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Simultaneous Contact-instrument *Flight Training*

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Simultaneous Contact-instrument *Flight Training*

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Foreword

Better power plants, better airframes, and better airplane instruments are the order of the day. To keep pace we need better training methods for those who are to fly the newer and improved aircraft. The results of another significant undertaking in the series of experiments that the Institute of Aviation and other units of the University, particularly the aviation psychology group, have been conducting over the years are the subject of this bulletin. The experiment asks the question, "Can both contact and instrument flight be taught efficiently at the same time?"

The authors of this bulletin are trained psychologists and formerly were rated pilots in the armed services of the United States. Their background and experience make them uniquely qualified to handle the experiment. They wish to express their appreciation for help in carrying out the experiment to Messrs. Jesse W. Stonecipher, Keith R. Stone, Clifford P. Marye, and John L. McGlone, flight instructors of the Institute staff, and to Mr. Scott G. Hasler of The Glenn L. Martin Company, and Mr. Ralph Flexman of the Air Forces Personnel and Training Research Center, Tyndall Air Force Base.

Funds for the experiment were provided by The Link Foundation.

In this monograph, as in all publications of the Institute, the authors have had complete freedom to express their opinions with the understanding that they will assume sole responsibility therefor.

September, 1955 LESLIE A. BRYAN, *Director*

Simultaneous contact-instrument instruction stresses the relationship of the aircraft attitude to the artificial horizon indicator.

Introduction

For many years airplanes could be flown safely only under "contact" conditions, i.e., when the weather was such that the pilot could at all times see the ground or horizon and fly by reference to it. This restriction greatly curtailed the utility of aircraft. In the 1920's instruments were developed which made it possible to fly under limited circumstances without being able to see the ground, if the pilot had been specially trained to use the instruments. Since that time the development of aircraft instruments and associated navigation, traffic control, and approach systems has proceeded to the point where today many cross-county flights are made without the pilot seeing the ground at all except, routinely, for the last few hundred feet of the approach.

Even so, a vast majority of pilots still regard instrument flight as something special although they may be qualified to perform it. Only a few pilots, notably airline pilots and some experienced military pilots, regard instrument flying as completely routine. For example, when the weather is poor a large proportion of civil (non-airline) and military flights are cancelled. Furthermore, interviews with many civil and military pilots show that, in general, instrument flying is disliked and avoided when possible. Thus it is evident that the development of equipment has outstripped the development of the skill and confidence of the average professional pilot who uses it. The aircraft is capable of greater utilization than the pilot is able or willing to exact from it for whatever reason.

Private pilots, who in general are not qualified to fly instruments, face a different problem. They are willing to accept the inconvenience of being grounded when the weather is poor. Far too many, however, get caught inadvertently in instrument weather and the consequences are often fatal; e.g., during the period December 11, 1954, through April 14, 1955, ten fatal accidents occurred to private aircraft within a radius of 180 miles of the University of Illinois airport. Twenty-seven people were killed. All of these accidents occurred during weather in which the pilot was not qualified to fly although the aircraft was adequately equipped in each case. As nearly as can be determined from the subsequent investigations every accident was caused by the pilot's losing control of the aircraft under conditions of instrument flight. It may be argued that these pilots used poor judgment in flying at all; yet in only one instance was the weather poor enough at takeoff to warrant cancellation of the flight. It is possible that had the pilots been equipped with even a minimum skill at instrument flight many of these accidents would not have occurred.

If both professional and private pilots are deficient with respect to instrument flight — the former because of inefficient utilization of the aircraft and the latter because of lack of skill — then it is worthwhile searching for possible remedies. In the first place it is clear that ability to fly an airplane under contact conditions does not imply ability to fly on instruments. Instrument flying must be learned as such, and it is generally regarded as a difficult task. On the other hand it is equally clear that the aircraft itself is unaware of weather conditions.

It is the same machine and it flies the same way whether or not the pilot's view of the ground is obscured by clouds. Hence the difference must depend upon the way in which information is presented to the pilot, i.e., through direct outside vision on the one hand or via instruments on the other.

One possible solution lies in the redesign of aircraft instrument displays and controls so that pilots are better able to use them. This human engineering approach is being pursued vigorously and it is expected that considerable improvement in general instrument flying ability will be achieved in this manner.

A second approach, of immediate concern here, is the method of training individuals to fly aircraft. With rare exceptions the sequence of training follows the historical development of the different kinds of flying involved. Thus students are taught how to fly under contact conditions first, then later, if ever, they are taught instrument flying. There is some evidence that suggests this may not be the best sequence.

In 1934-35, T. Lee, Jr., of the Boeing School of Aeronautics, trained sixteen students in instrument flying first and contact flying later. The results were deemed so successful that Mr. Lee concluded: "We are now so completely sold that we believe all students taking instruction for long-time courses, such as our Airline Pilot Course (250 hours), should begin their flight instruction under the hood."[1]

In 1953 Ritchie and Michael[2] studied transfer between instrument and contact flight training. Two groups of flight-naive students were taught to fly straight and level and to make 180° turns — one group on contact the other group on instruments. After a stated level of proficiency had been achieved the groups were switched, the contact group now learning to fly the maneuvers on instruments and the instrument group learning on contact. It was found that initial learning on instruments facilitated subsequent learning on contact but that initial learning on contact *interfered* with later learning on instruments.

Procedures

With these two studies in mind and recognizing the unsatisfactory results of conventional curricula, the present investigation was undertaken. The purpose was to determine the feasibility of incorporating both instrument and contact flight training within the time limits of a private pilot syllabus. It was felt that if this could be done successfully the student would benefit from early familiarity with instrument flight and that this mode of flying would seem as "natural" to him as contact flying. The scope of the project was determined by the resources available. Ideally the project should have been extended to carry students trained simultaneously in instrument and contact flight up to the level of professional pilot at which time they could be compared with students trained according to the conventional sequence. By restricting the flight syllabus to approximately thirty-five hours this important comparison could not be made. However it seems unlikely that an experimental syllabus of this type for the professional pilot would be successful if great difficulties were encountered during the first thirty-five hours. On the other hand,

[1] Lee, T., Jr., "Instrument Flying From Scratch," *Aviation,* Vol. 34 No. 12, December 1935

[2] Ritchie, M. L., and Michael, A. L., "Transfer Between Instrument and Contact Flight Training," *Journal of Applied Psychology,* Vol. 39 No. 3, June 1955

success during the first thirty-five hours, while not guaranteeing success for the whole, would strongly suggest that students trained this way would at least be as proficient as students receiving conventional training.

For the pilot ending his formal training at the private pilot level the experimental syllabus has direct significance. If training in instrument flying can be included in his syllabus without disrupting or interfering with its basic purpose, i.e., proficiency at contact flight, then this may represent a solution to the persistent hazard of being caught inadvertently on instruments.

In the present syllabus no attempt was made to equip the student with the skills needed to make a deliberate instrument flight. Practice at navigation, the use of radio aids, and approach procedures were not included. Students were expected to demonstrate positive control of the aircraft on instruments, i.e., ability to fly straight and level, climb, descend, turn, climbing and descending turns, and recovery from unusual attitudes. These, in a sense, are "life-saving" skills for the private pilot and at the same time represent a solid basis for the further training of those who are to become professionals.

METHOD

The syllabus used was based upon the Illinois Plan SR 354 (revised) syllabus.[3] It consisted of forty-seven periods requiring 64.4 hours of instruction. These hours were spent as follows:

Discussion	13.3 hours
Link instrument trainer	11.0 hours
Dual flight instruction	21.7 hours
Solo flight	10.4 hours
Simulated instrument flight	6.2 hours[4]
Observer time	8.0 hours[5]

An outline of the simultaneous contact-instrument syllabus, lesson by lesson, is presented in Appendix A.

It will be noted that the first five periods or 3.2 hours were spent in the Link Trainer and under the hood in the aircraft. This was done in order to take advantage of Ritchie and Michael's finding of positive transfer of training from instrument to contact flight. On the 6th period

[3] This syllabus utilizes more than the usual dual flight time, emphasizes cross-country flying and planned discussion periods, and in addition uses the School Link for contact flight instruction. Instruction given totals 62.9 hours, with 45 periods of instruction.

[4] Included in the 21.7 hours of dual instruction.

[5] During long cross-country flights.

contact flight was introduced and thereafter contact and instrument flying were interspersed within subsequent dual periods, except for periods devoted to night flying and other special purposes.

Throughout this instruction great emphasis was placed upon attitude instrument flying. The analogy between contact flight and attitude instrument flight was continually pointed out. It was made clear to the student that the airplane was flown exactly the same way on instruments as on contact. These points were emphasized by alternating the performance of a maneuver first in one mode then in the other within the same period. During the early part of the syllabus all that was required of the student was positive control of the attitude of the aircraft in the performance of the beginning maneuvers. Thus full use of the artificial horizon was required at the start. Later other instruments were introduced to the student as a means of increasing his precision over basic attitude control. The control of attitude by means of rate instruments was explained and practiced. Finally, toward the end of the syllabus, the artificial horizon and directional gyro were covered and the student practiced partial panel flying.

The approved syllabus upon which the experimental syllabus was based requires six hours of solo cross-country flying and twelve hours of dual cross-country flying.

Because the four-place aircraft used in this project were also needed in the regular Institute of Aviation flight course for dual cross-country flights, it was necessary for the experimental students to take their solo cross-country flights in two-place, tandem-type, aircraft. The experimental students, then, were checked out safe-for-solo-cross-country in a second aircraft and thus were obliged to fly for approximately nine hours without an opportunity to practice instrument flying. This arrangement was felt to be undesirable, but necessary under the circumstances. It did have the advantage, however, of enabling the students to check out in both conventional and tricycle gear aircraft.

EQUIPMENT

The Piper Tri-Pacer with a full panel of instruments was used as the training aircraft and students were also checked-out in the Aeronca 7-AC. Simulated instrument flight was conducted in the Tri-Pacer by covering the entire windshield and forward side windows with amber plexiglass. The student then wore blue goggles during instrument maneuvers. Two Link Trainers were used — the 1-CA-1 or C-8 Link Instrument Trainer and the 1-CA-2 or P-1 Link Trainer. The P-1 Link is similar to the C-8 except that the cockpit is a replica of the T-6 aircraft. A blackboard, a model airplane, and a hand-operated artificial horizon were used in discussion periods.

Simultaneous contact-instrument instruction was given in a modified Link Operational Flight Trainer (1CA-2).

SUBJECTS

The eighteen experimental subjects were selected from a group of undergraduate students enrolled in Aviation 101, the primary flying course at the University of Illinois. Students who were selected had had no previous flying experience as pilots and a minimum amount of experience as passengers. The only other criterion used to select the subject was ease of scheduling. The experimental group consisted of seventeen men and one woman.

INSTRUCTORS

Messrs. Clifford P. Marye, Keith Stone, and John L. McGlone were the flight instructors. These men were regular members of the Institute of Aviation flight instruction staff. They held commercial pilot certificates with instructor and instrument ratings and they had been instructing for an average of about 3½ years. They collaborated with Mr. Jesse Stonecipher, Chief Flight Instructor, and with the staff of the Aviation Psychology Laboratory in establishing a detailed flight syllabus and the particular methods of instruction. Tri-weekly meetings were held with these instructors to review progress, elaborate upon and assess the adequacy of the syllabus, and agree on minor changes that seemed warranted.

PRE-TEST OF SYLLABUS

It would have been desirable to try out the entire syllabus with several students before using it in the project; however, this was not possible. In the summer and fall of 1954 an Institute instructor had given a number of primary students training in instrument flight during the regular course of instruction. This was done in an aircraft equipped only with partial panel. A strict needle, ball, and airspeed system was used. The results of this instruction were very encouraging and the experiences encountered served as one basis for constructing the present syllabus. A form of pre-testing was achieved by having two members of the Aviation Psychology laboratory staff, Messrs. S. G. Hasler and L. E. Wilkerson, try out the syllabus with two extra students concurrently with the experimental group but about four periods in advance of the most advanced number of the regular group. Information about the syllabus gained from these students was then fed back into the main project by means of the tri-weekly meetings held with the instructors.

FLIGHT CHECK PROCEDURES

It was decided that the requirement of adequate proficiency at contact flight would be satisfied if the student could pass the regulation private pilot flight test. This test was administered to all students at the completion of the syllabus. Because of the widespread interest in this type of training, the students were checked by C.A.A. Airman Operatives Specialists from the C.A.A. office in Washington, D. C., and the C.A.A. regional office in Kansas City, as well as by agents from St. Louis, Indianapolis, and Springfield. Each student was given the standard private pilot flight test and at the discretion of the check pilot, basic airwork under simulated instrument conditions.

Two simulated instrument flight checks were also given by the flight instructors — one just prior to solo and the other just prior to the final C.A.A. flight check. Observations were recorded from the back seat by a member of the Aviation Psychology laboratory staff since the instructors were acting as safety pilots. Details of each flight check are given in Appendix B.

Both instrument flight checks contained five maneuvers in common. However, instructions to the students were such that on the second check these maneuvers were more difficult. On the first check rated climbs, descents, turns, or maintenance of specific airspeeds were not required, but instructions for the second check specified airspeeds, standard rate turns, and rated climbs and descents.

The method used in recording instrument performance was selected to give a reasonable description, rather than evaluation, of the student's performance during each maneuver. For this reason, observations were made at ten-second intervals to sample the student's performance throughout the recording interval. Maximum deviations were not recorded unless they coincided with the sample observations, but samples were taken at sufficient intervals to include sustained deviations.

Results

Results of the experimental training syllabus are of two general types: (a) those of an objective nature which can be discussed in terms of numbers, and (b) those of a subjective nature which are opinions and attitudes of the check pilots, instructors, and students themselves. The more objective evidence is considered first as a background for the subjective evaluations.

It was the purpose of the flight course to train private pilots. The result of first interest, therefore, is that all students passed the standard flight examination and received private pilot's certificates within the time allotted. Two students failed their flight tests on the first trial, and one of these required a third flight test to pass. C.A.A. agents or specialists administered 15 flight tests, including 2 retests to experimental students. A private pilot examiner from another airport gave one flight test. The remainder were given by Institute of Aviation examiners,[6] although the C.A.A. agents were offered the opportunity to fly with all students.

Total dual time, including all flight checks and tests, averaged 23.3 hours. Total solo time averaged 10.8 hours, or an average total flight time of 34.1 hours. A breakdown of flight time by students is shown in Table 1. Comparable averages for students taking the regular University of Illinois Private Pilot syllabus excluding flight check time are also shown in Table 1. A comparison of the averages for the students in the regular and experimental syllabus shows that the experimental students logged .8 hour more dual, and .3 hour less solo, on the average, than the students in the regular syllabus. The additional dual for the experimental students is more than accounted for by the final test and two instrument flight checks, which averaged 2.3 hours. The experimental students then actually had slightly less dual instruction flight time. This is in spite of the fact that all experimental students had no previous flight time, whereas many of the regular students had done some previous flying as pilots.

All students were given two objective-type flight checks under simulated instrument conditions. The first flight check was given prior to solo (immediately after period 13 in the syllabus). At this time the student was scheduled to have had 2.6 hours of simulated instrument instruction in the air and 4.8 hours of instruction in the Link. The second flight check was given just prior to the student's final preparation for the private pilot's flight test, i.e., after period 45. The details of each flight check are given in Appendix B.

[6] The University of Illinois Institute of Aviation has special authorization from the C.A.A. to administer examinations to its own students.

There was considerable variability in performance among students on the instrument checks. The greater variability occurred on the second flight check. All students were expected to maintain control of the aircraft throughout the 30-45 minute simulated instrument phase of the check, and with the exception of one student who was assisted on takeoff, all were able to do so throughout the first check.

Table 2 summarizes performance on both checks, in terms of deviations from desired headings and altitudes, and deviations from the student's own mean bank and mean airspeed. Deviations from the student's own mean are given because the students, prior to the first check, had not been specifically instructed in the use of airspeeds and bank angles, but rather in terms of attitudes as shown by the artificial horizon.

Mean banks and airspeeds, together with average deviations and average maximum deviations of the sample observations for all experimental students, are shown in Table 3. Pitch attitudes were defined to yield a 90 m.p.h. climb and glide airspeed for the first check. Prior to the second check, instruction was modified to require the student to maintain 80 m.p.h. during all climbs and glides.

An inspection of Table 2 shows that students flew within reasonable tolerances on most items. On the first check in the 360° level turn, for example, 15 out of 18 students held their altitude within 100′ of their initial altitude throughout the turn and for 30 seconds after roll out. Seventeen of the 18 rolled out and held their heading within 5° of the desired heading. Table 3 shows that the mean bank was 26.3°, with an average deviation of 2.6° during the 10-second observations, and an average maximum deviation of 5.9°. Average deviation of altitude was 31′, with an average maximum deviation of 64.4′.

Intentionally, the second instrument flight check was more difficult. The requirement of rated climbs, descents, and turns complicated the task considerably. The steep turn on partial panel was intended as a rigorous test of partial panel control.

Surprisingly, full panel performance on maneuvers common to both checks was not more precise on the second check, but was slightly inferior when the average of all students is considered. On the 360° level turn, altitude and heading deviations were considerably greater on the second check as compared to the first.

On the second check, the average angle of bank on rated turns was not significantly different from that required for a standard rate turn (14°), and average airspeed was precisely that required (80 mph). Variability, as shown by average deviations or average maximum deviations, was slightly greater on the second check. On some items, variability was considerably greater. Two students required assistance from the safety pilot

TABLE NO. 1

Flight Time by Student
Experimental Syllabus

Student	Total Dual	Total Solo	Hours† to Solo	Link	Disc.	Obs.	Examined By
1	22.5	11.5	5.8	11.1	13.0	8.0	CAA
2	30.5	10.1	9.3	11.0	***	***	CAA
3	23.5	10.3	5.0	11.0	18.5	8.0	Institute
4	21.2	10.8	6.6	11.0	14.0	8.0	CAA
5	21.7	10.9	5.8	11.1	13.2	8.0	Private Examiner
6	21.1	11.0	6.0	11.2	13.0	8.0	CAA
7	20.6	10.1	6.5	11.0	16.0	8.0	Institute
8	20.2	10.4	6.3	11.0	12.6	8.0	CAA
9	22.5	11.2	5.7	11.1	12.7	8.0	CAA
10	26.5	10.9	7.3	11.0	13.3	8.0	Institute
11	22.2	11.7	5.7	11.2	12.6	8.0	CAA
12	20.8	11.4	6.0	11.0	14.6	8.6	Institute
13	27.4	11.4	6.4	11.0	15.0	8.0	CAA
14	21.8	10.1	***	11.1	12.6	8.0	CAA
15	22.2	11.0	5.5	11.0	***	***	CAA
16	24.3	10.1	***	11.0	13.1	8.0	CAA
17	28.4	11.1	7.8	11.0	***	***	CAA
18	21.6	11.3	5.7	11.1	13.0	8.0	CAA
Mean for experimental students (N=18)	23.3	10.8	6.3*	11.5	13.8**	8.0**	
Mean for regular students (N=40)	22.5	11.1	6.0	11.0	15.9	8.6	

* N = 16 ** N = 15 † Included in Total Dual hours
*** Time not Logged

TABLE NO. 2

Summary of Instrument Flight Check Results

FULL PANEL	Number of Students Check No. 1	Number of Students Check No. 2
TAKE-OFF		
Unassisted	17	17
Stayed on runway	16	16
Airspeed: Climb out Within ±5 mph of desired (80 mph)	8	9
Within ±10 mph of desired (80 mph)	13	15
Heading: Within ±10 degrees of desired	9	6
1000′ STRAIGHT CLIMB		
Altitude: Within ±50′ of desired	12	
Within ±100′ of desired	17	
Airspeed: Within ±5 mph of own mean	5	
Within ±10 mph of own mean	11	
Heading: Within ±5° of desired	7	
Within ±10° of desired	10	
360° CLIMBING TURN		
Bank: Within ±5° of own mean	11	8
Within ±10° of own mean	17	17
Airspeed: Within ±5 mph of own mean	10	8
Within ±10 mph of own mean	14	15
Heading: For 30 seconds after roll out		
Within ±5° of desired	9	13
Within ±10° of desired	17	16
STRAIGHT AND LEVEL (2 MINUTES)		
Altitude: Within ±50′ of desired	10	9
Within ±100′ of desired	18	17
Heading: Within ±5° of desired	14	9
Within ±10° of desired	17	18
360° LEVEL TURN TO RIGHT, 30° BANK		
Bank: Within ±5° of own mean	8	9
Within ±10° of own mean	16	15
Altitude: Within ±50′ of desired	9	1
Within ±100′ of desired	15	8
Heading: for 30 seconds after roll out Within ±5° of desired	17	11
Within ±10° of desired	18	14

TABLE NO. 2 (Concluded)

	Number of Students	
	Check No. 1	Check No. 2
1000′ STRAIGHT GLIDE		
Altitude: for 30 seconds after level off Within ±50′ of desired	11	
Within ±100′ of desired	17	
Airspeed: Within ±5 mph of own mean	13	
Within ±10 mph of own mean	18	
Heading: Within ±5° of desired	3	
Within ±10° of desired	9	
360° GLIDING TURN		
Bank: Within ±5° of own mean	8	8
Within ±10° of own mean	16	15
Airspeed: Within ±5 mph of own mean	5	4
Within ±10 mph of own mean	16	17
Heading: for 30 seconds after roll out Within ±5° of desired	12	12
Within ±10° of desired	16	17
PARTIAL PANEL		
180° TURN		
Completed		15
Bank: Max. 20° or less		10
Max. 40° or less		14
Degrees Turned: 180° ±45° after 90 seconds		12
after 180 seconds		15
Airspeed: Max. variation 10 mph or less		8
Max. variation 20 mph or less		15
STEEP TURN (45° BANK)		
Unassisted		15
Bank: 30°-60° variation		6
25°-65° variation		9
Altitude: Within ±200′ of desired		8
Within ±400′ of desired		13
Airspeed: Max. variation 80-115 mph or less		5
Max. variation 70-125 mph or less		11
SIMULATED GCA APPROACH		
Unassisted landings out of approach		12

TABLE NO. 3

Mean Values of Instrument Flight Check Items for All Students

	Check No. 1			Check No. 2		
	Mean	Aver. Dev.	Aver. Max. Dev.	Mean	Aver. Dev.	Aver. Max. Dev.
TAKE OFF						
Heading (degrees)			3.4			3
CLIMB OUT						
Airspeed (mph)			8.4			7.7
Heading (degrees)			14.5			18.7
1000′ CLIMB						
Altitude (feet)			48.3			
Airspeed (mph)	87.7	4.2	10.2			
Heading (degrees)		4.5	13.0			
360° CLIMBING TURN						
Bank (degrees)	19.5	2.5	5.2	12	3	7
Airspeed (mph)	87	3.5	6.9	80	3.4	7.8
Heading after roll out (degrees)			6.2			10.0
STRAIGHT AND LEVEL FOR 2 MINUTES						
Altitude (feet)		25	51.7		24.4	58.9
Heading (degrees)		2.4	5.7		2.3	6.0
360° LEVEL TURN						
Bank (degrees)	26.3	2.6	5.9	28.2	3.3	6.7
Altitude (feet)		31.0	64.4		71.2	131.7
Heading after roll out (degrees)			3.8			16.4
1000′ GLIDE						
Altitude deviation after level off (feet)			56.7			
Airspeed (mph)	91.7	2.2	4.0			
Heading (degrees)		5.0	13.5			
360° GLIDING TURN						
Bank (degrees)	23.5	3.4	6.6	13.6	3.3	7.1
Airspeed (mph)	93.9	3.3	7.5	80.5	2.8	7.4
Heading after roll out (degrees)			6.1			7.0

while on full panel on the second check. One of these required assistance just after take-off with a slight crosswind, and the other during the 30° banked 360° level turn. When given a second opportunity to make the turn, the student performed satisfactorily. This same student was unable to make a steep turn partial panel.

All students maintained safe control of the aircraft during the 180° turn maneuver on partial panel. Fifteen of the 18 students were able to find their 180° heading ± 45° within three minutes. Some were erratic in bank and turned considerably more than 180°. However, they did not require assistance. As shown in Table 3, 12 students rolled out of a heading within 45° of the desired heading within 90 seconds. Three students were unable to find their 180° heading but retained control of the aircraft until the instructor terminated the maneuver when it became apparent that the student was not familiar with compass lead, lag, or movement reversals on North and South headings.

All but three students were able to complete a 720° steep turn without assistance, although most of the students showed considerable variation in bank and airspeed. The students who required assistance entered diving spirals which were terminated by the safety pilot removing the student's blue goggles to let him see his position and recover by contact. One student demonstrated a classical case of vertigo when he entered a diving spiral from straight and level flight when given control of the aircraft immediately after the safety pilot had made a steep turn to avoid another aircraft.

The second flight check was terminated with a simulated GCA approach to 200 feet altitude and ½ mile from the end of the runway. The approach was made on full panel instruments with the safety pilot acting as controller. Twelve students made acceptable contact landings from instrument approaches. The other students were unable to land either due to errors in vectoring by the safety pilot or because of poor approaches. Only one simulated GCA approach was attempted, and for most students it was their first since the maneuver was not included in the syllabus.

The subjective results, in the nature of opinions, attitudes, and comments of check pilots, instructors, and students indicated without equivocation that the simultaneous contact-instrument training technique was a desirable one. Most individuals had suggestions as to how the syllabus might be modified to improve it. Some were critical of certain aspects of the syllabus. The C.A.A. representatives who administered the private pilot's flight examination were in agreement that the instrument instruction did not detract from the student's contact proficiency. Most were of the opinion that, with the exception of landings (actual touch-down), students were above or well above average for the private pilot's certificate. All examiners commented that the students were exceptionally alert in looking for other aircraft. They stated also that a few of the students were sufficiently proficient to pass the basic airwork phase of a standard C.A.A. instrument flight test. All students were able to control the aircraft safely when instrument conditions were simulated during the private pilot's flight test.

The three instructors who taught the experimental syllabus were surprised at the ease with which the students learned to fly both instruments and contact and at their ability to check-out safe for solo and cross-country in two different aircraft. The instructors believed that this type of syllabus could and should be incorporated in normal private pilot training. It would be better, however, to design a syllabus independent of the present University of Illinois syllabus. A modified ground school syllabus oriented toward instrument flight techniques, in addition to contact flight techniques, would also be helpful.

There was no formal attempt to measure student attitudes towards the course. In so far as could be determined informally, all students were enthusiastic about the opportunity of receiving instrument instruction. Some said they felt better when flying under the hood than when flying on contact. None of the students expressed any dislike of instrument flying and many seemed surprised that anyone would even consider this possibility. To them it seemed natural to be able to use the flight instruments either when on contact or when under the hood.

It was not possible to determine whether these students felt sufficiently confident to attempt to fly on actual instruments even though not rated to do so. Throughout the course the flight instructor had carefully pointed out the limits of their instrument training, particularly in reference to navigation. Most students, although reasonably confident of their ability to control the aircraft safely, seemed aware that there was much more to learn.

Discussion of Results

Since all students passed the private pilot flight test and in addition demonstrated appreciable ability to fly by instruments, it may be concluded that it is feasible to combine instrument and contact flight instruction in a primary syllabus. Two students failed the flight test on their first attempt. Some had difficulty with landings. However, students who are trained according to the regular University of Illinois syllabus occasionally have such difficulty. This syllabus calls for considerable cross-country flying at the possible expense of intensive training in landings. It is doubtful that the introduction of instrument flying contributed to these deficiencies.

There was considerable variability in the instrument flying skill demonstrated on the final instrument checks. A few students performed reasonably close to the requirements for instrument air work proficiency as stated in the C.A.A. instrument flight check. At the other end of the distribution, three students lost control of the aircraft in steep turns on instruments. A few had difficulty turning to headings on partial panel. Variability of this magnitude suggests that the syllabus used was actually a minimum syllabus for the purpose. Students, instructors, and check pilots all felt that an additional five to eight hours of instruction, distributed throughout the syllabus, would have been desirable and would have improved the weak students to the point of being completely safe on all maneuvers.

There are other possible reasons for the great amount of variability on the second instrument check. Those possibilities are (a) much greater turbulence on the second check than on the first check, (b) less concentrated practice on instruments due to the requirement for cross-country flying in the Aeronca, and increased emphasis on contact maneuvers during the latter part of the course, and (c) introduction of partial panel flying. With regard to the latter, requirement of rated turns, climbs, and glides was introduced as a means of teaching the student to learn to use the rate instruments in conjunction with the artificial horizon and also as an introduction to partial panel flying. Because of possible misplaced emphasis during the training, the students tended to ignore the artificial horizon even when on full panel and concentrated on the rate instruments. In effect many were flying partial panel during the entire check flight and some even made the 30° banked turn by reference to the deflection of the turn needle rather than the artificial horizon. Such "partial panel" flying in turbulent air could very well have been a principal reason for some students' poor performances on the second instrument check.

As anticipated, the project raised more questions than it settled. Of particular interest is the question of the value of introducing instrument flying at the very beginning and interspersing it with contact flying to the greatest extent possible. The instructors reported considerable surprise at the speed with which students learned at the beginning. This factor may have led to a more ambitious syllabus than was originally planned. There is no way of knowing if the reported speed-up was real or if it would have occurred within another sequence of instruction. However, now that it is known that this kind of syllabus is feasible, the next step must be to determine its best form, i.e., the best arrangement of contact and instrument flying within the course of instruction.

A second unanswered question concerns the possible long range effects of the training received by these students. At the end of training all concerned felt that even the weakest students were better equipped to cope with unexpected instrument weather than is the average private pilot. How long will the instrument flying proficiency of these students last without practice? How much practice is needed to maintain or regain an acceptable level of skill? These are questions that should be answered.

In the case of students who will continue their training and become professional pilots, it was hoped that students trained according to this syllabus would have a different and a better attitude toward instrument flying. Being familiar with and proficient at instrument flying from the very start it was hoped that they would find instrument flight "natural", acceptable, and routine. Those concerned with the project believe that this desire had been realized in so far as it could be during the short training period. Only further flying and further training of the same nature could definitely determine this point. Such an attitude would assist any pilot, particularly the professional pilot, in achieving full utilization of a modern, well-equipped aircraft.

A third unanswered question might be phrased in this form: "Is a little instrument flight training a dangerous thing?" This question imposed a rather difficult instructional problem in this experimental situation. It was the intent of the training course to teach the students as many instrument flying skills as possible and to instill as much confidence in instrument flying as possible within the time allotted. Paradoxically, it was also necessary to teach the student that he should make every effort to avoid using the skills he was being taught. The resolution of the conflict in training aims was to point out to the student that, although he could control the aircraft on instruments under some conditions, he did not have all the skills necessary to carry out intentional instrument flight, particularly those skills necessary to navigate on instruments. The flight instructors believed that the instrument training given was the best way of developing a proper respect for instrument flying and that the experimental students would be less likely to fly on instruments intentionally than would private pilots without instrument training.

There is some informal supporting evidence from preliminary results of the Institute of Aviation's 180° turn syllabus. Students who have completed that syllabus report that they are now more cautious and do not fly in marginal conditions that previously would not have disturbed them. The question of the effect of a little instrument training cannot be answered from the results of the present experiment. However, those who participated in the design and conduct of the experiment are firmly convinced that such training is the best approach to reducing fatal accidents during marginal weather conditions.

Conclusions

The objective of this study was a relatively simple one: to determine whether it was possible to incorporate both instrument and contact flight training into the time limits of the approved University of Illinois private pilot syllabus, without interfering with the students' contact flying ability. This objective was accomplished. All students reached the required contact proficiency and, in addition, possessed a reasonable proficiency in control of the aircraft under simulated instrument conditions.

Simultaneous instruction on instrument and contact flying is, therefore, feasible in a regular course of instruction. Such instruction promotes rapid learning of both instrument and contact skills and also encourages a favorable attitude towards instrument flying.

Appendix A

Syllabus of Instruction

Period	Disc.	Link	Dual	Solo	S.I.	Obs.
1 DISCUSSION: forces on airplane; axes of rotation; aileron and elevator control of attitude, and gyro-horizon display; straight and level attitude; emphasize effect of bank for turn; shallow, medium, steep bank turns; use of rudder with aileron; Link vs. plane. LINK: effect of controls on gyro-horizon; return to straight and level attitude; shallow bank turns.	.5 (.5)	.5 (.5)				
2 DISCUSSION: altimeter; power is primary altitude control; effect of power on altitude, gyro-horizon, attitude; straight and level flight; stick correction for minor	.5 (1.0)	.5 (1.0)				

Period	Disc.	Link	Dual	Solo	S.I.	Obs.
altitude corrections; introduce gyro-compass and compass rose; straight climbs and glides as functions of power and attitude; torque; specify various power settings. **LINK**: review period 1; straight and level flight; straight climbs and glides; hood closed .3 to .4.						
3 **LINK**: review and practice previous periods; climbing and gliding turns; level-offs; use of elevator trim; coordination.	(1.0)	1.0 (2.0)				
4 **DISCUSSION IN AIRPLANE**: cockpit check; starting; taxiing; run-up; torque effect on take-off; normal take-offs. **DUAL**: goggles on, follow through on take-off; at minimum safe altitude student takes over; climbs, glides, straight and level; climbing and gliding turns.	.5 (1.5)	(2.0)	.5 (.5)		.5 (.5)	
5 **DISCUSSION**: slow flight as function of power; stick and attitude. **LINK**: review climbs, glides, straight and level, level-offs, shallow turns, slow flight, climbing, gliding and maintaining altitude.	.3 (1.8)	.7 (2.7)	(.5)		(.5)	
6 **DISCUSSION**: steep turns; instrument take-off; emphasize relationship of contact cues and gyro-horizon. **DUAL**: I.T.O.; climbs; glides; shallow turns; slow flight; straight and level; steep turns; level-offs; alternate instrument and contact.	.3 (2.1)	(2.7)	.7 (1.2)		.4 (.9)	
7 **DISCUSSION**: review forces on airplane, straight and level vs. steep bank turn, adverse yaw eliminated by rudder, and stall as function of angle of attack. **LINK**: climbs; glides; slow flight; straight and level; level-offs; shallow turns to headings.	.5 (2.6)	.5 3.2)	(1.2)		(.9)	

Period	Disc.	Link	Dual	Solo	S.I.	Obs.
8 **LINK**: review period 7; require closer tolerances; emphasize pressures rather than control movements; torque correction; instrument lag; cross-checking.	(2.6)	1.0 (4.2)	(1.2)		(.9)	
9 **DUAL**: contact take-off; climbs; glides; level-offs; straight and level; shallow and medium turns on instruments first then contact; emphasize relationship of attitude instrument display to contact cues; stalls on instruments; traffic pattern contact.	(2.6)	(4.2)	1.0 (2.2)		.5 (1.4)	
10 **DISCUSSION**: review traffic pattern, practice area landings, emergencies on take-off. **LINK**: review climbs, glides, slow flight, straight and level, level-offs, shallow bank turn to headings, and simulated traffic pattern.	.4 (3.0)	.6 (4.8)	(2.2)		(1.4)	
11 **DISCUSSION**: drift correction; crosswind take-offs and landings; slips. **DUAL**: emergency on take-off; climbing turns and level-off instrument; phugoids; rudder turns (confidence maneuvers); slips; stalls; landing contact.	.5 (3.5)	(4.8)	.5 (2.7)		.3 (1.7)	
12 **DISCUSSION**: high altitude emergencies; unusual attitudes. **DUAL**: contact take-off; climbing turns; level-off; unusual attitudes instrument; slips; high altitude emergency; landing contact.	.3 (3.8)	(4.8)	.7 (3.4)		.4 (2.1)	
13 **DISCUSSION**: review periods 11 and 12. **DUAL**: repeat period 12 plus stalls and normal and crosswind landings.	.1 (3.9)	(4.8)	.9 (4.3)		.5 (2.6)	
13x **CHECK PERIOD**						
14 **DISCUSSION**: take-offs and landings. **DUAL**: take-offs and landings. **SOLO**: take-offs and landings.	.1 (4.0)	(4.8)	.6 (4.9)	.3 (.3)	(2.6)	

Period	Disc.	Link	Dual	Solo	S.I.	Obs.
15 DISCUSSION: take-offs and landings. DUAL: take-offs and landings. SOLO: take-offs and landings.	.2 (4.2)	(4.8)	.3 (5.2)	.5 (.8)	(2.6)	
16 DUAL: traffic pattern; slips to landings. SOLO: traffic pattern; slips to landings.	(4.2)	(4.8)	.5 (5.7)	.5 (1.3)	(2.6)	
17 DISCUSSION: standard rate turns; introduce needle-ball, clock, importance of proper trim, magnetic compass; stress use of these in rough air. LINK: timed standard rate turns to headings.	.5 (4.7)	.5 (5.3)	(5.7)	(1.3)	(2.6)	
18 DISCUSSION: power approaches; normal and crosswind landings; take-offs. DUAL: same as above.	.5 (5.2)	(5.3)	.5 (6.2)	(1.3)	(2.6)	
19 DISCUSSION: review take-offs and landings. SOLO: supervised power-on and power-off approaches and landings.	.2 (5.4)	(5.3)	(6.2)	.8 (2.1)	(2.6)	
20 DISCUSSION: introduce airspeed and rate of climb as attitude instruments; lag; airspeed and altitude function of attitude and power (stick and throttle); these are secondary to gyro-horizon, but make precision flying possible.	.3 (5.7)	.7 (6.0)	(6.2)	(2.1)	(2.6)	
21 DISCUSSION: review period 20; introduce Able pattern (square, 2 minute legs). See page 28. LINK: rated climbing and gliding turns; timed and counted turns to headings; Able patterns.	.2 (5.9)	.8 (6.8)	(6.2)	(2.1)	(2.6)	
22 DISCUSSION: climbing turn, gliding turn, and accelerated stalls. DUAL: instrument take-off; rated climbing timed turns to headings; stalls and steep turns; contact and instrument.	.3 (6.2)	(6.8)	.7 (6.9)	(2.1)	.4 (3.0)	
23 DISCUSSION: review period 22. DUAL: review period 22.	.1 (6.3)	(6.8)	.9 (7.8)	(2.1)	.6 (3.6)	

Period	Disc.	Link	Dual	Solo	S.I.	Obs.
24 **DISCUSSION**: review needle, ball, airspeed, and rate of climb as attitude instruments. **LINK**: partial panel climbs; glides; slow flight; straight and level; timed and counted turns to headings; review Able pattern.	.5 (6.8)	.5 (7.3)	(7.8)	(2.1)	(3.6)	
25 **DISCUSSION**: introduce Dog pattern. **LINK**: review period 24; Dog pattern partial panel. See page 28.	.1 (6.9)	.9 (8.2)	(7.8)	(2.1)	(3.6)	
26 **DISCUSSION**: review stalls, slips, high altitude emergencies. **DUAL**: same as discussion; climb to altitude on instruments.	.5 (7.4)	(8.2)	.5 (8.3)	(2.1)	.2 (3.8)	
27 **DISCUSSION**: review all flight instruments; introduce Vertical "S." See page 28. **LINK**: review and Vertical "S."	.5 (7.9)	.5 (8.7)	(8.3)	(2.1)	(3.8)	
28 **DISCUSSION**: around pylons; low altitude emergencies; coordination exercise. **DUAL**: same as above.	.5 (8.4)	(8.7)	.5 (8.8)	(2.1)	(3.8)	
29 **LINK**: review rated climbs and glides, slow flight, straight and level, level-offs, timed and counted turns to headings, Able, Dog, and Vertical "S" patterns; full and partial panel.	(8.4)	1.0 (9.7)	(8.8)	(2.1)	(3.8)	
30 **DUAL**: review for mid-term flight check maneuvers required on private pilot flight test.	(8.4)	(9.7)	1.0 (9.8)	(2.1)	.4 (4.2)	
31 **DUAL**: mid-term flight check.	(8.4)	(9.7)	1.0 (10.8)	(2.1)	.4 (4.6)	
32 **DISCUSSION**: cross-country flight planning. **DUAL**: 3 hour leg of 9 hour cross-country, including 1 hour simulated instruments. **OBSERVER**: navigation and communication.	1.0 (9.4)	(9.7)	3.0 (13.8)	(2.1)	1.0 (5.6)	6.0 (6.0)
33 **DISCUSSION**: Aeronca 7 AC check-out. **DUAL**: Aeronca 7 AC check-out.	.5 (9.9)	(9.7)	*.5 (14.3)	(2.1)	(5.6)	(6.0)

* Aeronca 7 AC.

Period	Disc.	Link	Dual	Solo	S.I.	Obs.
34 DUAL: strange airport procedures; short field take-offs and landings; dragging fields.	(9.9)	(9.7)	*1.0 (15.3)	(2.1)	(5.6)	(6.0)
35 DISCUSSION: local night flying. DUAL: same as above.	.5 (10.4)	(9.7)	*1.0 (16.3)	(2.1)	(5.6)	(6.0)
36 DISCUSSION: necessary to check student out in Aeronca 7 AC safe for solo. DUAL: same as above.	.2 (10.6)	(9.7)	*.5 (16.8)	*.3 (2.4)	(5.6)	(6.0)
37 DISCUSSION: review cross-country flight planning, weather checking, lost procedures, flight plans, etc. SOLO: three-leg cross-country.	.7 (11.3)	(9.7)	(16.8)	*3.0 (5.4)	(5.6)	(6.0)
38 Same as period 37. DISCUSSION: night cross-country flight planning.	.7 (12.0)	(9.7)	(16.8)	*3.0 (8.4)	(5.6)	(6.0)
39 DUAL: one-hour leg of three-leg night cross-country OBSERVER: navigation and communication.	1.0 (13.0)	(9.7)	1.0 (17.8)	(8.4)	(5.6)	2.0 (8.0)
40 DISCUSSION: review partial panel emphasizing attitude instrument flying. LINK: review basic maneuvers and Able, Dog, and Vertical "S" patterns on partial panel.	.2 (13.2)	.8 (10.5)	(17.8)	(8.4)	(5.6)	(8.0)
41 DISCUSSION: review maneuvers and performance required on flight test. DUAL: same as above.	.1 (13.3)	(10.5)	.9 (18.7)	(8.4)	.2 (5.8)	(8.0)
42 SOLO: practice for flight test.	(13.3)	(10.5)	(18.7)	1.0 (9.4)	(5.8)	(8.0)
43 DUAL: review for flight test.	(13.3)	(10.5)	1.0 (19.7)	(9.4)	.2 (6.0)	(8.0)
44 SOLO: practice for flight test.	(13.3)	(10.5)	(19.7)	1.0 (10.4)	(6.0)	(8.0)

* Aeronca 7 AC.

Period	Disc.	Link	Dual	Solo	S.I.	Obs.
45 LINK: review basic partial panel attitude instrument flying maneuvers.	(13.3)	.5 (11.0)	(19.7)	(10.4)	(6.0)	(8.0)
46 DUAL: recommendation ride for flight test.	(13.3)	(11.0)	1.0 (20.7)	(10.4)	.2 (6.2)	(8.0)
47 DUAL: private pilot flight test.			1.0			
Total	(13.3)	(11.0)	(21.7)	(10.4)	(6.2)	(8.0)

Definition of Instrument Flight Patterns:

"Able" Pattern: Square pattern left or right with 2 minute legs.

"Dog" Pattern: Straight and level 1 minute; climb 500 fpm for 1 minute; straight and level 1 minute; climb 500 fpm for 2 minutes; etc. All climbs and glides at 500 fpm.

Vertical "S" Pattern: Climb 1000′, descend 1000′, climb 500′, descend 500′, climb 250′, descend 250′, all climbs and descents at 500 fpm.

Appendix B

Instructions to Observer

Instrument Check No. 1

INSTRUMENT TAKE-OFF: Start stop watch when student adds throttle.

Airspeed: Record maximum deviation in airspeed from 30 seconds after throttle is added until reaching an altitude of 400′.

Heading: Record maximum deviation in heading during ground run and from 30 seconds after throttle is added until reaching an altitude of 400′.

1000′ CLIMB: Start timing when instructor touches student's shoulder to start climb.

Altitude: Record at 10-second intervals during climb and for 30 seconds after level-off.

Airspeed: Record at 10-second intervals during climb until 900′ has been gained or level-off started.

Heading: Record at 10-second intervals during climb and for 30 seconds after level-off.

360° CLIMBING TURN: Start timing when instructor touches student's shoulder to start turn. Record starting airspeed and heading.

Bank: Record at 10-second intervals after start of turn until start of roll out or within 30° of desired heading, whichever is later.

Airspeed: Record airspeed at 10-second intervals during turn and for 30 seconds after roll out.

Heading: Record heading at 10-second intervals for 30 seconds after wings level on roll out.

STRAIGHT AND LEVEL:

Altitude: Record initial altitude and the altitude at 10-second intervals for 2 minutes after instructor signals to start.

Heading: Record initial heading and the heading at 10-second intervals for 2 minutes after instructor signals to start.

360° LEVEL TURN: Start timing when instructor signals to start turn.

Bank: Record at 10-second intervals until start of roll out.

Altitude: Record initial altitude and the altitude at 10-second intervals until 30 seconds after wings level.

Heading: Record initial heading and the heading at 10-second intervals for 30 seconds after wings level.

1000′ GLIDE: Start timing when instructor signals to start glide.

Altitude: Record initial altitude and the altitude at 10-second intervals for 30 seconds after power added to level-off.

Airspeed: Record initial airspeed and the airspeed at 10-second intervals until start of level-off.

Heading: Record initial heading and the heading at 10-second intervals until 30 seconds after level-off.

360° GLIDING TURN: Record initial heading and airspeed at start of turn.

Bank: Record at 10-second intervals until roll out.

Airspeed: Record the airspeed at 10-second intervals until 30 seconds after wings level on roll out.

Heading: Record the heading at 10-second intervals until 30 seconds after wings level on roll out.

Instructions to Students

Instrument Check No. 1

INSTRUMENT TAKE-OFF: You are lined up for take-off on runway________. When you are ready, add throttle and take off. After take-off, hold your heading until you have reached 400′.

1000′ CLIMB (FROM NORMAL CRUISE, STRAIGHT AND LEVEL): When I touch your shoulder, start a climb holding your heading of________. Climb to________ feet and level off, holding your heading.

360° CLIMBING TURN: Establish a climb on a heading of________. When I touch your shoulder start a 360° climbing turn to the left. After reaching your original heading keep climbing on heading.

STRAIGHT AND LEVEL (2 MINUTES): Hold a heading of________ and altitude of ________ feet for two minutes. I'll touch your shoulder to let you know when the timing starts and will tell you when the time is up.

360° LEVEL TURN: When I touch your shoulder, start a medium bank, 360° turn to the right. Roll out on your original heading and hold.

1000′ GLIDE (FROM STRAIGHT AND LEVEL, NORMAL CRUISE): Hold a heading of _________ degrees, lose 1000′ and level off. Start when I touch your shoulder.

360° GLIDING TURN: Establish a glide holding a heading of_________ degrees. Start a 360° gliding turn to the left when I touch your shoulder. After reaching your original heading, hold it and continue your glide.

Instructions to Observer

Instrument Check No. 2

INSTRUMENT TAKE-OFF: Start stop watch when student adds throttle.

Airspeed: Record maximum deviation in airspeed from 30 seconds after throttle is added until reaching an altitude of 400′.

Heading: Record maximum deviation in heading during ground run and from 30 seconds after throttle is added until reaching an altitude of 400′.

360° CLIMBING TURN: Start timing when instructor touches student's shoulder to start turn.

Bank: Record at 10-second intervals after start of turn until start of roll out or within 30° of desired heading, whichever is later.

Airspeed: Record initial airspeed and the airspeed at 10-second intervals during turn and for 30 seconds after roll out.

Heading: Record initial heading and the heading at 10-second intervals for 30 seconds after wings level on roll out.

STRAIGHT AND LEVEL:

Altitude: Record initial altitude and the altitude at 10-second intervals for 2 minutes after instructor signals to start.

Heading: Record initial heading and the heading at 10-second intervals for 2 minutes after instructor signals to start.

360° LEVEL TURN: Start timing when instructor signals to start turn.

Bank: Record at 10-second intervals until start of roll out.

Altitude: Record initial altitude and the altitude at 10-second intervals until 30 seconds after wings level.

Heading: Record initial heading and the heading at 10-second intervals for 30 seconds after wings level.

360° GLIDING TURN:

Bank: Record at 10-second intervals until roll out.

Airspeed: Record initial airspeed and the airspeed at 10-second intervals until 30 seconds after wings level.

Heading: Record initial heading and the heading at 10-second intervals for 30 seconds after wings level on roll out.

180° LEVEL TURN (PARTIAL PANEL): Start timing when student initiates turn.

Bank: Record at 10-second intervals for first 60 seconds.

Altitude: Record maximum deviation from initial altitude from start of turn to completion of 180 seconds.

Airspeed: Record initial airspeed and the airspeed at 10-second intervals from start of turn to completion of 180 seconds.

Heading: Record initial heading and the heading at 10-second intervals after first 60 seconds and until completion of 180 seconds.

720° STEEP TURN (PARTIAL PANEL): Start timing when instructor signals to start turn.

Bank: Record at 10-second intervals until start of roll out.

Altitude: Record initial altitude and the maximum deviation during turn and for 30 seconds after roll out.

Airspeed: Record initial airspeed and the airspeed at 10-second intervals until 30 seconds after roll out.

SIMULATED GCA (FULL PANEL):

Entry leg: Start timing when student has completed roll out to heading.

Altitude: Record at 10-second intervals until turn to downwind leg.

Airspeed: Record at 10-second intervals until turn to downwind leg.

Heading: Record initial heading and the heading at 10-second intervals until turn to downwind leg.

DOWNWIND LEG AND FINAL APPROACH: Start timing after student has completed roll out to heading.

Altitude: Record at 10-second intervals until start of final descent.

Airspeed: Record at 10-second intervals until approach completed (goggles off).

Heading: Record initial heading and the heading at 10-second intervals until turn on crosswind or final approach.

Instructions to Students

Instrument Check No. 2

FULL PANEL

INSTRUMENT TAKE-OFF: You are lined up for take-off on runway__________. When you are ready, add throttle and take off. Hold your heading and airspeed until you have reached 400 feet.

360° CLIMBING TURN: Starting at 2000 feet set up a 500 fpm, 80 mph climb. When I touch your shoulder, start a 360° standard rate climbing turn to the left. After reaching your original heading, hold that heading and continue your climb.

STRAIGHT AND LEVEL (2 MINUTES): Hold a heading of ______ and altitude of ______ feet for two minutes. I'll touch your shoulder to let you know when the timing starts and will tell you when the time is up.

360° LEVEL TURN: When I touch your shoulder, start a 30° bank, 360° turn to the right. Roll out on your original heading and hold.

360° GLIDING TURN: Set up a 500 fpm, 80 mph glide. When I touch your shoulder, start a 360° standard rate gliding turn to the left. After reaching your original heading, hold that heading and continue your glide.

PARTIAL PANEL

Climb to 3000′ on contact and level off on a heading of (360° or 180°).

180° TURN: You are on a cross-country flight and have run into bad weather. Put the goggles on and make a 180° turn as soon as you are ready. After your turn, hold your heading for two minutes.

720° STEEP TURN: Do a 720° steep turn to the left. I'll tell you when to roll out.

FULL PANEL

SIMULATED GCA APPROACH: (Instructor acting as GCA approach control)

Pacer______, this is Champaign GCA approach control. We have you on our scope ______ miles ______ (NE, SW, etc.) of the field. Turn to a heading of ______ and descend to 1550′. (Instructor continued vectoring to bring student in on a 45° entry, downwind leg, and final approach to 200′ and ½ mile. Student then removed goggles and made contact landing if in position to do so.)

THE INSTITUTE OF AVIATION, established in 1945 as the Institute of Aeronautics, is operated as the administrative agency responsible for the fostering and correlation of the educational and research activities related to aviation in all parts of the University. Other functions include academic instruction, flight training, management of the University of Illinois Airport, and aeronautical research.

In connection with the latter function, the Institute issues two types of publications . . . first, a group of reports on research results, and second, a series of bulletins on aviation subjects of an extension-service nature to the citizens of the State.

The following publications have been issued:

BULLETIN ONE: Municipal Airport Management, Leslie A. Bryan, 1947. (Out of print)

BULLETIN TWO: Landscape Planting for Airports, Florence B. Robinson, 1948.

BULLETIN THREE: Labor Relations in the Air Transport Industry Under the Amended Railway Labor Act, E. B. McNatt, 1948. (Out of print)

BULLETIN FOUR: Airport Zoning, J. Nelson Young, 1948. (Out of print)

BULLETIN FIVE: Evaluation of the School Link as an Aid in Primary Flight Instruction, A. C. Williams, Jr. and Ralph E. Flexman, 1949.

BULLETIN SIX: Lightplane Tires on Turf and Concrete, Leslie A. Bryan, 1949.

BULLETIN SEVEN: Light Aircraft Operating Costs, Leslie A. Bryan, 1949.

BULLETIN EIGHT: Evaluation of the School Link and Special Methods of Instruction in a Ten-Hour Private Pilot Flight-Training Program, Ralph E. Flexman, William G. Matheny, and Edward L. Brown, 1950. (Out of print)

BULLETIN NINE: Flight by Periscope: I. Performing an Instrument Flight Pattern; the Influence of Screen Size and Image Magnification, Stanley N. Roscoe, 1951.

BULLETIN TEN: Operating Costs of a Light Aircraft Fleet, Leslie A. Bryan, 1952.

BULLETIN ELEVEN: 180-Degree Turn Experiment, Leslie A. Bryan, Jesse W. Stonecipher, and Karl Aron, 1954.

BULLETIN TWELVE: Aviation Ground School, Leslie A. Bryan, 1954.

BULLETIN THIRTEEN: Organizing for Flight Operations, Leslie A. Bryan, 1954.

BULLETIN FOURTEEN: Developing an Aircraft Maintenance Curriculum, Leslie A. Bryan, 1955.

BULLETIN FIFTEEN: Airport Shop Operations, Leslie A. Bryan, 1955.

BULLETIN SIXTEEN: College and University Airport Management, Leslie A. Bryan, 1955.

BULLETIN SEVENTEEN: Parachute Flares as an Aid in Night Forced Landings, Jesse W. Stonecipher, Miller R. Green, Richard E. Mankus, 1955.

BULLETIN EIGHTEEN: Simultaneous Contact-instrument Flight Training, Alexander C. Williams, Jr., Robert C. Houston, Lowell E. Wilkerson, 1955.

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