit three lights is the explanation that the instructor inadvertently lit three lights, and this leads to the conclusion that this instructor is pretty shaky about his knowledge of what constitutes a normal climb, or else he is pretty sloppy in his flying habits. The fact is, more instructors had one light lit than had none lit, and this was also true of students and of private pilots. It looks as though these people were just naturally climbing more steeply than a normal climb. The ratio of flights made under turbulent conditions to flights made under conditions of no turbulence was not as great as the ratio between the number of pilots having one light lit and the number of pilots having no lights lit in the climb to altitude before the first maneuver.

Return To The Field. It was anticipated that after the last maneuver had been performed, and the examinee had been instructed to return to the field, he would relax and indulge in a lot of sloppy flying, and have a number of lights lit when he was supposed to be in normal flight. That this did not happen is shown in Table 22, which presents the distribution of the numbers of lights lit during the return to the field: after the instruction had been given to return to the field and up until the time of the turn into the traffic pattern, presumably at an angle of 45° to the downwind leg and in the middle third of the leg. No pilot lit more than two lights, and a preponderant number of those in each class lit no lights at all. Of course the return to the field was accompanied by a loss of altitude, so that the airplane was probably flown at a fairly low angle of attack with power on, and this condition of flight clearly militated against the lighting of lights through careless flying. Nevertheless, the fact is that the flying during the return to the field was very safe flying indeed in most cases, the five occasions on which two lights were lit being easily explainable in terms of turbulence.

Traffic Pattern. It was anticipated also that after the examinee had entered the traffic pattern and was subject to distractions caused by other airplanes in the vicinity, together with the necessity for observing the control tower or other traffic direction facility, and planning the final approach, the intended normal flight condition might not be attained, and the examinee might depart from that normal condition in the direction of a stall approach. Table 23 indicates that this did not happen. Instead, all but four of the 249 pilots had either no lights lit or only one light lit, and the ratio of ones to zeros in the numbers of lights lit is smaller than the ratio of turbulent days to calm days for the flight examinations. Even the four pilots who lit two lights apiece in the traffic pattern were still two lights away

TABLE 21

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS DURING CLIMB TO ALTITUDE AFTER TAKE-OFF

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	-	-	-	-
5	-	-	-	-
4	-	-	-	-
3	-	1	1	2
2	9	7	5	21
1	57	52	53	162
0	26	20	20	66
Total	92	80	79	251
No observation	1	-	2	3

* The figure 6 means that the airplane was stalled.

TABLE 22

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS DURING RETURN TO FIELD

Number of Lights Lit	Type of Pilot			All Pilots
	Student	Private	Instructor	
6*	0	0	0	0
5	0	0	0	0
4	0	0	0	0
3	0	0	0	0
2	2	1	2	5
1	17	11	6	34
0	73	66	70	209
Total	92	78	78	248
No observation	1	2	3	6

* The figure 6 means that the airplane was stalled.

TABLE 23

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS IN TRAFFIC PATTERN

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	-	-	-	-
5	-	-	-	-
4	-	-	-	-
3	-	-	-	-
2	2	1	1	4
1	28	25	10	63
0	62	52	68	182
Total	92	78	79	249
No observation	1	2	2	5

* The figure 6 means that the airplane was stalled.

from any incipient stall condition in the airplane.

Final Turn Into Field. Unfortunately this practically ideal state of affairs did not hold during the final turn into the field: the turn which has become so famous as the occasion for a stall accident. Table 24 presents the data and shows that one private pilot was actually on the edge of a stall in this turn while another private pilot had three lights lit and was hard on the heels of his four-light comrade in setting himself up to become a newspaper headline. The rest of the pilots of all classes lit no more than two lights, but even two lights on this last turn into the field are something which might well be avoided. Because of the low altitude at which the turn is made, and the possibility that conditions of turbulence might result in a sudden increase in angle of attack, the pilot would do well to keep his nose down during this turn. And of course there is the further possibility that distractions introduced by the necessity for watching the traffic and planning the final glide might easily induce the pilot to light still more lights if he has already carelessly allowed two of them to come on.

It is true that only one private pilot lit as many as four lights, and only one other lit as many as three. However, these performances should not be dismissed too lightly, for after all the fact is that among 73 more or less unselected observations of the final turn into the field by private pilots, one pilot has been discovered in a definite stall approach during this turn, and another who is very close to it. If even one out of every 73 final turns into the field made by private pilots is going to be accompanied by a stall approach, there are going to be an awful lot of newspaper headlines about airplane accidents.

Final Glide. It was anticipated that the stretching of the final glide might provide an occasion for the pilots' exhibiting inadvertant departures from the normal glide in the direction of a stall approach. Table 25 shows that two pilots, one a student and one a private pilot, lit as many as three lights during the final glide. This is not good, since it indicates a definite departure from the normal glide, and since the instructions were so very clear, and indeed are always so very clear concerning the final glide into the field, that the examinee is to make a normal glide and not a mushy glide and and not a high-speed dive. We must take these two occasions when three lights were lit as meaning inadvertant departures from normal flight in the direction of a stall approach.

No instructor lit more than two lights, and only one lit that many. The private pilots were the worst offenders, a somewhat larger proportion of them lighting lights on the final glide than was the case for the students.

The student pilot who lit three lights on the final glide was one of the ones who took his examination at Nashville, where the field is rather small compared to the Westchester County Airport or Bedford Field in Massachusetts. But the field at Nashville is not small enough to make it necessary to use other than a normal glide in landing. The private pilot who lit three lights on the final glide was one of those who took his examination at the Westchester County Airport, where the shortest runway is several thousand feet long,

TABLE 24

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS DURING LAST TURN INTO FIELD

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	-	-	-	-
5	-	-	-	-
4	-	1	-	1
3	-	1	-	1
2	3	3	1	7
1	29	27	12	68
0	57	41	66	164
Total	89	73	79	241
No observation	4	7	2	13

* The figure 6 means that the airplane was stalled.

TABLE 25

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS DURING FINAL GLIDE

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	-	-	-	-
5	-	-	-	-
4	-	-	-	-
3	1	1	-	2
2	-	3	1	4
1	21	22	11	54
0	64	43	68	175
Total	86	69	80	235
No observation	7	11	1	19

* The figure 6 means that the airplane was stalled.

and there was no occasion for attempting a short-field landing such as might, in a very short field, require a washing glide which would light as many as three lights.

An interesting commentary on the effect of unconscious practice on stall recognition is provided by the fact that the check pilot at Westchester County Airport went up with another check pilot and himself took the flight examination after having flown more than 80 examinees through the test. This check pilot had had 5,500 hours of solo flight experience at that time, 175 of which had been in the preceding 90 days. In this same plane make and model he had flown 110 hours during the preceding 90 days. He was 42 years old, had first soloed in 1929, and held an instrument rating in addition to his instructor's rating. There was no turbulence at the time, and the horizon was dimly visible. In spite of the fact that at least four lights can be lit during any of the scheduled maneuvers without stalling the airplane, this check pilot at no time lit more than three lights. In the right gliding turn and the left gliding turn he lit only two. On his final glide into the field, he lit two lights, so when this check pilot after 80 examinations of experience attempted a stall approach in a right gliding turn (in maneuver number 4 and again in maneuver number 9), he lit no more lights when he thought he was on the verge of stalling than he did when he was making his final glide to a landing after the examination was over! In spite of the fact that he could quite handily light five lights in a steep right turn at altitude and still fly away with a normal turn recovery without employing any stall recovery, his attempts at stall approaches in such steep turns resulted in lighting only three lights each time.

Comments On Individual Examination Records. Some of the individual examination records are rather interesting. A number of student pilots stalled the airplane as many as three times during the examination, proving that they did not learn to avoid the stall, even after having experienced it earlier during the same flight. Two students at Bedford stalled the airplane as many as three times, one of them on maneuvers 1, 3 and 7, and the other during maneuvers 6, 9, and 11. This latter student did this stalling along toward the end of the examination when he had clearly had a substantial amount of practice immediately preceding this behavior. His first stall was out of the right climbing turn and resulted in a spin. Two students at Nashville stalled the airplane on three maneuvers apiece, and one attained four actual stalls. In each case the last stall was well along toward the end of the examination except in the case of the boy who committed the four stalls. His last stall was on maneuver 7, and he did very well in numbers 8, 9, 10, and 11. One student at Westchester committed as many as three stalls, these being in maneuvers 4, 7 and 8, the last of which is pretty well along toward the end of the examination flight. There was no turbulence, but the visibility was very poor, the horizon being altogether absent. No private pilot attained a record of three stalls, and neither did any instructor.

All of the students who committed three or more stalls each during the attempted approaches flew during conditions of lowered visibility, the horizon in each case being reported as vague. It is possible that student pilots are depending entirely too much upon the horizon and the relative attitude of the air-

plane with reference to the horizon, in judging the condition of stall.

One of the student pilots who flew at Bedford stalled the airplane so violently when he attempted the stall approach straight ahead with climbing power that the check pilot was moved to write "Wow!" in the fifth column along with the two double check marks indicating the stall.

That the lights do not need to be lit in normal flight is borne out by the experience of the Westchester pilot who flew the test plane to Miller Field at Nyack, New York. This is a small field with short runways. There he tested an instructor, aged 33 years, with 4,000 total solo flight hours, 70 in the past 90 days, 20 of these in the make and model of plane used in the examination. There was some turbulence, and the horizon was vague. On the take-off, the examinee lit one light, and in the final glide he lit two. The vanes were so adjusted that such a skilled pilot should be able safely to light three lights, and should indeed be able to plan on deliberately doing so. However, only one or two lights were lit during this short-field take-off and landing, despite the turbulence.

One of the students at Nashville exhibited a rather interesting landing pattern. The last four lines on the examination sheet, it will be remembered, were for observations to be made (a) during the return to the field, (b) in the traffic pattern, (c) during the final turn into the field, and (d) during the final glide. During these four conditions of flight, this student had respectively no lights, one light, two lights, and three lights. For the sake of this student, it looks as if he may as well have had two more lines for the observations.

As an experiment to determine something definite about the operation of the vane installation, the Bedford check pilot encouraged one of his friends to perform circles and loops with the test plane in order to see how many lights would light. During each of two loops four lights were lit. During one chandelle three lights were lit, and during the other, two.

An instructor at a neighboring airport ventured to fly the test ship through a series of eight or nine right and left chandelles, eight lights. The horizon was distinct, but the turbulence was quite severe at the time. Thus turbulence does not indicate a desirable lighting of lights unintentionally.

RESEARCH CENTERS

The investigations in the unfamiliar plane were conducted at the Bedford examining center only. Mr. Charles Davis was the check pilot for tests conducted in the unfamiliar plane.

PLANES EMPLOYED

Since the study was planned to include an investigation of the question of how well the typical pilot can recognize the incipience of the stall in an unfamiliar airplane, a Taylorcraft L2M which had been used by the United States Army as a field artillery liaison plane was fitted up for flight examinations at the Bedford center. Photographs of this airplane are presented in Figures 8 and 9. This airplane was chosen because it was similar to the Aeronca Champion, used as the familiar airplane at the Bedford examining center, but nevertheless had flight characteristics, and in particular had stall characteristics, rather markedly different from those of the Aeronca Champion. The two airplanes were similar in the following ways:

1. They are both high-wing monoplanes.
2. They both have conventional landing gear.
3. They are both tandem trainers.
4. In each of them the throttle is operated by the left hand and the control stick is operated by the right hand.
5. Both ships are equipped with heel brakes.
6. Each is equipped with 65 horsepower Continental engine.
7. Each is equipped with a fixed-pitch propeller.
8. Each employs a steerable tail wheel, both similarly mounted and operated.
9. At Bedford Field where both planes are operated both planes are normally soloed from the front seat.
10. Any pilot who under any conditions is permitted by CAA regulations to carry passengers under any set of restrictions in one of the airplanes is permitted legally under the same conditions to carry passengers under the same set of restrictions in the other airplane.

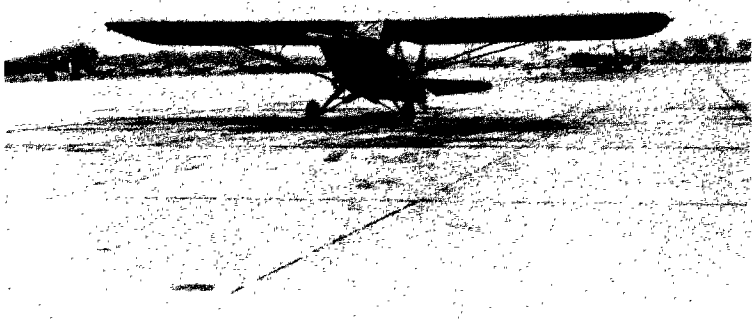

FIGURE 8

FRONT VIEW OF THE "UNFAMILIAR" PLANE (TAYLORCRAFT L2M)

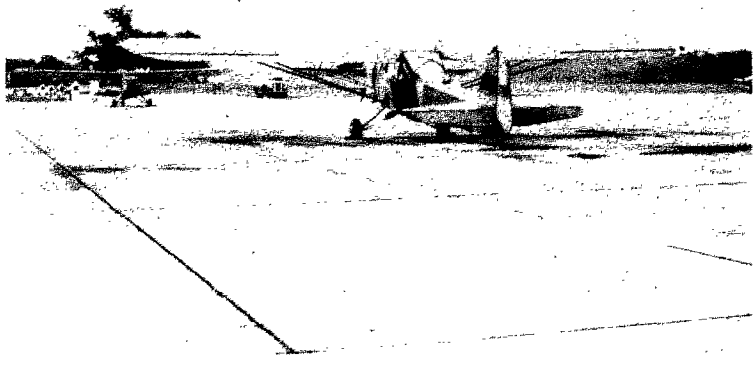

FIGURE 9

REAR VIEW OF THE "UNFAMILIAR" PLANE (TAYLORCRAFT L2M)

The airplanes are dissimilar in the following ways:

1. The Aeronca Champion has slightly more dihedral in the wings.

2. The Taylorcraft had more instruments, being equipped for instrument flight.

3. The Aeronca Champion had a streamlined fuselage behind the wing, whereas the Taylorcraft had a plexiglass enclosure for use by a field artillery observer.

4. The Taylorcraft was noticeably heavier, having a longer take-off run and a slower climb.

5. The lower surface of the wings of the Taylorcraft had negative camber, whereas the lower surface of the wings of the Champion had zero camber. This is probably the most important distinction between the two airplanes, since it largely accounts for the difference in the stall characteristics of the two craft.

6. The Taylorcraft had gussets at the roots of the wing trailing edges.

7. The Taylorcraft had rather softer aileron controls and rather stiffer elevator controls as compared to the Aeronca.

The vane installation and stall recording apparatus was the same as that employed on the familiar plane.

PROCEDURES AND CONDITIONS OF ADMINISTRATION OF CHECK FLIGHTS

The same maneuvers were included in the check flights in the unfamiliar plane as in the check flights in the familiar plane.

The flying of examinees in the unfamiliar airplane was all done between 9 June and 10 July inclusive. The number of examinees flown on various days is shown in Table 26, which shows also that a total of 39 student pilots, 44 private pilots, and 36 instructors were flown, making a total of 119 in all.

The flights were made at almost all hours of the day from before nine o'clock in the morning until seven o'clock in the evening. Table 27 shows a distribution of the flights by hours (to the nearest hour) of the day, hours being labeled on the 24-hour clock. As can be seen from this table, the median time of flight was between one and two in the afternoon. This was true for all types of pilots. On any days on which turbulence developed, some could have been avoided had the flights been conducted at an earlier hour in

NUMBER OF EXAMINATION FLIGHTS IN THE SWEARINGEN AIRPLANE
DISTRIBUTED BY TYPE OF PILOT AND DATE OF FLIGHT

Date	Student Pilots	Private Pilots	Instructors	All Pilots
June 9	-	1	-	1
10	-	2	2	4
11	9	-	-	9
12	-	2	3	3
13	-	0	2	4
14	-	4	1	5
15	-	2	1	3
16	-	2	3	5
17	-	3	4	7
18	4	6	4	8
19	-	-	1	7
20	6	2	-	6
21	3	-	1	6
22	-	-	1	1
23	-	3	1	4
24	-	0	-	-
25	3	0	1	4
26	4	1	2	7
27	3	2	1	6
28	-	-	3	3
29	2	2	1	5
30	-	0	-	-
July 1	2	1	-	3
2	1	3	2	6
3	-	0	0	-
4	1	2	-	3
5	-	1	2	3
6	-	5	-	5
7	-	0	0	-
8	-	0	0	-
9	-	0	-	-
10	1	-	-	1
Total	39	44	36	119

TABLE 27

FLIGHT EXAMINATIONS IN THE UNFAMILIAR AIRPLANE
DISTRIBUTED BY TIME OF DAY AND BY TYPE OF PILOT

Time of Day to Nearest Hour*	Student Pilots	Private Pilots	Instructors	All Pilots
9	3	3	-	6
10	10	8	2	20
11	7	4	5	16
12	2	6	4	12
13	3	4	6	13
14	3	4	9	16
15	2	4	4	10
16	3	6	2	11
17	1	5	3	9
18	4	-	-	4
19	1	-	1	2
Total	39	44	36	119

* Hours are indicated on the 24-hour clock.

the morning, or at a later hour in the afternoon.

Actually the record indicates that only moderate turbulence was encountered in most of the flights. The check pilot was directed to record degree of turbulence in the same way as in the earlier study with the familiar airplane, and on all except four of the flights this was done. Table 28 shows a distribution of the flights by type of pilot and by degree of turbulence, and indicates that nearly all of the flights were done during conditions of what the check pilot regarded as "moderate turbulence."

Most of the flights were made when the horizon was visible, at least vaguely. Table 29 shows the examination flights distributed in accordance with the check pilot's report of the appearance of the horizon. It will be seen that the typical flight was made when the horizon appeared vague, and that this was true for all classes of pilots. Relatively few flights were made under conditions of no horizon. If the examinees appear to do very poorly, they cannot be excused on grounds of poor visibility.

The typical flight examination lasted between 40 and 45 minutes. Table 30 shows the 119 examination flights distributed by type of pilot and by the number of minutes of flight time (to the nearest five minutes) used in the examination. As can be seen from this table, nearly all of the flights took either 40 or 45 minutes, with some taking as long as 50 minutes, and only a few taking as little as 35 minutes, or as much as 55 minutes.

SUBJECTS

As was the case for the investigation using the familiar airplane, it was intended in the unfamiliar airplane study that the student pilots should have logged between 10 and 20 solo hours inclusive and that the private pilots should have logged between 40 and 60 hours inclusive. Table 31 shows a distribution of the pilots by type of certificate and by number of total solo hours, and shows that 3 student pilots had an excess of 20 hours of solo. In spite of their falling outside the intended limits for total solo hours, these three student pilots were included in the tabulation because their examination sheets looked much the same as those of the other student pilots, and it was not believed that the additional 2 or 3 hours could have any significance. The table shows that most of the private pilots had between 40 and 60 (inclusive) total solo hours as planned, with two minor exceptions and one striking exception. One private pilot had 61 hours, which appears to be a matter of no consequence, another had 75 hours, and one who was in fact an airport manager at one of the neighboring airports where the examination was given, had 1,000 hours of total solo flight time on his record as a private pilot. All of these apparent exceptions were included in the tabulations in spite of their falling outside of the planned limits, because the examination records for these people looked no better than any other examination records for that class of pilot.

It will be seen from Table 31 that the instructors ranged in total solo flight experience from 235 hours to 5,500 hours, with a median of about 1250 hours. Only three had less than 500 hours, so it must be supposed that these instructors were properly experienced pilots.

TABLE 28

EXAMINATION FLIGHTS IN UNFAMILIAR AIRPLANE DISTRIBUTED BY DEGREE OF TURBULENCE AND TYPE OF PILOT

Degree of Turbulence	Student Pilots	Private Pilots	Instructors	All Pilots
Much turbulence	2	1	-	3
Moderate turbulence	31	38	31	100
Little turbulence	6	4	2	12
Total	39	43	33	115
No Record	-	1	3	4

TABLE 29

EXAMINATION FLIGHTS IN THE UNFAMILIAR AIRPLANE DISTRIBUTED BY DISTINCTNESS OF HORIZON AND BY CLASS OF PILOT

Appearance of Horizon	Student Pilots	Private Pilots	Instructors	All Pilots
Absent	1	10	9	20
Vague	24	18	15	57
Distinct	14	16	9	39
Total	39	44	33	116
No Report	-	-	3	3

TABLE 30

DISTRIBUTION OF PILOTS WHO FLEW UNFAMILIAR AIRPLANE, BY TYPE OF PILOT AND BY NUMBER OF MINUTES OF EXAMINATION FLIGHT TIME

Number of Minutes	Student Pilots	Private Pilots	Instructors	All Pilots
60	1	-	-	1
55	2	2	2	6
50	5	6	4	15
45	14	13	8	35
40	15	23	19	58
35	-	-	2	2
30	1	-	1	2
Total	39	44	36	119

TABLE 31

PILOTS WHO FLEW THE CESSNA AIRPLANE DISTRIBUTED BY NUMBER OF TOTAL SOLO HOURS OF FLIGHT EXPERIENCE AND TYPE OF PILOT

Number of Solo Hours	Student Pilots	Private Pilots	Instructors	All Pilots
5500	-	-	2	2
5000	-	-	2	2
4500	-	-	1	1
4000	-	-	1	1
3500	-	-	2	2
3050	-	-	1	1
3000	-	-	1	1
2600	-	-	2	2
2200	-	-	1	1
1900	-	-	1	1
1800	-	-	1	1
1600	-	-	2	2
1300	-	-	4	4
1200	-	-	2	2
1100	-	-	3	3
1000	-	1	1	2
900	-	-	-	-
850	-	-	-	-
700	-	-	2	2
650	-	-	1	1
400	-	-	2	2
250	-	-	1	1
235	-	-	1	1
75	-	1	-	1
61	-	1	-	1
60	-	7	-	7
59	-	1	-	1
58	-	1	-	1
56	-	1	-	1
55	-	1	-	1
54	-	1	-	1
51	-	2	-	2
50	-	3	-	3
48	-	1	-	1
47	-	2	-	2
45	-	3	-	3
44	-	1	-	1
41	-	2	-	2
40	-	3	-	3
22	1	-	-	1
20	11	-	-	11
18	2	-	-	2
17	1	-	-	1
15	2	-	-	2
14	2	-	-	2
12	1	-	-	1
11	1	-	-	1
10	2	-	-	2

There was a very wide range in all pilot categories as regards the number of solo hours of flight experience a pilot had had in the 90 days preceding the date of the flight. Table 32 shows a distribution of the pilots by number of solo hours in the past 90 days as reported on the examination record. Surprisingly enough, the student pilots ranged all the way from two who had 23 hours each of solo flight experience in the 90 days preceding the examination to two who had no solo flight experience in the preceding 90 days. The private pilots distributed themselves still more widely, one of them having as many as 65 solo hours in the preceding 90 days, and three of them having no such experience. The instructors were still more widely scattered, one having no less than 250 hours of solo flight experience during the preceding 90 days, and one having only one hour.

The median number of hours for the student pilots was between 11 and 12; for the private pilots between 16 and 17; and for the instructors, between 90 and 100.

Since the instructors were a group of pilots unselected as regards the amount of flying done, it is interesting to note that the median of a fairly large group of such pilots enlisted for such a study should show between 90 and 100 hours of flight in the past 90 days. This indicates that this group fly at the rate of approximately 360 to 400 hours a year.

All of the 36 instructors held CAA instructor ratings with their commercial certificates, and 8 of them held instrument ratings. Since the instrument rating requires 200 hours of solo flight experience, no private pilot in this study had an instrument rating, and of course no student pilot had such a rating.

Most of the student pilots had made their first solo flight during the calendar year 1947. Table 33 shows a distribution of the pilots according to "year of first solo," for each class of pilots. It will be seen that 30 of the 39 student pilots first soloed in 1947, and that all but three of them had first soloed during the past three years. One student pilot first soloed in 1936.

Nearly all of the private pilots were also relatively recent initiates to the flying business, 28 of the 44 having first soloed either in 1946 or 1947. Two of the private pilots first soloed as early as 1930.

The instructors were, naturally, the oldest hands at flying. Two of them first soloed as early as 1927, but the median instructor soloed during the year of Pearl Harbor. One first soloed as recently as 1946.

No age restrictions were put upon the pilots employed, and there was substantial variation in the ages of all classes of pilot. Table 34 shows how the pilots were distributed with respect to age at last birthday. The median pilot in each class was in his middle twenties. The student pilots ranged from 17 to 62 years of age, but except for one student, the range was from 17 to 34, with a median around 24. The private pilots ranged from 19 to 48, with a median around 25. The instructors ranged in age from 22

TABLE 32

PILOTS WHO FLEW THE UNFAMILIAR AIRPLANE DISTRIBUTED BY NUMBER OF SOLO HOURS OF FLIGHT EXPERIENCE IN PAST 90 DAYS, AND TYPE OF PILOT

Number of Hours	Student Pilots	Private Pilots	Instructors	All Pilots
250			1	1
210			1	1
200			4	4
160			1	1
150			6	6
125			1	1
120			1	1
100			6	6
90			1	1
80			2	2
65		1		1
60			1	1
50		3	5	8
45		1		1
40		3	1	4
35		3		3
32		1		1
30		2	2	4
25		3	1	4
23	2	1		3
22	1			1
20	6	6	1	13
18	1			1
17	2			2
16	1			1
15	3	5		8
14	2	1		3
12	3			3
11	1			1
10	7	3		14
9	1			1
8	2			2
5		2		2
4		2	1	3
3	2			2
2		2		2
1	1		1	2
0	2	3		5
Totals	39	44	36	119

TABLE [illegible]

DISTRIBUTION OF PILOTS WHO FLEW THE UNFAMILIAR AIRPLANE BY TYPE OF PILOT AND BY CALENDAR YEAR OF FIRST SOLO FLIGHT

Year	Student Pilots	Private Pilots	Instructors	All Pilots
1947	30	12	-	42
1946	5	16	1	22
1945	1	3	-	4
1944	-	6	4	10
1943	-	-	6	6
1942	2	1	7	10
1941	-	1	4	5
1940	-	1	2	3
1939	-	2	2	4
1938	-	-	-	-
1937	-	-	3	3
1936	1	-	1	2
1935	-	-	1	1
1934	-	-	-	-
1933	-	-	-	-
1932	-	-	1	1
1931	-	-	-	-
1930	-	2	1	3
1929	-	-	1	1
1928	-	-	-	-
1927	-	-	2	2
Total	39	44	36	119

TABLE 34

DISTRIBUTION OF PILOTS WHO FLEW UNFAMILIAR AIRPLANE, BY TYPE OF PILOT AND BY AGE AS OF LAST PRECEDING BIRTHDAY

Age	Student Pilots	Private Pilots	Instructors	All Pilots
62	1	-	-	1
48	-	1	-	1
46	-	1	-	1
45	-	-	1	1
44	-	-	1	1
43	-	1	-	1
42	-	1	-	1
39	-	1	-	1
37	-	2	-	2
35	-	2	1	3
34	1	-	1	2
33	3	1	3	7
32	1	1	3	5
31	1	3	1	5
30	1	-	1	2
29	3	3	-	6
28	2	2	1	5
27	3	-	1	4
26	1	3	1	5
25	3	2	7	12
24	3	4	4	11
23	1	1	4	6
22	3	2	6	11
21	5	8	-	13
20	6	2	-	8
19	-	3	-	3
17	1	-	-	1
Total	39	44	36	119

to 36, with a median around 25.

RESULTS: UNFAMILIAR PLANE

Assigned Maneuvers

The results from the assigned maneuvers as a whole indicate a very sorry picture as regards the performance of the aircraft pilot in recognizing the incipience of the stall in an unfamiliar airplane, even though the airplane is of a horsepower classification with which he is familiar, is of the tandem seating type in which he learned to fly, and has the controls arranged in the cockpit in approximately the same manner as those in the airplane of his student days. Table 35 shows the frequency with which various classes of pilots lit various numbers of lights when attempting to come as close as possible to stalling the airplane without actually stalling it.[12] As can be seen from the last column of the table, the typical pilot lights only three lights when the aircraft is so equipped that at least four can be lit in any maneuver without stalling the airplane. A total of 507 observations indicates only three lights lit. Furthermore, as the pilot tries to get closer to the stall, he fails to stop in time, and actually stalls the airplane. No fewer than 261 records indicate that the approach was carried too far, and the airplane was actually stalled.

Of course the student pilots are the most diverse as a group, but they still show the common characteristic. More records showed three lights lit than any other number, while a very large fraction of the students went so far as to stall the airplane when they were explicitly instructed not to. Equally distressing is the record of failures to approach the stall. Fourteen records of students' attempts indicate that when the student decided he was on the verge of stalling the airplane, there were actually no lights lit at all. Five more records indicate only one light lit, and 57 indicate only two lights lit, in an airplane so equipped that the lighting of two lights is demonstrably far distant from the stall, no matter the maneuver from which the stall is approached.

The private pilots do almost as badly. No fewer than 15 records show either no lights lit at all or only one light lit when the private pilot thinks he is about to stall. The typical private pilot again lights only three lights, and almost one-quarter of the records (114 out of 470) shows the private pilot actually stalling the airplane instead of avoiding the stall after coming close to it.

Even the instructors present an unattractive picture. The typical in-

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[12] The data for the separate maneuvers are given in Tables 40, and 29A through 38A in Appendix A.

TABLE 35

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS IN ATTEMPTING STALL APPROACHES IN ALL ASSIGNED MANEUVERS

Number of Lights Lit	Type of Pilot			All Pilots
	Student	Private	Instructor	
6*	88	114	59	261
5	2	11	24	37
4	66	70	85	221
3	145	190	172	507
2	57	70	54	181
1	5	[illegible]	1	13
0	14	8	-	22
Total	377	478	393	1242
No observation	52	1	1	07

* The figure 6 means that the airplane was stalled.

structor lights only three lights. Of 39 maneuvers, only 10 (8% plus 2%) show either four or five lights lit, and not a chance half this number show that the instructor himself went too far and stalled the airplane. About the most that can be said for these instructors is that only one of them failed to get at least two lights lit when he was trying to light four or five.

Gliding Turns. Among the 11 assigned maneuvers were four gliding turns: a left gliding turn and a right gliding turn, each repeated. Table 36 shows the number of lights lit by various classes of pilots when deliberate approaches to the stall were made beginning with the airplane in a gliding turn.[13] The vanes were so installed that in this kind of a maneuver the stall occurs just as the number 5 light goes on, so that it was almost impossible to light the fifth light without stalling the airplane. Only one pilot managed to do so, and he managed it only once in four tries, as can be seen from the "private" column of Table 36. The tabulations in this table are such that, had any pilot managed in all four gliding turns, to light the fifth light without stalling the airplane the figure in the second line of the table would be a "4". The vanes were so installed that a proper recognition of the incipience of the stall called for lighting four lights, yet every single class of pilot stalled the airplane more frequently than he lit four lights without stalling it, and the typical pilot lit only three lights instead of four. The table leaves no doubt about the finding that in the gliding turn (which is the maneuver used to make the last turn into the field at low altitude) the pilots do not, in an unfamiliar airplane, know where the airplane breaks into a stall. The pilots either fail to get the airplane to the edge of the stall or they go too far and actually stall the airplane. Three attempts by student pilots resulted in lighting no lights whatever when they presumably thought the airplane was about to stall, and two more attempts resulted in lighting only one light. One private pilot's attempt also resulted in lighting no lights.

The instructors were somewhat better than the privates or the students, but nowhere near enough better to warrant their holding the exalted reputation to which their instructor rating should entitle them. One attempt by an instructor actually resulted in lighting only one light.

Climbing Turns. There were two climbing turns, one to the left and one to the right, included in the 11 assigned maneuvers from which the approaches to the stall were made. The instructors did a fairly good job of approaching the stall while in the climbing turn. Table 37 shows the number of lights lit by the three classes of pilots and by all pilots combined.[14] The vanes were so installed that number 5 triggered just as the airplane broke into the stall

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[13]The data for the separate maneuvers are given in Tables 31A, 34A, 36A, and 38A in the Appendix.

[14]The data for the separate maneuvers are given in Tables 30A and 33A in the Appendix.

TABLE 30

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS IN ATTEMPTING STALL APPROACHES IN FOUR GLIDING TURNS

Number of Lights Lit	Type of Pilot			All Pilots
	Student	Private	Instructor	
6*	35	45	19	99
5	-	1	-	1
4	19	20	16	55
3	76	86	86	248
2	21	22	21	64
1	2	-	1	3
0	3	1	-	4
Total	156	175	143	474
No observation	-		1	2

* The figure 6 means that the airplane was stalled.

TABLE 37

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS IN ATTEMPTING STALL APPROACHES IN TWO CLIMBING TURNS

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	16	12	4	40
5	-	-	-	-
4	16	18	29	63
3	20	29	27	76
2	15	20	12	48
1	2	1	-	3
0	6	2	-	8
Total	76	96	72	238

* The figure 6 means that the airplane was stalled.

out of a climbing turn, so no pilot succeeded in lighting the fifth light without actually stalling the airplane. The figures for all pilots combined indicate that the typical pilot either lights only three lights or else goes too far and stalls the airplane, although a substantial number of them do succeed in lighting four lights, which were the correct number. In these two turns the instructors exhibited their expected superiority over the other classes of pilots. As can be seen from the figures in the instructor column, only four instructors went so far as actually to stall the airplane, and more of them lit four lights than any other number. It is apparent also, however, that a very substantial number of them (27) succeeded in lighting only three lights, and 12 attempts resulted in lighting only two lights, which cannot be called a satisfactory performance at all.

Neither the student pilots nor the private pilots did well with the stall approach out of the climbing turn, although the privates did slightly better than the students. Eighteen attempts by private pilots resulted in stalling the airplane, and more private pilots lit three than any other number of lights. This is also true for the student pilots, but the student pilots scattered more widely, six attempts among them resulting in having no lights lit at all. If either no lights, one light, or two lights be regarded as a highly unsatisfactory degree of recognition of the stall, then it must be admitted that the private pilots were very little better than the students inasmuch as 23 of their 88 attempts resulted in lighting no more than two lights, while 24 of the students' 78 attempts resulted in lighting no more than two.

Table 37 indicates without very much doubt that it is highly unreasonable to suppose that a student pilot or a private pilot flying an unfamiliar airplane can be trusted to recognize the stall approach in a climbing turn, even though the airplane is of the same basic design and horsepower classification as the one in which he has been trained.

Steep Turns. The vanes were so mounted in the airplane that in the steep turn at altitude (as in the 720° turn in a CAA flight examination) all five lights could be lit without stalling the airplane. Indeed, the reasonably skillful pilot could (if he could see the lights) light all five lights and then recover without any danger of stalling the airplane. The results from the attempted stall approaches in steep turns indicated that without knowledge of the lights, the instructors did not do as well as one has a right to expect of instructors. Table 38 presents the data.[15] It will be observed that just as many instructors went too far and stalled the airplane as recovered after lighting five lights. Of 72 attempts by instructors, a total of 24 showed fewer lights lit than the number (5) which indicated optimum stall recognition. Two attempts by instructors resulted in lighting only two lights each time, a performance which cannot be credited as being at all acceptable as regards the recognition of the incipience of the stall.

Nevertheless, the instructors were substantially better at this part of the examination than were the student pilots or private pilots. Of the three types of pilots, the privates seemed to do the worst. The number (26) who went too far and stalled the airplane was greater than the number (22) who lit either

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[15] The data for separate maneuvers are given in Tables 32A and 37A in Appendix A.

TABLE 36

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS IN ATTEMPTING STALL APPROACHES IN TWO STEEP TURNS

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	2	28	24	54
5	1	9	24	34
4	12	13	12	37
3	5	13	10	28
2	4	7	2	13
1	-	5	-	5
0	2	1	-	3
Total	26	76	72	174
No observation	52	12	-	64

* The figure 6 means that the airplane was stalled.

four or five lights. Lighting three lights means coming nowhere near stalling the airplane, and yet just as many privates lit three as lit four, and more lit three than lit five. At the other end of the scale, one attempt by a private pilot resulted in lighting no lights at all, and a total of 13 out of 76 private pilots' attempts resulted in lighting no more than two lights, which is three lights away from the optimum number. Twelve attempts by private pilots resulted in a failure to hold the steep turn long enough to make the stall approach.

Even more of the student pilots were unable to hold the steep turn long enough to attempt the stall approach. Out of 78 scheduled entries into the turn, 52 resulted in failing to establish or to hold the turn long enough to attempt a stall approach, so that we have records on only 26 attempts by student pilots to approach the stall in the steep turn. These 26 attempts show that the student pilot does very badly in recognizing the stall in this condition of flight. Two attempts resulted in lighting no lights whatever, and four others resulted in lighting only two lights, which is a long way from the stall condition. Indeed only one student pilot succeeded in lighting five lights, which is the optimum number. The typical student pilot lights only four lights, whereas it is known from the test-flying of the installation and can be seen by the results from the instructors in this same Table 38, that five lights can be lit without stalling the airplane.

Straight Flight. In the stall approach straight ahead with power, the instructors were again substantially better than either the students or the private pilots. Table 39 shows the results for all three types of pilots. In this table have been combined the results from the attempted stall approach straight ahead with cruising power and the attempt straight ahead with climbing power, since the two maneuvers yielded similar results. The results for these two maneuvers separately are presented in the appendix[16] to this report. The indicator installation was such that the airplane broke into a stall at almost exactly the same instant that the fifth light lit, so that only one attempt by a private pilot and one by a student pilot resulted in lighting the fifth light without stalling the airplane. Just as many instructors stopped with three lights as went on to the optimum number four. Seven attempts by instructors resulted in stalling the airplane, which was forbidden, while 11 attempts resulted in lighting only two lights, which is a performance substantially different from achieving stall incipience. Both the students and the private pilots characteristically lit three lights or else went too far and stalled the airplane. Of the students' attempts, a smaller number resulted in the optimum four lights than resulted in either three lights or an actual stall. The attempts by private pilots resulted in just as many stalls as in lighting the optimum number of lights. A substantial number of both student pilots and private pilots recovered after lighting no more than two lights. A total of 14 attempts by student pilots resulted in lighting two lights or fewer, and a total of 21 attempts by private pilots resulted in lighting no more than two.

The only summary statement that seems appropriate to such results is that the stall is not recognized by student or private pilots in a slightly unfamiliar ship, even when they are alerted to the attempt. And the performance of the instructors is not what might be expected.

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[16] The data for the separate maneuvers are given in Tables 29A and 35A in Appendix A.

TABLE 39

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS IN ATTEMPTING STALL APPROACHES STRAIGHT AHEAD, ONCE WITH CRUISING POWER, ONCE WITH CLIMBING POWER

Number of Lights Lit	Type of Pilot			All Pilots
	Student	Private	Instructor	
6*	22	15	7	44
5	1	1	-	2
4	16	15	27	58
3	25	36	27	88
2	10	16	11	37
1	1	1	-	2
0	3	4	-	7
Total	78	88	72	238

* The figure 6 means that the airplane was stalled.

Straight ahead with power off is the flight condition in which pilots behave most consistently in the stall approach. Table 4 shows the numbers of lights lit. All pilots either lit two, three, or four lights, or they went too far and stalled the airplane. No pilot failed to light at least two lights. The vanes were so installed that it was practically impossible to light the fifth light without actually stalling the airplane, and no pilot succeeded in doing so. However, the typical pilot lights only three lights instead of four, and there can be no doubt that four lights are the optimum number for this maneuver with the installation used. Five instructors actally stalled the airplane, and more instructors stopped at three lights than at any other number.

Private pilots were the most consistent, since practically all of them stopped with three lights lit, although 8 of them went too far and stalled the airplane. The student pilots presented a bi-modal distribution with very few doing anything but either lighting three lights, which is not going far enough, or else going too far and stalling the airplane.

Apparently the student pilots and the private pilots are not to be trusted to recognize the stall in an unfamiliar airplane when flying straight ahead with power off.

Unassigned Maneuvers

It will be remembered that the examination records had 34 lines, on each of which the check pilot recorded his observation of a number of lights lit. Eleven lines were used for the 11 assigned maneuvers, and the other 23 lines were devoted to observations made by the check pilot on the examinee's undirected flying. The examinees had been clearly told that whenever they were not performing maneuvers under the direction of the check pilot, they were to fly normally, using normal climb, normal glide, normal turns, and normal cruising attitude. The results of the check pilots' observations indicate that all types of pilots were guilty of inadvertent approaches to stalls. The combined results for all unassigned maneuvers[17] are presented in Table 41. The thing which first strikes the eye in this table is the figure "3" in the upper left-hand corner indicating that the airplane was stalled three times while a student pilot was attempting to fly without approaching a stall. Almost as bad is the figure "4" showing that on four occasions four lights were lit by student pilots presumably trying to perform non-stall flight. It will be remembered that two of the assigned maneuvers were such that five lights could be lit without stalling the airplanes. However, in no unassigned maneuvers was this the case. Therefore, lighting four lights in any unassigned maneuver meant that the airplane was on the edge of a stall. This happened four times with student pilots, twice with private pilots, and four times with instructors. The only interpretation that seems possible is that these pilots inadvertently brought the airplane to the very edge of the stall. Even the lighting of three lights inadvertently cannot be accounted for by the degree of turbulence characterizing the conditions under which most of these flights were made. Yet the record shows 44 observations (20 for students, 16 for privates, and 8 for instructors) of three lights lit.

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[17] The data for the separate observations are given in Tables 45, 46, 47, 48, and 49, and in Tables 39A through 56A in the Appendix.

TABLE 40

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS IN ATTEMPTING STALL APPROACH STRAIGHT AHEAD, POWER OFF

Number of Lights Lit	Type of Pilot			All Pilots
	Student	Private	Instructor	
6*	11	8	5	24
5	-	-	-	-
4	3	4	1	8
3	19	26	22	67
2	6	5	8	19
1	-	-	-	-
0	-	-	-	-
Total	39	43	36	118
No observation	-	1	-	1

* The figure 6 means that the airplane was stalled.

TABLE 41

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS DURING ALL 23 UNASSIGNED MANEUVERS

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	3	-	-	3
5	-	-	-	-
4	4	2	4	10
3	20	16	8	44
2	120	110	89	319
1	164	204	156	524
0	567	655	529	1751
Total	878	987	786	2651
No observation	19	25	12	86

* The figure 6 means that the airplane was stalled.

With Table 41 in hand, one can more readily understand why so many pilots of all kinds get killed in crashes resulting from inadvertent stalls.

Clearing Turns. Apparently the moderately steep turn with power is not a dangerous maneuver, even in an unfamiliar airplane, providing it is of short duration. During the examination each examinee was required to make a total of eight moderately banked clearing turns. Table 42 shows the number of lights lit during all of these turns.[18] Only one turn resulted in lighting as many as four lights, whereas it is easily possible to light five lights in a steep turn without actually stalling the airplane. However, the typical pilot, whether student, private, or instructor, cannot be credited with making his clearing turns in a "normal" manner. About one-sixth of the clearing turns made by each class of pilot resulted in lighting one or two lights. Lighting one light might be occasioned by moderate turbulence, and even lighting two lights cannot be considered dangerous, but nevertheless, it must be admitted that a great many clearing turns are being made in a manner other than "normal."

"Normal" Flight Between Maneuvers. Strangely enough, the three inadvertent stalls which were noticed in Table 41 took place during what was supposed to be normal flight between examination maneuvers. Table 43 shows the tabulation of seven observations for each pilot during flight between maneuvers.[19] The three stalls appearing in the upper left of this table were committed by two student pilots, one of whom stalled the airplane in an attempt at normal flight between maneuvers 9 and 10 (the right gliding turn and the steep right turn at altitude), and the other of whom stalled the plane between maneuvers 3 and 4, and again between maneuvers 8 and 9.

Consultation with the check pilot reveals that these stalls were secondary stalls taking place during recovery from the attempted stall approach In the case of the student who stalled once between maneuvers 9 and 10, what happened was this: he attempted a stall approach in a right gliding turn and actually stalled the airplane. Having done so, he rapidly dropped the nose in order to pick up speed and soon after having lowered the nose came back on the stick to raise the nose to the horizon for normal flight. However, he came back on the stick so rapidly that he stalled the airplane again, this time at a relatively high speed. This was also the case for the other student, who committed two inadvertent stalls between maneuvers. His first was between maneuvers 3 and 4. On maneuver 3, the left climbing turn, he went too far and actually stalled the airplane. In the recovery he dropped the nose by forward motion of the stick and then to raise the nose to the horizon pulled back on the stick so much that he stalled the airplane during the recovery from the first stall. The same thing happened between maneuvers 8 and 9. He went too far in maneuver 8 (straight ahead with climbing power) and stalled the airplane. Then in the recovery he stalled the airplane again in a relatively high speed secondary stall.

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[18] The data for the separate observations are given in Tables 39A, 40A, 42A, 43A, 45A, 46A, 48A, and 49A in Appendix A.

[19] The data for the separate maneuvers are given in Tables 50A through 56A in Appendix A.

TABLE 42

NUMBER OF LIGHTS LIT, BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS DURING EIGHT CLEARING TURNS

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	-	-	-	-
5	-	-	-	1
4	3	-	-	-
3	-	-	-	41
2	29	11	10	84
1	33	27	24	824
0	256	314	254	950
Total	318	352	288	2
No observation	2	-	-	

* The figure 6 means that the airplane was spoiled.

TABLE 43

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS DURING SEVEN OBSERVATIONS OF FLIGHT BETWEEN MANEUVERS

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	3	-	-	3
5	-	-	-	-
4	3	1	4	8
3	19	11	8	38
2	77	68	58	203
1	77	116	90	283
0	78	89	52	219
Total	257	285	212	754
No observation	16	23	40	79

* The figure 6 means that the airplane was stalled.

The relatively high speed secondary stall is probably the one upon which least emphasis is placed in the typical training program, and may easily be the stall which kills the pilot when he is buzzing his girl friend's house. If he dives the airplane and in the recovery from the dive pulls back too rapidly on the stick, he stalls at an airspeed which he thinks gives him security. This stall is generally much more vicious than the stall used in training maneuvers, and at the same time it is accomplished with the airplane going at a sufficiently higher than expected speed during the stall so that the time left for recovery from such a stall if the airplane is near the ground may be far too short for the unskilled pilot.

Comparison of Table 43 with Table 41 indicates that the most dangerous condition of flight is flight between maneuvers. Table 43 shows that the airplane was either stalled or had four lights lit a total of 11 times during flight between maneuvers. Table 41 for all unassigned maneuvers showed 13 occasions on which the airplane was either stalled or had four lights lit. All but two of these 13, therefore, took place during flight between maneuvers. This may account for the frequency with which unskilled pilots get killed "buzzing the girl friend's house." Our data on the moderately banked turn with power indicate that it is a relatively safe maneuver, even in an unfamiliar ship. It will be remembered that very few lights were lit during the eight clearing turns, and even when the pilots tried to stall the airplane out of a tight level turn, they failed to do so. It now appears from Table 43 that the hazard in "buzzing the girl friend's house" is not so much in the maneuvers performed over her adoring head as in the intended return to normal flight between times.

Climbs to Altitude. During the examination there were three occasions upon which the examinee was instructed to climb back up to altitude in order to perform more stall approaches. Apparently this maneuver is not very dangerous, but neither is it one which is performed "normally" by pilots instructed to do so. Table 44 shows the combined results for all three of the climbs to altitude between maneuvers.[20] These climbs took place between maneuvers 2 and 3, between maneuvers 4 and 5, and between maneuvers 7 and 8. The instructors lit only two lights at most, and seldom were this many lit. These could easily have been due to turbulent conditions, but they cannot be considered normal flight, even during turbulent conditions. The private pilots did slightly worse than the student pilots in their intended normal climb, 15 climbs out of 131 exhibiting either two or three lights for the private pilots, while only 10 out of 117 attempts by student pilots showed two or three lights lit. No very dangerous flying appears to have been done in the intended normal climb, but a good deal of climbing was done which could not be regarded as normal climbing.

The climb to altitude after take-off was a considerably longer climb than the others, and the results from it have therefore been tabulated separately in Table 45. The results are much the same as for the climbs to altitude between maneuvers, except for a couple of instances in which a private pilot lit three or four lights. It is not a happy thing to see a private pilot (or indeed any other pilot) light four lights during what he regards as a normal climb, even during conditions of extreme turbulence, since the vanes were so set that four lights were about as far as any pilot could go without actually stalling

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[20] The data for the separate maneuvers are given in Tables 41A, 44A, and 47A in the Appendix.

TABLE 44

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS DURING THREE CLIMBS TO ALTITUDE BETWEEN MANEUVERS

Number of Lights Lit	Type of Pilot			All Pilots
	Student	Private	Instructor	
6*	-	-	-	-
5	-	-	-	-
4	-	-	-	-
3	1	2	-	3
2	9	13	6	28
1	20	24	15	59
0	87	92	87	266
Total	117	131	108	356
No observation	-	1	-	1

* The figure 6 means that the airplane was stalled.

TABLE 45

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS DURING CLIMB TO ALTITUDE AFTER TAKE-OFF

Number of Lights Lit	Type of Pilot			All Pilots
	Student	Private	Instructor	
6*	-	-	-	-
5	-	-	-	-
4	-	1	-	1
3	-	1	-	1
2	9	10	10	29
1	19	18	11	48
0	11	14	15	40
Total	39	44	36	119

* The figure 6 means that the airplane was stalled

the airplane, turbulence or no turbulence. It will be remembered (see Table 39) that in the attempt at a stall approach straight ahead with power on, no instructor succeeded in lighting more than four lights without stalling the airplane. This private pilot who lit four lights in what he regarded as a normal climb is on his way to becoming a newspaper headline during a short-field take-off. The papers are going to report that the airplane unexplainably dived suddenly to the ground killing its pilot, who should have known a great deal better than to embark in these new-fangled contraptions in competition with the birds.

Return To Field. After the last assigned maneuver had been performed, the examinee was told to return to the field. Beginning at this point, four unassigned observations were made, one of them covering the period following the last examination maneuver and preceding the turn into the traffic pattern at the field, presumably at 45° to the downwind leg of the pattern. As was the case for the examinations in the familiar airplane, the expectation here was that the examinee would relax and fly sloppily and light a good many lights during his return to the field. That this didn't happen, or at least that very many lights were not lit, is shown in Table 46, in which it is seen that no pilot of any type lit more than two lights during his return to the traffic pattern, and very few of them lit even two. Since one or two lights can easily be lit by turbulent air, we have here what appears at first to be a rather surprising finding: namely, that in returning to home base the pilots fly quite acceptably. It must be remembered, however, that this return to the field involves a loss of altitude with power on, so that it is quite likely that the air speed was relatively high, or in any case the angle of attack relatively low. But there appears to be no legitimate criticism of the normality of the flying during the return to the field.

Traffic Pattern. It had been expected also that the distractions caused by other aircraft in the traffic pattern at busy fields like Bedford Airport might encourage the pilot to fly in a hazardous manner in the traffic pattern. Accordingly, a record was kept of the number of lights lit in the traffic pattern, before the last turn into the field. Table 47 shows that only two pilots out of 119 lit more than two lights in the traffic pattern. These two were both private pilots, and there is nothing about this performance for which they should be congratulated. The airplane can be flown safely with three lights lit, but even conditions of severe turbulence should not excuse the two pilots for having as many as three lights lit while flying in the traffic pattern. It will be noticed that the instructors are quite uniform in their satisfactory flight attitude in the traffic pattern, 32 out of 36 lighting no lights at all.

Last Turn Into Field. The number of lights lit during the last turn into the field was recorded and tabulated separately, because of the interest in this turn in private flying. This is the turn which is made close to the ground under conditions of distraction caused by planning the landing, attending to the control tower signals, remaining alert for other traffic, and so forth. As can be seen in Table 48, the pilots flying the unfamiliar airplane kept the nose well down on this turn. It is possible that they made this turn at an excessive speed, but in any case they did not make it dangerously. No pilot lit more than two lights, and only a few lit that many. Since as many as two lights might be lit by gusts in turbulent air, we must admit that the pilots turning into the field in the unfamiliar airplane did so in a safe

TABLE 46

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS DURING RETURN TO FIELD

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	-	-	-	-
5	-	-	-	-
4	-	-	-	-
3	-	-	-	-
2	2	3	1	6
1	7	7	-	14
0	30	34	35	99
Total	39	44	36	119

* The figure 6 means that the airplane was stalled.

TABLE 47

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS IN TRAFFIC PATTERN

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	-	-	-	-
5	-	-	-	-
4	-	-	-	-
3	-	2	-	2
2	1	2	-	3
1	5	5	4	14
0	33	35	32	100
Total	39	44	36	119

* The figure 6 means that the airplane was stalled.

TABLE 48

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS DURING LAST TURN INTO FIELD

Number of Lights Lit	Type of Pilot			All Pilots
	Students	Private	Instructor	
6*	-	-	-	-
5	-	-	-	-
4	-	-	-	-
3	-	-	-	-
2	2	1	1	6
1	3	4	9	16
0	34	37	26	97
Total	39	44	36	119

* The figure 6 should that the airplane was pulled

manner, so far as inadvertent approaches to the stall are concerned.

Final Glide. The same could be said about the final glide. As can be seen by reference to Table 49, no pilot lit more than two lights in the final glide. Since conditions of turbulence and the deliberate intention of the pilot could account for as many as two lights, we must admit that the final glide was performed in very satisfactory style. Indeed, the only people who lit as many as two lights were instructors, and no students lit any. The fact that conditions of turbulence will account for lighting one or two lights argues for the belief, substantiated by the reactions of the check pilots, that the student pilots landed the airplane too fast, but they landed it safely, so far as inadvertent approaches to the stall are concerned, and it is such inadvertent approaches which give the final glide its slang label of "suicide glide" when stretched.

Comments On Individual Examination Records. The individual records of flight performances in the unfamiliar ship were noticeably different from those in the familiar airplane. In the familiar airplane only a few pilots actually stalled the airplane as many as three times, and only one as many as four times. Among the smaller number of examinees who flew the unfamiliar ship, no fewer than two student pilots, eight private pilots, and four instructors earned records of actually stalling the airplane five or more times when directed to come as close as possible to stalling but not to stall. Both of the student pilots who earned this unenviable record were among those who were unable to hold the steep turn long enough to attempt the stall approach in it. One of them stalled the airplane in six of the 11 assigned maneuvers. He was 34 years old, had a total of 10 solo hours of which only one was in the past 90 days. He had first soloed in the year 1946. He flew under conditions of severe turbulence and clear visibility. Since he did not attempt the stall approach in either of the steep turns, his record shows only three approaches (without stalling) for the 11 maneuvers. In the first right climbing turn he lit only two lights. In the second left gliding turn he lit three, and straight ahead with climbing power he lit three. So not once in 11 maneuvers did he light the optimum number of lights.

The other student actually stalled the airplane no fewer than eight times. Since he did not try the stall approach in the steep turns, this left only one maneuver, straight ahead with climbing power, with a record of an approach without a stall. In this one he did a good job, lighting four lights. He lit very few lights unintentionally despite the moderate turbulence and the vague horizon. He had first soloed in 1946, and had a record of 15 total solo hours, all of which were in the past 90 days, but none of which, of course, were in this make and model of airplane. Everything about this student is more or less routine except the fact that his age as of his last birthday was 62.

Two of the private pilots committed five actual stalls apiece. One of them was a green hand at flying, having first soloed in 1947 at the age of 29. He had 40 total solo hours, all of which were in the past 90 days, with of course none in this make and model of airplane. When he flew the horizon was clear and the turbulence was moderate. His record for the assigned maneuvers was very spotty, but before and after and between maneuvers he lit very few lights.

TABLE 49

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS DURING FINAL GLIDE

Number of Lights Lit	Type of Pilot			All Pilots
	Student	Private	Instructor	
6*	=	=	=	=
5	=	=	=	=
4	=	=	=	=
3	=	=	=	=
2	=	=	3	3
1	=	1	3	6
0	32	40	28	106
Total	58	63	34	215
No observation	1	=	2	4

* The figure 6 means both (or all) that was studied.

The other private pilot who committed five stalls was an older hand, age 34, who first soloed in 1942 and had 60 solo hours, of which 25 were in the past 90 days, but none of these, of course, in this make and model of airplane. When he flew the horizon was vague and turbulence was moderate. He always lit as many as three lights on the assigned maneuvers, and never lit more than two on the unassigned maneuvers.

One of the private pilots who committed six stalls was a 19-year-old who had soloed in 1944 and who had 40 total solo hours, but none in the past 90 days. When he flew the horizon was not visible, and turbulence was moderate. Aside from his stalls, his approaches were inadequate. He lit no more than three lights on any approach unless he went too far and stalled the airplane. His performance on the unassigned maneuvers was good. Another of the private pilots who committed as many as six stalls was a 20-year-old who had first soloed in 1941, apparently at the minimum allowable age. He had 50 solo hours, of which only two were in the past 90 days. The horizon was distinct and there was little turbulence. None of his attempts resulted in lighting four lights. Straight ahead with cruising power he lit none at all. He couldn't hold the steep turn long enough to try the stall approaches. In the right climbing turn he lit three lights, and in the second right gliding turn only two, after having stalled the airplane in the attempted approach during the first right gliding turn. The third pilot who was guilty of six actual stalls was a 42-year-old who had just experienced his first solo. He had 41 total solo hours of which 32 were in the past 90 days. There was little turbulence, and the horizon was distinct. On no attempted approach did he light the optimum number of lights. He lit three each in the attempted approaches in the left climbing turn, first right gliding turn, second right gliding turn, and steep right turn at altitude. He lit two only during the right climbing turn. This is no more than he had lit unintentionally during his third clearing turn left between maneuvers. In fact he had two lights lit a lot of the time between maneuvers, and his record generally was very spotty.

One private pilot committed seven actual stalls. He was a 24-year-old who had first soloed in 1946 and had 60 total solo hours, only four of which were in the past 90 days, but of course none of these in the make and model of plane used in the examination. When he flew the horizon was distinct, but the turbulence was extreme. He started off by lighting only three lights in the attempted approach straight ahead with cruising power and following that he stalled out of three successive maneuvers. He then successfully lit five lights in a steep left turn at altitude, but unhappily proceeded to stall out of the next two approaches. He then lit three lights straight ahead with climbing power and stalled out of the next maneuver, which was a right gliding turn. He followed this by lighting only two lights in the other steep turn, the two being a long way indeed from the optimum five. Finally in maneuver 11 he stalled out of the intended approach. He frequently had as many as two lights lit between maneuvers when he should have had none, but we cannot hold this against him too much in view of the extreme turbulence at the time.

One private pilot stalled out of nine attempted approaches. He was a 21 year-old who first soloed in 1946 and had accumulated 60 solo hours, 35 in the past 90 days, of which of course none were in the make and model of airplane used in the examination. The horizon was clear and there was little turbulence when he flew. He frequently had as many as two lights lit between maneuvers.

Only in the left gliding turn at the very end of the examination did he light the optimum number of lights. His nine stalls allowed him only one other opportunity to light this optimum number of lights, and he did not do so but lit only three in the first right gliding turn.

The private pilot who had 1,000 solo hours did not do so well. As had been already remarked, his case was included in the tabulation because it was only slightly worse and not different in kind from other cases whose numbers of hours qualified them for inclusion. This man was 37 years old, had first soloed in 1940, and had flown 50 hours in the past 90 days, although of course none of these hours was experienced in the make and model of airplane used in the examination. When he flew the turbulence was only moderate, but the horizon was not visible. His 10 stalls left him only one maneuver in which to score an approach, and in this one he did very well, lighting four lights in the first right gliding turn. He twice had as many as three lights lit between maneuvers, both times immediately after a stall, so that he probably lit these lights in the recovery from the stall and was on the way to a secondary stall when he did so. He had as many as two lights lit during three separate climbs in spite of the fact that the turbulence was only moderate. He had one light lit six times between maneuvers, but in five of these cases this light was lit following a stall out of a maneuver.

Three instructors committed as many as five stalls each during assigned attempts at stall approaches. They had total solo flight hours of 5,000, 2,600, and 1,600 respectively, having first soloed in 1930, 1937, and 1937 respectively. They had had 100, 50, and 30 solo hours in the past 90 days, with of course none in the make and model of airplane used. None of them had instrument ratings. In all three flights the horizon was not visible, and the turbulence was [illegible]. All three of them succeeded in lighting the optimum number of lights on two maneuvers, but they did not agree on which maneuvers. They all frequently had as many as two lights lit between maneuvers.

One instructor actually stalled the unfamiliar airplane six times during his attempts at stall approaches. He was a 23-year-old who had first soloed in 1940 when apparently very young, and since that time had accumulated 1,200 solo hours of which 150 were in the preceding 90 days, with of course none of these in the make and model of airplane used in the examination. When he flew the horizon was vague and the turbulence was moderate. In addition to his six outright stalls, he succeeded in lighting the optimum number of lights in four maneuvers and fell only one light short on the remaining maneuver, the first left gliding turn. Unhappily, he also lit four lights in his recovery from the stall out of the second right gliding turn, thus approaching a secondary stall. Likewise he lit as many as three lights between maneuvers 1 and 2, at which time he was not recovering from anything except a deliberate stall approach. This was true also of his lighting of three lights between maneuvers 8 and 9. Aside from these inadvertent stall approaches, he had very few lights lit between maneuvers.

As a matter of his own personal interest, the check pilot at Bedford had two private pilots each try a left and right chandelle. In three cases the maximum number of lights lit was three, and in the other case four.

Also as a matter of interest, an instructor was allowed to fly a left spiral in the unfamiliar ship. He did so without lighting any lights.

APPENDIX A

COMPILED DATA ON PERFORMANCE OF SUBJECTS IN INDIVIDUAL ASSIGNED AND UNASSIGNED MANEUVERS

Tables 1A-48A - Data on performance in "familiar" plane.
Tables 49A-56A - Data on performance in "unfamiliar" plane.

TABLE 1-A
(Familiar Plane)

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS IN ATTEMPTING STALL APPROACH STRAIGHT AHEAD, CRUISING POWER

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	2	3	-	5
5	15	10	20	45
4	18	26	27	71
3	32	29	32	93
2	17	8	-	25
1	7	4	2	13
0	2	-	-	2
Total	93	80	81	254

* The figure 6 means that the airplane was stalled.

TABLE 2-A
(Familiar Plane)

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS IN ATTEMPTING STALL APPROACH IN LEFT CLIMBING TURN

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	4	4	1	9
5	25	21	26	72
4	23	21	32	76
3	24	24	17	65
2	12	9	5	26
1	1	1	-	2
0	4	-	-	4
Total	93	80	81	254

* The figure 6 means that the airplane was stalled.

TABLE 3-A
(Familiar Plane)

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS IN ATTEMPTING STALL APPROACH IN FIRST RIGHT GLIDING TURN

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	2	1	1	4
5	3	4	1	8
4	24	15	16	55
3	44	46	53	143
2	14	9	9	32
1	4	4	1	9
0	2	1	-	3
Total	93	80	81	254

* The figure 6 means that the airplane was stalled.

TABLE 4-A
(Familiar Plane)

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS IN ATTEMPTING STALL APPROACH IN STEEP LEFT TURN AT ALTITUDE

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	5	3	-	8
5	30	41	59	130
4	15	6	13	34
3	25	12	8	45
2	9	6	1	16
1	5	7	-	12
0	2	4	-	6
Total	91	79	81	251
No observation	2	1	-	3

* The figure 6 means that the airplane was stalled.

TABLE 5-A
(Familiar Plane)

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS IN ATTEMPTING STALL APPROACH IN RIGHT CLIMBING TURN

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	7	2	-	9
5	16	14	25	55
4	20	20	26	66
3	34	25	21	80
2	11	11	7	29
1	3	7	2	12
0	2	1	-	3
Total	93	80	81	254

* The figure 6 means that the airplane was stalled.

TABLE 6-A
(Familiar Plane)

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS IN ATTEMPTING STALL APPROACH IN FIRST LEFT GLIDING TURN

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	5	3	-	8
5	12	7	9	28
4	25	30	33	88
3	40	33	34	107
2	9	6	3	18
1	1	1	2	4
0	1	-	-	1
Total	93	80	81	254

* The figure 6 means that the airplane was stalled.

TABLE [illegible]
(Familiar Planes)

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS IN ATTEMPTING STALL APPROACH STRAIGHT AHEAD, CLIMBING POWER

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	5	3	1	9
5	19	24	28	71
4	22	25	32	79
3	34	20	14	68
2	9	4	5	18
1	4	4	1	9
0	-	-	-	-
Total	93	80	81	254

* The figure 6 means that the airplane was stalled.

TABLE 8-A
(Familiar Planes)

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS IN ATTEMPTING STALL APPROACH IN SECOND RIGHT GLIDING TURN

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	7	3	-	10
5	2	2	2	6
4	23	21	25	69
3	47	38	45	130
2	10	12	7	29
1	3	4	2	9
0	-	-	-	-
Total	92	80	81	253
No observation	1	-	-	1

* The figure 6 means that the airplane was stalled.

TABLE 9-A
(Familiar Plane)

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS IN ATTEMPTING STALL APPROACH IN STEEP RIGHT TURN AT ALTITUDE

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	3	3	-	6
5	13	22	43	78
4	20	15	15	50
3	23	13	14	50
2	12	7	7	26
1	13	14	2	29
0	5	5	-	10
Total	89	79	81	249
No observation	4	1	-	5

* The figure 6 means that the airplane was stalled.

TABLE 10-A
(Familiar Plane)

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS IN ATTEMPTING STALL APPROACH IN SPIRAL LEFT GLIDING TURN

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	7	5	-	12
5	13	11	10	34
4	25	27	36	88
3	35	27	31	93
2	11	10	2	23
1	2	-	2	4
0	-	-	-	-
Total	93	80	81	254

* The figure 6 means that the airplane was stalled.

TABLE 11-A
(Familiar Plane)

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS DURING LEFT CLEARING TURN BEFORE MANEUVER 1

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	-	-	-	-
5	-	-	-	-
4	-	-	-	-
3	-	-	-	-
2	1	-	-	1
1	6	6	8	20
0	81	72	71	224
Total	88	78	79	245
No observation	5	2	2	9

* The figure 6 means that the airplane was stalled.

TABLE 12-A
(Familiar Plane)

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS DURING RIGHT CLEARING TURN BEFORE MANEUVER 1

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	-	-	-	-
5	-	-	-	-
4	-	-	-	-
3	-	-	-	-
2	1	-	-	1
1	7	10	4	21
0	80	68	75	223
Total	88	78	79	245
No observation	5	2	2	9

* The figure 6 means that the airplane was stalled.

TABLE 13-A
(Familiar Plane)

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS DURING CLIMB TO ALTITUDE BEFORE MANEUVER 3

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	-	-	-	-
5	-	-	-	-
4	-	-	-	-
3	1	-	-	1
2	4	2	2	8
1	29	36	19	84
0	51	39	47	137
Total	85	77	68	230
No observation	8	3	13	24

* The figure 6 means that the airplane was stalled.

TABLE 14-A
(Familiar Plane)

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS DURING LEFT CLEARING TURN BEFORE MANEUVER 3

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	-	-	-	-
5	-	-	-	-
4	-	-	-	-
3	-	-	-	-
2	5	1	-	6
1	13	21	13	47
0	69	58	62	189
Total	87	80	75	242
No observation	6	-	6	12

* The figure 6 means that the airplane was stalled.

TABLE 15-A
(Familiar Planes)

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS DURING RIGHT CLEARING TURN BEFORE MANEUVER 3

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	-	-	-	-
5	-	-	-	-
4	-	-	-	-
3	-	-	-	-
2	2	1	-	3
1	16	12	9	37
0	70	67	66	203
Total	88	80	75	243
No observation	5	-	6	11

* The figure 6 means that the airplane was stalled.

TABLE 16-A
(Familiar Planes)

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS DURING CLIMB TO ALTITUDE BEFORE MANEUVER 5

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	-	-	-	-
5	-	-	-	-
4	-	-	-	-
3	-	1	1	2
2	-	4	2	6
1	35	33	21	89
0	53	38	46	137
Total	88	76	70	234
No observation	5	4	11	20

* The figure 6 means that the airplane was stalled.

TABLE 17-A
(Familiar Planes)

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS DURING LEFT CLEARING TURN BEFORE MANEUVER 5

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	-	-	-	-
5	-	-	-	-
4	-	-	-	-
3	-	-	-	-
2	1	4	1	6
1	17	14	11	42
0	72	58	64	194
Total	90	76	76	242
No observation	3	4	5	12

* The figure 6 means that the airplane was stalled.

TABLE 18-A
(Familiar Planes)

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS DURING RIGHT CLEARING TURN BEFORE MANEUVER 5

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	-	-	-	-
5	-	-	-	-
4	-	-	-	-
3	-	1	1	2
2	-	1	-	1
1	13	13	6	32
0	76	61	68	205
Total	89	76	75	240
No observation	-	4	6	14

* The figure 6 means that the airplane was stalled.

TABLE 19-A
(Familiar Plane)

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS DURING CLIMB TO ALTITUDE BEFORE MANEUVER 8

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	-	-	-	-
5	-	-	-	-
4	-	-	-	-
3	1	1	1	3
2	6	3	1	10
1	27	37	28	92
0	54	33	39	126
Total	88	74	69	231
No observation	5	6	12	23

* The figure 6 means that the airplane was stalled.

TABLE 20-A
(Familiar Plane)

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS DURING LEFT CLEARING TURN BEFORE MANEUVER 8

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	-	-	-	-
5	-	-	-	-
4	-	-	-	-
3	1	-	-	1
2	2	3	1	6
1	17	21	13	51
0	68	54	65	187
Total	88	78	79	245
No observation	5	2	2	9

* The figure 6 means that the airplane was stalled.

TABLE 21-A
(Familiar Plane)

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS DURING RIGHT CLEARING TURN BEFORE MANEUVER 8

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	-	-	-	-
5	-	-	-	-
4	-	-	-	-
3	-	-	-	-
2	1	4	1	6
1	14	12	10	36
0	72	62	69	203
Total	87	78	80	245
No observation	6	2	1	9

* The figure 6 means that the airplane was stalled.

TABLE 22-A
(Familiar Plane)

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS DURING FLIGHT BETWEEN MANEUVERS 1 AND 2

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	-	-	-	-
5	-	-	-	-
4	-	-	-	-
3	-	1	-	1
2	1	1	-	2
1	9	8	5	22
0	73	62	75	205
Total	83	72	75	230
No observation	10	8	6	24

* The figure 6 means that the airplane was stalled.

TABLE 24
(Familiar Plane)

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS DURING FLIGHT BETWEEN MANEUVERS 3 AND 4

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	-	-	-	-
5	-	-	-	-
4	-	-	-	-
3	-	-	-	-
2	-	1	-	1
1	7	8	4	19
0	78	66	72	216
Total	85	75	76	236
No observation	8	5	5	18

* The figure 6 means that the airplane was stalled.

TABLE 24-A
(Familiar Plane)

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS DURING FLIGHT BETWEEN MANEUVERS 5 AND 6

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	-	-	-	-
5	-	-	-	-
4	-	-	-	-
3	-	-	-	-
2	-	1	-	1
1	4	-	2	6
0	85	75	77	237
Total	89	76	79	244
No observation	4	4	2	10

* The figure 6 means that the airplane was stalled.

TABLE 25-A
(Familiar Plane)

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS DURING FLIGHT BETWEEN MANEUVERS 6 AND 7

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	-	-	-	-
5	-	-	-	-
4	-	-	-	-
3	-	1	-	1
2	1	-	-	1
1	8	6	4	18
0	79	71	74	224
Total	88	78	78	244
No observation	5	2	3	10

* The figure 6 means that the airplane was stalled.

TABLE 26-A
(Familiar Plane)

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS DURING FLIGHT BETWEEN MANEUVERS 8 AND 9

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	-	-	-	-
5	-	-	-	-
4	-	1	-	1
3	1	-	-	1
2	2	2	-	4
1	7	5	2	14
0	83	69	77	229
Total	93	77	79	249
No observation	-	3	2	5

* The figure 6 means that the airplane was stalled.

TABLE 27-A
(Familiar Plane)

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS DURING FLIGHT BETWEEN MANEUVERS 9 AND 10

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	-	-	-	-
5	-	-	-	-
4	-	-	-	-
3	-	-	1	1
2	1	1	2	4
1	8	10	3	21
0	79	65	69	213
Total	88	76	75	239
No observation	5	4	6	15

* The figure 6 means that the airplane was stalled.

TABLE 28-A
(Familiar Plane)

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS DURING FLIGHT BETWEEN MANEUVERS 10 AND 11

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	-	-	-	-
5	-	-	-	-
4	-	-	-	-
3	-	-	-	-
2	-	1	-	1
1	4	2	5	11
0	72	68	69	209
Total	76	71	74	221
No observation	17	9	7	33

* The figure 6 means that the airplane was stalled.

TABLE 29-A
(Unfamiliar Plane)

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS IN ATTEMPTING STALL APPROACH STRAIGHT AHEAD, CRUISING POWER

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	12	7	2	21
5	1	1	-	2
4	6	5	14	25
3	11	19	12	42
2	7	9	8	24
1	1	-	-	1
0	1	3	-	4
Total	39	44	36	119

* The figure 6 means that the airplane was stalled.

TABLE 30-A
(Unfamiliar Plane)

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS IN ATTEMPTING STALL APPROACH IN LEFT CLIMBING TURN

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	13	10	2	25
5	-	-	-	-
4	9	11	15	35
3	7	15	13	35
2	8	7	6	21
1	-	1	-	1
0	2	-	-	2
Total	39	44	36	119

* The figure 6 means that the airplane was stalled.

TABLE 31-A
(Unfamiliar Plane)

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS IN ATTEMPTING STALL APPROACH IN FIRST RIGHT GLIDING TURN

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	11	10	5	26
5	-	-	-	-
4	-	7	4	11
3	20	20	20	60
2	6	6	6	18
1	1	-	1	2
0	1	-	--	1
Total	39	43	36	118
No observation	-	1	-	1

* The figure 6 means that the airplane was stalled.

TABLE 32-A
(Unfamiliar Plane)

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS IN ATTEMPTING STALL APPROACH IN STEEP LEFT TURN AT ALTITUDE

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	1	16	14	31
5	1	8	15	24
4	7	6	2	15
3	2	5	5	12
2	1	1	-	2
1	-	2	-	2
0	1	-	-	1
Total	13	38	36	87
No observation	26	6	-	32

* The figure 6 means that the airplane was stalled.

TABLE 33-A
(Unfamiliar Plane)

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS IN ATTEMPTING STALL APPROACH IN RIGHT CLIMBING TURN

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	5	8	2	15
5	-	-	-	-
4	7	7	14	28
3	13	14	14	41
2	8	13	6	27
1	2	-	-	2
0	4	2	-	6
Total	39	44	36	119

* The figure 6 means that the airplane was stalled.

TABLE 34-A
(Unfamiliar Plane)

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS IN ATTEMPTING STALL APPROACH IN FIRST LEFT GLIDING TURN

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	8	12	5	25
5	-	-	-	-
4	4	7	6	17
3	21	19	19	59
2	6	6	6	18
1	-	-	-	-
0	-	-	-	-
Total	39	44	36	119

* The figure 6 means that the airplane was stalled.

Table 35-A
(Unfamiliar Plane)

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS IN ATTEMPTING STALL APPROACH STRAIGHT AHEAD, CLIMBING POWER

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	10	8	5	23
5	-	-	-	-
4	10	10	13	33
3	14	17	15	46
2	3	7	3	13
1	-	1	-	1
0	2	1	-	3
Total	39	44	36	119

* The figure 6 means that the airplane was stalled.

TABLE 36-A
(Unfamiliar Plane)

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS IN ATTEMPTING STALL APPROACH IN SECOND RIGHT GLIDING TURN

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	9	13	5	27
5	-	-	-	-
4	7	4	2	13
3	16	23	22	61
2	5	3	6	14
1	1	-	-	1
0	1	1	-	2
Total	39	44	35	118
No observation	-	-	1	1

* The figure 6 means that the airplane was stalled.

TABLE 37-A
(Unfamiliar Plane)

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS IN ATTEMPTING STALL APPROACH IN STEEP RIGHT TURN AT ALTITUDE

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	1	12	10	23
5	-	1	9	10
4	5	7	10	22
3	3	8	5	16
2	3	6	2	11
1	-	3	-	3
0	1	1	-	2
Total	13	38	36	87
No observation	26	6	-	32

* The figure 6 means that the airplane was stalled.

TABLE 38-A
(Unfamiliar Plane)

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS IN ATTEMPTING STALL APPROACH IN SECOND LEFT GLIDING TURN

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	7	10	4	21
5	-	1	-	1
4	8	2	4	14
3	19	24	25	68
2	4	7	3	14
1	-	-	-	-
0	1	-	-	1
Total	39	44	36	119

* The figure 6 means that the airplane was stalled.

TABLE 39-A
(Unfamiliar Plane)

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS DURING LEFT CLEARING TURN BEFORE MANEUVER 1

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	-	-	-	-
5	-	-	-	-
4	-	-	-	-
3	-	-	-	-
2	-	3	1	4
1	3	1	1	5
0	36	40	34	110
Total	39	44	36	119

* The figure 6 means that the airplane was stalled.

TABLE 40-A
(Unfamiliar Plane)

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS DURING RIGHT CLEARING TURN BEFORE MANEUVER 1

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	-	-	-	-
5	-	-	-	-
4	-	-	-	-
3	-	-	-	-
2	2	1	-	3
1	3	1	3	7
0	34	42	33	109
Total	39	44	36	119

* The figure 6 means that the airplane was stalled.

TABLE 41-A
(Unfamiliar Plane)

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS DURING CLIMB TO ALTITUDE BEFORE MANEUVER 3

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	-	-	-	-
5	-	-	-	-
4	-	-	-	-
3	-	-	-	-
2	4	5	1	10
1	7	8	6	21
0	28	30	29	87
Total	39	43	36	118
No observation	-	1	-	1

* The figure 6 means that the airplane was stalled.

TABLE 42-A
(Unfamiliar Plane)

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS DURING LEFT CLEARING TURN BEFORE MANEUVER 3

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	-	-	-	-
5	-	-	-	-
4	1	-	-	1
3	-	-	-	-
2	4	1	1	6
1	4	3	3	10
0	29	40	32	101
Total	38	44	36	118
No observation	1	-	-	1

* The figure 6 means that the airplane was stalled.

TABLE 43-A
(Unfamiliar Plane)

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS DURING RIGHT CLEARING TURN BEFORE MANEUVER 3

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	-	-	-	-
5	-	-	-	-
4	-	-	-	-
3	-	-	-	-
2	2	2	1	5
1	2	3	1	6
0	34	39	34	107
Total	38	44	36	118
No observation	1	-	-	1

* The figure 6 means that the airplane was stalled.

TABLE 44-A
(Unfamiliar Plane)

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS DURING CLIMB TO ALTITUDE BEFORE MANEUVER 5

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	-	-	-	-
5	-	-	-	-
4	-	-	-	-
3	1	1	-	2
2	1	2	1	4
1	9	8	4	21
0	28	33	31	92
Total	39	44	36	119

* The figure 6 means that the airplane was stalled.

TABLE 45-A
(Unfamiliar Plane)

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS DURING LEFT CLEARING TURN BEFORE MANEUVER 5

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	-	-	-	-
5	-	-	-	-
4	-	-	-	-
3	-	-	-	-
2	3	1	1	5
1	5	4	3	12
0	31	39	32	102
Total	39	44	36	119

* The figure 6 means that the airplane was stalled.

TABLE 45-A
(Unfamiliar Plane)

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS DURING RIGHT CLEARING TURN BEFORE MANEUVER 5

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	-	-	-	-
5	-	-	-	-
4	-	-	-	-
3	-	-	-	-
2	3	1	-	4
1	4	3	4	11
0	32	38	32	101
Total	39	42	36	119

* The figure 6 means that the airplane was stalled.

TABLE 47-A
(Unfamiliar Plane)

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS DURING CLIMB TO ALTITUDE BEFORE MANEUVER 8

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	-	-	-	-
5	-	-	-	-
4	-	-	-	-
3	-	1	-	1
2	4	6	4	14
1	4	8	5	17
0	31	29	27	87
Total	39	44	36	119

* The figure 6 means that the airplane was stalled.

TABLE 48-A
(Unfamiliar Plane)

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS DURING LEFT CLEARING TURN BEFORE MANEUVER 8

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	-	-	-	-
5	-	-	-	-
4	-	-	-	-
3	-	-	-	-
2	4	1	4	9
1	6	5	5	16
0	29	38	27	94
Total	39	44	36	119

* The figure 6 means that the airplane was stalled.

TABLE 49-A
(Unfamiliar Plane)

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS DURING RIGHT CLEARING TURN BEFORE MANEUVER 8

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	-	-	-	-
5	-	-	-	-
4	-	-	-	-
3	-	-	-	-
2	2	1	2	5
1	6	5	3	14
0	31	38	31	100
Total	39	44	36	119

* The figure 6 means that the airplane was stalled.

TABLE 50-A
(Unfamiliar Plane)

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS DURING FLIGHT BETWEEN MANEUVERS 1 AND 2

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	-	-	-	-
5	-	-	-	-
4	1	-	-	1
3	4	4	3	11
2	21	12	11	44
1	9	15	10	34
0	2	10	6	18
Total	37	41	30	108
No observation	2	3	6	11

* The figure 6 means that the airplane was stalled.

TABLE 51-A
(Unfamiliar Plane)

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS DURING FLIGHT BETWEEN MANEUVERS 3 AND 4

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	1	-	-	1
5	-	-	-	-
4	1	-	-	1
3	3	1	1	5
2	16	9	10	35
1	12	20	13	45
0	4	11	6	21
Total	37	41	30	108
No observation	2	3	6	11

* The figure 6 means that the airplane was stalled.

TABLE 52-A
(Unfamiliar Plane)

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS DURING FLIGHT BETWEEN MANEUVERS 5 AND 6

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	-	-	-	-
5	-	-	-	-
4	-	-	-	-
3	-	-	-	-
2	2	5	3	10
1	6	17	13	36
0	28	18	14	60
Total	36	40	30	106
No observation	3	4	6	13

* The figure 6 means that the airplane was stalled.

TABLE 53-A
(Unfamiliar Plane)

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS DURING FLIGHT BETWEEN MANEUVERS 6 AND 7

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	-	-	-	-
5	-	-	-	-
4	-	-	1	1
3	3	1	1	5
2	10	12	7	29
1	17	19	20	56
0	7	9	2	18
Total	37	41	31	109
No observation	2	3	5	10

* The figure 6 means that the airplane was stalled.

TABLE 54-A
(Unfamiliar Plane)

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS DURING FLIGHT BETWEEN MANEUVERS 8 AND 9

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	1	-	-	1
5	-	-	-	-
4	1	-	1	2
3	2	2	2	6
2	19	12	13	44
1	11	14	9	34
0	3	13	5	21
Total	37	41	30	108
No observation	2	3	6	11

* The figure 6 means that the airplane was stalled.

TABLE 55-A
(Unfamiliar Plane)

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS DURING FLIGHT BETWEEN MANEUVERS 9 AND 10

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	1	-	-	1
5	-	-	-	-
4	-	1	2	3
3	6	3	1	10
2	9	12	13	34
1	15	15	10	40
0	6	10	5	21
Total	37	41	31	109
No observation	2	3	5	10

* The figure 6 means that the airplane was stalled.

TABLE 56-A
(Unfamiliar Plane)

NUMBER OF LIGHTS LIT BY STUDENT PILOTS, PRIVATE PILOTS, AND INSTRUCTORS DURING FLIGHT BETWEEN MANEUVERS 10 AND 11

Number of Lights Lit	Type of Pilot: Student	Private	Instructor	All Pilots
6*	-	-	-	-
5	-	-	-	-
4	-	-	-	-
3	1	-	-	1
2	-	6	1	7
1	7	16	15	38
0	28	18	14	60
Total	36	40	30	106
No observation	3	4	6	13

* The figure 6 means that the airplane was stalled.

APPENDIX B

INSTRUCTIONS TO THE CHECK PILOT FOR THE CONDUCT OF THE EXAMINATION FLIGHT

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After the take-off the check pilot should instruct the examinee to "climb to 2,000 feet," or whatever altitude indicates the usual field policy for practice in stalls, and give such other instructions as are necessary to get the airplane to an acceptable practice area. After reaching the area at altitude, the check pilot may say, "O.K., make your clearing turns left and right, and then fly straight ahead with cruising power." With the airplane flying straight ahead with cruising power, the check pilot may say, "All right, now come as close to stalling as you can, but don't stall." As the stall is approached, the lights on the clipboard will come on from left to right. The check pilot will note the farthest one to the right which lights, and put a check mark in the column underneath it. Notice that the printing for all of the numbered maneuvers sits on a solid purple line underneath a broken purple line. The check mark must therefore be on a solid purple line and underneath a broken purple line.

As soon as the examinee has returned to a straight-ahead cruise, the check pilot may say, "O.K., let's try it straight ahead with power off. Come as close as you can to stalling, but don't stall."

When this approach has been finished, the student should be told, "O.K., climb to 2,200 feet," or to any reasonable altitude higher than when this order is given. When the altitude is reached, the examinee may be told, "All right, make your left and right clearing turns." And after they are finished, the check pilot may say, "Now go into a left climbing turn and after you are in it, try the stall again. Come as close as you can, but don't stall." After this, the student is told to go into a right gliding turn and try another approach to the stall.

Then comes another climb to a specified higher altitude (that is, higher than the altitude at which the instruction is given to climb to altitude--the idea is merely to follow the flight examination sheet the same at all centers and this climb to altitude may be necessary in some, depending on how much altitude is lost in the maneuvers, and it therefore suggested for all centers). After this the clearing left and right turns, after which the examinee is told to to enter a steeply banked turn as in the 720 degree turn. After this turn is established, he is to make his stall approach. Similarly in number 6, the approach to the stall is to be commenced after a right climbing turn is established. The same holds for number 7, the left gliding turn, and after that there is the climb to altitude and clearing turns

By this time there has been a great deal of opportunity to look around the country to see whether other airplanes are in the vicinity, and it should be possible to run the next four maneuvers without any further clearing turns left or right. Of course if traffic conditions warrant clearing turns, they should be inserted wherever necessary.

In number 8 the examinee is to establish a straight-ahead climb, and thereafter make a stall approach. Similarly in number 9, he establishes a right gliding turn and then approaches the stall. Also in number 10, which is a steep turn to the right as in the 720 degree turn, the turn is established first, and then the stall approach is made. This also holds for the final maneuver, number 11, the left gliding turn, after which the airplane is returned to the field.