SPECIALIST FLYING TRAINING

SFT

T67M

INSTRUCTORS GUIDE

CONTENTS

## INTRODUCTION

1 This handbook aims to be a comprehensive guide to the inexperienced instructor and an aide memoire to the experienced. The recommended sequence of the air exercises is the result of extensive experience, but this book cannot be a substitute for individual instructional experience and in no way removes from the instructor the right to use his initiative. Therefore it is not essential for each lesson to take the precise form given as long as the student becomes proficient. The handbook indicates the important points which should be emphasised during an exercise, outlines possible difficulties and suggests a logical method of presentation of the exercise.

2 Learning to fly is the accumulation of a store of knowledge and skill. Exercises are demonstrated, explained and practised until the student is able to react quickly and instinctively to ordinary problems without having to resort to laborious elementary reasoning. Solutions are provided from the fund of ready answers which has been accumulated through experience. This leaves extra capacity for other tasks (eg airmanship).

### General Rules

3 It is the instructor's responsibility to produce a pilot who is well versed in general flying, who is capable of clear thought and action and who has real enthusiasm for his flying. The art of instructing is largely acquired through practice and each instructor evolves a technique that is best suited to his individual personality. The inexperienced instructor will have no standard by which to judge the progress of his student and will frequently require guidance on the best way of approaching his task. To this end there are some general rules which will provide a sound foundation on which to base his instruction:

a **Relationship** The attitude of the instructor towards his student can have a significant effect on the rate of progress. The student must be made to feel that he is subject to benevolent instruction in congenial surroundings and everything possible must be done to remove discomforts and doubts. The wise instructor will readily appreciate that careful attention to the comfort and welfare of his student will be amply rewarded by trust and respect.

b **Preparation** Prepare every lesson thoroughly so that you know exactly what you have to teach and how you are going to teach it. Study the aim of the exercise and keep it constantly in mind.

c **Interest** Make the exercise as interesting as possible and present it as a step towards the ultimate goal by defining the object and stating its practical application.

d **Student Comfort** See that the student is comfortable and correctly equipped.

**e Speech** Speak clearly and deliberately; keep your voice pitched up and make sure that the student can hear every word.

**f Accuracy** Demonstrations must be accurate to be convincing and the aircraft must be doing what you say it is doing. Be especially careful before quoting speeds, heights or other settings and make sure that you are in fact using them.

**g Visual Cues** Remember that in the initial stages the student will be learning to fly the aircraft using visual references and using his instruments only to check that the references he has selected are correct. Good visual cues need a good horizon and an explicit explanation of what the student is seeking to attain.

**h Explicitness** When setting him a task, give the student clear and precise instructions before giving him control of the aircraft. He cannot make a success of anything unless he knows exactly what he is to do.

**j Participation** The student's active participation in the exercise is all-important. He should be allowed to take control of the aircraft as soon as possible when learning a new exercise, and to this end, the essentials should be taught first and the refinements dealt with after the student has practised the basics.

**k Intensity of Instruction** In the initial demonstration of an exercise it may be unwise to attempt to cover all the observations. The intensity of the instruction given should be tailored to the ability of the student, the aim being eventually to cover all the points in a reasonable time.

**l Tolerance** Be patient when the student makes mistakes and remember that he learns by them. Put yourself in his position and recall the difficulties you experienced when under training.

**m Illustrations** During discussions on the ground, make full use of diagrams, models and other training aids. Do not bore the student by trying to write down everything you say but show the important points, so that he can form a mental picture of the subject that will help to impress it on his memory.

**o Self Analysis** Teaching requires constant care on the part of the instructor. Make periodical reviews of your method, especially your treatment of individual students and satisfy yourself that you are working along the right lines.

## Avoidable Errors

4 Just as there are rules which should be followed by instructors there are errors which must be avoided. It is possible to avoid most of them by using ordinary discretion and common sense, but a few of the more common errors are worth mentioning.

**a Verbosity** Never talk to much in the air. Put over the important points and give the student a chance to absorb them.

**b Hypercriticism** Do not criticise every single mistake your student makes. Concentrate initially on his major errors and work your way down to the minor ones as he improves. Do not confine criticism to mere factual indications but guide the student in analysis of his faults.

**c Subterfuge** Never try to gloss over or disguise your own mistakes. The student is not likely to be taken in and will respect you far more if you admit an error and show how it could have been avoided.

**d Ostentation** Even the most enthusiastic student can lose confidence in his instructor after an itimidating or foolhardy exhibition of trick flying.

**e Air Sickness** It cannot be over emphasised that if this aircraft is the first one in which the student is to receive flying instruction, every effort must be made to ensure that his self-confidence is progressively built up during the early sorties. Violent manoeuvres introduced too early in his flying career may give rise to anxiety, due in part to the conflictions between visual and other sensory systems in the body, and become manifest as nausea. Air sickness will not only undermine his self-confidence but it may be self-perpetuating and become an added source of stress for the student. If a student is air sick or apprehensive, aerobatics should not be demonstrated until after the circuit consolidation period. By then the student will have settled down in his new environment. Even a mild attack of air sickness without nausea can reduce the student's ability to absorb flying instruction. This could delay his progress, and just as important, destroy his enjoyment of flying. Continued air sickness, however, should be brought to the attention of a doctor and may be an indication of unsuitability for further training.

**f Post-flight Neglect** Never neglect to discuss the flight with the student immediately after the sortie while any difficulties are still fresh in his mind.

**The Student**

5 All students volunteer to learn to fly and this is a great advantage to the instructor. Despite their undoubted enthusiasm, however, some students are bound to be eliminated in a selective system, and an unduly slow rate of progress should always be regarded in the first place as a sympton of some deep-rooted difficulty. Whilst students differ so widely that it is difficult even to attempt to categorize them, some of the more common traits outlined below may help the instructor to analyse individual students' shortcomings:

a **Over-confidence** A conceited student often displays a degree of confidence which is not borne out by his ability. The instructor should insist relentlessly on a high standard of accuracy and airmanship, criticising imperfections in a firm but fair manner so that the student is constantly aware of his shortcomings. A more difficult case occasionally arises in which a feeling of inferiority or insecurity is cloaked in an attitude of agressiveness; the subject may betray himself by nervous gestures or mannerisms when off his guard. This complex requires careful handling, since repressing the apparent over-confidence may only aggravate the cause.

b **Under-confidence** The nervous, diffident student needs encouragement. He tends to be extremely self-critical and becomes discouraged if not assured that his progress is normal. He should be praised freely when doing well and his mistakes should be explained carefully without undue reflection on his ability. Care must be taken in the air to avoid any signs of apprehension while he is in control of the aircraft.

c **Forgetfulness** Most students forget a great deal of what they are taught and facts must be instilled by constant revision. Forgetful students should be made to take a very active part during dual instruction and should be called upon to recount on the ground what they have learned in the air. Faulty checks should be corrected and the student made to repeat the correct drill in its entirety; periodical and incidental checks should be called out aloud by the student. Neglect flying cannot be tolerated indefinitely, however, and the student should be warned that his progress is being hampered by this lack of attention.

d **Inconsistency** The progress of learning is an irregular one and many instructors are discouraged when they find their students becoming stale from time to time. This is because the mind can become saturated with new ideas and the student's receptivity often deteriorates until the fresh information has been consolidated in his memory. Flying training takes place in an entirely new medium and it is not uncommon for a student to make a slow start, only to progress rapidly at a later stage when he feels more at home. It is therefore unwise to worry unduly if the student appears to stand still for a while; when this occurs it is best to revise the earlier lessons until the student has recovered his pace. A lenghty lapse, however, is usually due to some more profound difficulty and requires closer investigation.

e **Apathy** If a student becomes unusually slow, inattentive or erratic, it can be due to a number of troubles. It may, of course, be mere backsliding but it would be wrong to assume this without having investigated the case. It is always possible that he may be distracted by some problem of his own which the instructor should try to discover as tactfully as possible. Worry can often be reduced simply by having someone in whom to confide. The three most common reasons for loss of enthusiasm are private worries, distaste for flying or personal antipathy between student and instructor.

**f Distaste for Flying** A student who has been quite keen sometimes loses his zest for flying because of adverse comments about the aircraft he is flying. He may on the other hand have been shaken by an accident to himself or another student. He will seldom admit his loss of confidence but often betrays it by expressing a dislike for the aircraft or some aspect of flying or by general loss of interest which may show up more clearly in his ground school record. Such students need careful treatment and must be reassured by all possible means; rumours can usually be exposed as perversions of the truth and it can be explained that serious accidents are rare and become even less likely as skill and experience increase. The condition is usually a passing phase but it sometimes happens that the student has suddenly realised that he is not suited to flying; in this case there is no alternative but to discontinue his training.

**g Personal Antipathy** A clash of personalities can destroy the sympathetic atmosphere which is essential between student and instructor. Therefore if the student fails to progress, particularly in the early stages, and there is reason to believe that this may be the cause, a change of instructor should be made without delay.

## The Lesson

6 Ideally a lesson should consist of 4 parts, a long briefing, a pre-flight briefing, an airborne lesson, and a post flight discussion.

a **Long Briefing** The long briefing is a detailed discussion and should be given sufficiently in advance of the airborne lesson to allow the student to digest the new information. It should cover the subject thoroughly and link the instruction given in ground school to the practical aspects of flying. The briefing should be practical and aimed directly at what is to be taught in the air.

b **Pre-flight Briefing** The pre-flight briefing which is given just before each sortie should include details of the administrative and operational aspects of the flight and give a resume of the main points of the lesson.

c **Airborne Lesson** After revision of those skills which are relevant to the new exercise, the airborne lesson should follow a logical sequence from known to unknown; from easy to difficult. Complex skills or procedures may initially be taught in part. When a degree of competency has been attained at these parts the exercise may be tied together and practised as a whole. Although it may not fit every air exercise exactly, the broad method behind teaching in the air is in the following sequence:

1 A demonstration by the Flying Instructor.

2 A student practises with as much verbal or handling assistance as the instructor considers necessary until the student has reached an acceptable standard; beware, however, of flying the exercise for him. Let him fly and make mistakes, unless they endanger the aircraft. Avoid explantions while he is at the controls. Confine your assistance to simple reminders of matters of degree. If explanations are required, take over control from the student before talking. As the student gains proficiency, the assistance decreases. When it becomes minimal, he is ready for the next step.

3 Student practises without assistance while the instructors mentally assesses his preformance, and if necessary, decides whether the student could safely perform the exercise solo.

d **Post Flight Discussion** The post-flight discussion is used to review the exercise and amplify or explain any special point of interest or difficulty that has arisen. This discussion is invaluable for consolidating what the student has just learnt.

EXERCISE 1

INSTRUCTIONAL GUIDE

## FAMILIARIZATION WITH THE AIRCRAFT

**AIM**: To familiarize the student with the aircraft's controls and systems and teach him the checks and emergency drills.

### Introduction

1 The impressions formed by the student at this stage largely determine his attitude towards instruction and his confidence in himself and the aircraft. The instructor must aim to develop the confidence and co-operation of his student from the outset. The student should not be swamped with a mass of detail at this stage.

### The Aircraft

2 All the instruction in this exercise involving the external features of the aircraft, cockpit layout, and the checks should be given at the aircraft. The instructor should first show the student the external features, pointing out constructional and technical details, re-fuelling points, and so on. The dangers associated with propellers should be mentioned and the student should be told to always enter and leave the aircraft via the trailing edge of the wing.

3 Having dealt with the external points of primary interest, the cockpit can be entered and its layout explained. A good method of teaching the disposition of the controls and instruments is to work through the check lists in the Operators Manual and Check Cards: in this way the student also learns to associate the Manual and Cards with aircraft familiarization. The vital importance of systematic checking should be emphasized and the student should realize that the checking of every item on the check list is essential to safe flying. Any questions should be answered within the limitations of the student's background knowledge, but discussions on engine and aircraft handling are premature and should be avoided at this early stage.

### Aircraft Systems

4 By the time the student is ready for solo he should be familiar with the following:

a Fuel system.

b Engine and propeller control systems.

c Brake system.

d Electrical system.

e Handling and use of radio equipment.

## Check Lists and Controls

5 The student must learn all check lists thoroughly so that the actions become instinctive. He should be able to locate all controls and switches without looking for them; to this end the student should seat himself in the aircraft and practise with the aid of the Manual and cards.

## Emergency Drills

6 When teaching emergency drills do not give the impression that such occurences are commonplace. Stress the fact that since emergencies are rare, the unexpected nature of the occurrence demands a well practiced drill which can be used should an emergency occur which requires a fast reaction. However, a correct drill carried out methodically is better than an incorrect drill completed at lightning speed. The following drills must be learnt thoroughly:

a Action in the event of fire in the air and on the ground.

b Action in the event of engine failure.

c Restarting the engine in the air.

d Loss of R/T.

e Abandoning the aircraft

7 Instructors must ensure that students know the above drills before first solo and must continue instruction and revision at frequent intervals thereafter.

EXERCISE 2

INSTRUCTIONAL GUIDE

## PREPARATION FOR FLIGHT AND ACTION AFTER FLIGHT

**AIM:** To teach thorough preparation for flight and action after flight.

### General

1 Thorough and efficient preparation before flight is essential for the safety and overall success of any flight and particularly for training flights. This preparation entails a check of equipment and aircraft, and careful planning and briefing for the flight to be undertaken. The learning process is gradual and progressive; thus the preparation for flight should be a feature of all lessons and the student must be allowed to play an increasing part until he is proficient. The student should be encouraged to use the Flight Reference Cards until he is fully conversant with the checks.

### Flying Clothing

2 The importance of wearing the appropriate clothing must be impressed on the student as any discomfort may affect his flying. This is particularly important in the fit and functioning of the flying helmet and the checking and use of the parachute.

### Maps

3 Ensure that the student always carries the appropriate maps. These should be marked with the local area, prohibited areas, airways, and any other pertinent navigational or air traffic information. From time to time check for serviceability and currency.

### Flight Authorization

4 The student should be introduced to such points of pre-flight planning as the latest weather information, flying state and air traffic information, avoiding too much detail in the early stages. Reference should also be made to the need to check for any new information before signing the authorization sheet, and the importance of correct recording of times after flight.

### Technical Log

5 The use of the technical log should be explained and the student should be shown how to complete the document before and after flight. Before flying solo he should be able to check the log before flight and know how to enter flying times and defects after flight.

## External Checks

6 The instructor should point out the following:

a Siting of the aircraft for starting: state of ground, direction of slipstream, etc.

b Availability of fire extinguisher.

c Importance of checking the immediate taxi path for obstructions which cannot be seen from the cockpit.

d The pilot's responsibility in respect of the external condition of the aircraft should be explained and a check of the points listed in the Cards carried out.

## Internal Checks

7 On entering the cockpit, check that the student knows how to fasten and adjust his safety harness and see that the rudder pedals are suitably adjusted; ensure that he adjusts them symmetrically. After these preliminaries the internal checks (as listed in the Cards) should be made. During these checks the student should be kept actively engaged; this only helps him to learn the checks but makes him more familiar with the cockpit.

## Starting and Warming Up

8 When demonstrating the starting procedures, the various safety precautions should be emphasized. The student should be allowed to start the engine for his first flight, as this small achievement can make him more receptive to further instruction. During the warm-up period the student should be kept aware of the engine instrument readings and alert to the general nature of things going on in the immediate vicinity of his aircraft.

## Power Checks

9 Power checks should be carried out as laid down in the Cards. Explain the reasons why each part of the check is done.

## Running Down and Switching Off

10 It should be pointed out that the handling of aircraft engines necessitates a correct running down and stopping procedure in order to prolong the life of the engine and ensure reliability. Carry out the running down and stopping procedure and emphasize the dangers of leaving the ignition switches on.

## Leaving the Aircraft

11 Explain the advisability of leaving the canopy closed in wet weather. After vacating the cockpit carry out the final external check of the aircraft and explain that this is done to check for any signs of leaking fluid or other indications of unserviceability.

## EXERCISE 3

## INSTRUCTIONAL GUIDE

## AIR EXPERIENCE

**AIM:** To introduce the student to the sensations of flying and the totally new aspect of the ground when seen from the air.

1 This sortie is flown to enable the student to experience the environment in which he will fly in the future. Whether it is his first flight ever, the first in a light aircraft or the first in instructional conditions, the impression he gains can have a definite bearing on his subsequent interest, enthusiasm and ability to learn.

2 The flight should be made in the local training area using standard procedures. It is not an instructional sortie in the strictest sense but neither is it a time for the instructor to relax and enjoy himself. Violent or extreme manoeuvres should be avoided. A calm, considerate and disciplined manner should be maintained throughout. Explain the unexpected and warn him of aspects such as large power changes which could startle the uninitiated. Slant the conversation towards future training. Assure him that no detail will be left uncovered. Aim to lay a firm foundation for his instruction, suited to your style.

3 At this early stage the fear of failure and the desire to create the right impression looms large in the student's mind. This, in conjunction with the unfamiliar and possibly claustrophobic effect of the cockpit and flying equipment causes a significant number to experience nausea and air-sickness. Maintain a constant vigil for any symptoms which could lead to this and whenever possible, take action early.

4 Aerobatics should not be performed unless the student makes a firm and unsolicited request for them. Carefully assess each request and be ready to provide an excuse for not doing them if the student is not convincingly sincere: he may think it is the "done thing". If aerobatics are demonstrated they should involve positive 'g' only and be of short duration. Remember that air-sickness delays and sometimes halts progress.

EXERCISE 4

INSTRUCTIONAL GUIDE

# EFFECTS OF CONTROLS

**AIM:** To teach the effects of the controls on the aircraft in flight, and to select attitudes and trim.

## General

1 Since this is to be the student's first lesson in the air the instruction should be unhurried. Points which are obvious to the experienced pilot are not so to the student and should not be glossed over or omitted; an example is the direction of movement of the rudder bar to obtain a required movement from the aircraft. The student's clear understanding of the principles of this lesson is an essential foundation for later exercises. More than one lesson is required to cover the scope of this exercise adequately. Sequences 5 to 11 of the Air Exercise need not be taught immediately after sequences 1 to 4, but can be left until after sequence 2 of Straight and Level. The later sequences of Effects of Controls can then be taught either in one lesson or individually at the beginning of other exercises which require that particular knowledge; eg effect of flap prior to descending.

## Before Flight

2 **Preparatory Instruction** The subject matter should be confined to that of immediate interest. The following points should be discussed before the lesson:

a Function of the flying controls.

b Effects of airspeed and slipstream.

c Effects of bank.

d Effects of yaw.

e Trimming control.

f Use of engine controls. (throttle, RPM, mixture).

g Effects of power.

h Flaps.

## During Flight

3 Make certain that the student can hear clearly and is relaxed and comfortable. Check that he holds the controls correctly. Show how the visual horizon is used as a reference for interpreting the aircraft attitude. Point out that the position of the nose relative to the horizon changes when the attitude changes.

4 Avoid harsh control movements which may startle or cause discomfort to the student.

5 Allow the student to attempt all the effects demonstrated and give sufficient time for him to become used to the feel of the controls and to appreciate their effects. Be sure that the aircraft is correctly trimmed before handing over control. Show the student the datum (level flight) attitude and teach him to return to that attitude every time he handles the controls.

6 **Airmanship**

a Since the student cannot be expected to keep a good lookout at this stage, the instructor should explain any actions that he takes for reasons of good airmanship.

b Ensure that the student knows the correct method of handing over control, taking over control, and "following through".

7 **Primary Effects**

a When showing the primary effects of the rudder, remind the student that the prime function of the rudder is not to control the direction but to balance the flight of the aircraft.

b Show that the response of the aircraft to control movements depends on the IAS and the amount of slipstream, as well as on the quickness and magnitude of the control movements.

8 **Further Effects** It must be quite evident to the student that only the one control is being used. This can be done by allowing the student to rest his hands and feet on the controls.

9 **Effect of Airspeed** Ensure that the student appreciates that, although the effectiveness of the controls is reduced and the aircraft response becomes poor when the speed is reduced, a measure of positive control is still available.

10 **Effects of Trim** Briefly remind the student of the purpose of the the trimming control. Demonstrate that the initial adjustment to the aircraft attitude should be made by the flying control and that the trimmer should then be adjusted until no force is required on the control to maintain the attitude. During retrimming practice ensure that the student has his hands and feet resting only lightly on the controls, otherwise he may fail to identify the zero force trim setting.

11 **Effects of Power** After the effect of power has been demonstrated to the student he should be taught to maintain the datum attitude and retrim the aircraft after power has been varied.

12 **Engine Controls** The natural series of engine control movements and subsequent guage indications can best be introduced during the engine test on the ground. One of the many ways of remembering the throttle/propeller drill to avoid "top loading" the engine is "REV UP - THROTTLE BACK".

13 **Flap Locking** The 'g' limitations change dramatically with flap down so if unlocked flap comes down under sprung pressure at low speed (top of a loop?) overstress can easily result. This can be shown on some aircraft where flap system "stiction" is low by leaving the lever unlocked (leave a few degrees of flap down) and reducing speed.

**EXERCISE 4**

**AIR EXERCISE**

**EFFECTS OF CONTROLS**

**AIM:** To teach the effects of the controls on the aircraft during flight, and to select attitudes and trim.

1 **Airmanship**

a Handing over and taking over control.
b Lookout.
c Engine limitations - RPM/MAP.

| SEQUENCE | OBSERVATIONS |
|---|---|
| 2 Effects of Flying Controls | |
| a Demonstrate primary effects of controls from straight and level flight at cruising power(100K). | a Elevators:<br>1) Fore and aft movement of control column.<br>2) Nose up and down (pitching)<br>3) Airspeed changes<br><br>b Ailerons:<br>1) Lateral movement of control column.<br>2) Wing up and down (rolling)<br><br>c Rudder:<br>1) Rudder pedal movement.<br>2) Nose left and right (yawing).<br>3) Heavy feel.<br><br>d Smooth progressive control movement desired.<br><br>e Aircraft response continues until control is returned to the neutral position.<br><br>f Response of aircraft related to amount of control deflection. |
| b Demonstrate primary effects in banked attitudes. | Effects are in relation to aircraft axes and not to the horizon. |
| c Demonstrate further effects from straight and level flight at cruising power (100K). | a Elevators - no further effect. |

| SEQUENCE | OBSERVATIONS |
|---|---|
| | b Ailerons:<br>1) Primary effect is roll - this produces a banked attitude and side slip.<br>2) Further effect of the side slip is yaw which leads to further roll and therefore a spiral descent. |
| | c Rudder:<br>1) Primary effect is yaw.<br>2) Further effect is roll leading to a spiral descent. |
| **3 Effect of Airspeed and Slipstream** | |
| a Demonstrate the effects of controls at a high (130K) airspeed and low (70K) airspeed at a constant low-power setting. | a High speed.<br>1) Firm feel.<br>2) Increased control effectiveness and response.<br><br>b Low speed.<br>1) Reduced feel.<br>2) Reduced control effectiveness and aircraft response. |
| b Demonstrate the effect of the controls of slipstream by increasing the power (MAX RPM and full throttle) from the low speed, low power of the previous demonstration and maintain 70K | a Note the control effectiveness at low speed, low power.<br><br>b Strong slipstream.<br>1) Rudder and elevators more effective and firmer feel.<br>2) Aileron feel and effectiveness unaltered. |
| **4 Effect of Trim** | |
| a **Elevator** The student maintains a constant attitude while trimmer is moved by the instructor. The student then adjusts trimmer until control force is removed. Use cruising power. | a Increasing load on elevators.<br><br>b Sense of trim control movements.<br><br>c Adjustment to relieve control force<br><br>d Demonstrate control loads at full trim movements - up and down. Significance of trimming in the wrong direction.<br><br>e Aircraft remains in selected attitude when accurately trimmed. |

| SEQUENCE | OBSERVATIONS |
|---|---|
| **5 Effect of Throttle** | |
| At 100k with 2700 RPM set. | a RPM/MAP limitation. |
| | b Sense of throttle movement. |
| | c MAP and fuel pressure indications with throttle movement. |
| | d RPM change at low throttle settings outside CSU range. |
| | e Show how power settings/IAS change relate. |
| **6 Effect of RPM Lever** | |
| a With 18" MAP set show effect of RPM lever. | a RPM/MAP limitation |
| | b Sense of movement. |
| | c RPM change |
| | d Slight MAP change |
| | e Slight IAS change related to small power change |
| | f Move smoothly to prevent overspeed or damage to fine pitch stop. |
| b Vary airspeed at fixed throttle/RPM setting. | a RPM unchanged |
| | b Slightly higher MAP as speed increases |
| **7 Changing Power** | |
| Show how to change power using both RPM and throttle levers. | a Increasing power - RPM lever ("Rev up") |
| | b Decreasing power - throttle ("throttle back"). |
| | c Overboosting. Rule of 4 |
| **8 Use of Mixture Control** | a Sense of movement |
| | b Fuel pressure indication |
| | c Over-weakening results in loss of power (RPM decrease) and rough running |
| | d Use of guide figures for power settings. |

| SEQUENCE | OBSERVATIONS |
|---|---|
| **9 Effect of Power** | |
| Demonstrate the effect of power changes. | |
| a At 2400 RPM 100k trim the aircraft, then increase power to full throttle. | a Increasing power:<br>1) Nose rises<br>2) Slight yaw to port (ball) |
| b At full throttle and 120k trim the aircraft then close the throttle. | a Decreasing power:<br>1) Nose drops<br>2) Slight yaw to starboard (ball) |
| c Demonstrate how to maintain attitude and direction while changing power | a Use of elevator and rudder<br><br>b Retrim |
| **10 Induction Air Filter Bypass** | a No pilot controls<br><br>b Conditions that could cause it<br><br>c Indications: CHT, MAP drop, power loss |
| **11 Effect of Flap** | |
| Trim to straight and level before each demonstration. Retrim level after initial observations of flap effect. | |
| a Lower take-off flap at 85k, pointing out ASI indicator of max flap speed | a Attitude and airspeed in level flight before lowering flap<br><br>b When flap selected (below 88k) note slight nose down attitude change.<br><br>c Flap locking indicator<br><br>d When counteracted with elevator, note:<br>1) Slight trim change<br>2) Slightly lower airspeed |
| b Lower landing flap | a Maximum speed 88k<br><br>b Observations as for take-off flap, but airspeed changes more marked whilst attitude and trim changes are less. |

| SEQUENCE | OBSERVATIONS |
| --- | --- |
| **11 Effect of Flap** (continued) | |
| c Raise flap to take-off | a Attitude and airspeed in level flight before raising the flap<br><br>b Flap raised:<br>1) Nose up change of attitude<br><br>c When countered by elevator:<br>1) Trim change<br>2) Higher airspeed |
| d Raise flap completely | a Observations as for raising flap to take-off, but attitude, trim and airspeed changes more marked<br><br>b Flap lock indicator<br><br>c Flap creep at low speed if not locked |
| 12 Post-Flight Discussion | |

**EXERCISE 5**

**INSTRUCTIONAL GUIDE**

# TAXYING

**AIM:** To teach how to manoeuvre the aircraft on the ground.

## General

1 The elements of taxying should be introduced as early as possible and the student should be given progressively more responsibility as his proficiency increases. The temptation to take over control in order to save time must be resisted so that the student accumulates the maximum amount of taxying under supervision.

2 The sequence in which the items of this exercise are taught depends on variables such as wind velocity, airfield layout and local regulations as well as the student's ability. The lesson should therefore be adapted to the prevailing circumstances. Whenever permissible the initial taxying lessons are best done in an open space on the airfield where there is plenty of room to manoeuvre.

## Before the Exercise

3 **Preparatory Instruction** The following subjects should be discussed with the students:

a Effect of inertia and momentum.

b Use of controls.

c Use of power.

d Effect of wind.

e Braking system and use of brakes.

f Use of nosewheel steering.

g Engine handling.

h Propeller tip clearance.

j Marshalling signals.

k Traffic rules.

**During the Exercise**

4 Emphasize the constant need for a careful lookout and the inherent lack of manoeuvrability of aircraft on the ground. Mention the following points:

- a Distribution of the keel surface tends to make the aircraft weathercock into wind.

- b There is a time lag between throttle movement and the aircraft responding.

- c Tricycle undercarriage directional stability.

5 **Airmanship** The student should be told that the captain is ultimately responsible for the safety of the aircraft and that although marshallers' signals should normally be obeyed the captain is at libery to disregard them if he considers that the safety of his aircraft is endangered by following them. Flight instrument serviceability checks should be carried out during taxying.

6 **Lookout** The view from the aircraft is excellent but the importance of a continuous watch for obstacles and other aircraft should be emphasized. When taxying, pilots must be prepared to give way to aircraft approaching to land and taking off.

7 **Brake Failure** Brake failure which may result in either the brakes seizing on or "fading" or not working at all, can arise either through mechanical failure or pilot misuse. Excessive or heavy braking can lead to brake failure. The main considerations affecting the action to be taken if the brakes fail are:

- a Proximity of obstacles and other aircraft.

- b Wind strength and direction.

- c Nature and gradient of the surface.

All these points should be discussed with the student but it should be made clear that usually the safest course of action is to switch off the engine after steering the aircraft clear of danger. If only one brake fails the aircraft can be stopped by use of the remaining brake in conjunction with the nosewheel steering.

8 **Nosewheel Steering** In the event of nosewheel steering failure directional control can be maintained using the toe brakes. It should be emphasized that under these circumstances the aircraft should be stopped and towed back to dispersal as the pilot has no way of knowing exactly what has gone wrong with the nosewheel.

9 **Starting and Stopping** A gentle progressive increase of power should be applied until the aircraft starts moving. The aircraft will accelerate to normal taxying speed without the need for further throttle movement. When at normal taxying speed, the throttle setting will need to be reduced slightly to stop further acceleration. Throttle movements and brake applications should always be smoothly executed. To stop the aircraft, close the throttle and brake gently until the aircraft stops. Once the aircraft is stopped, apply full toe brake pressure and engage the parking brake.

10 **Control of Speed** When demonstrating the correct taxying speed, point out that the most accurate assessment is obtained from the apparent movement of the ground close to the aircraft. Power changes should be anticipated in order to maintain a constant speed over varying surfaces. The throttle should always be closed before using brake to slow down or stop do not use power against brake.

11 **Testing the Brakes** The left-hand wheel system is separate from the right-hand wheel system, and the left-hand seat pedals are a different system from the right. Thus the fact that one brake is working must not lead to the conclusion that all are working. All four pedals should be tested independently (two when solo) before the brakes are pronounced fit.

12 **Directional Control and Turning** Because of the inherent directional stability of a nosewheel undercarriage, the aircraft will maintain a given direction unless the wind is of sufficient strength to cause a weathercock tendency. Turning is achieved by nosewheel steering through the rudder bars and may be assisted by directional braking. The toe brakes should not be used alone to turn as this will put large side loads on the nose leg. When clear of dispersal, apply full rudder in each direction to ensure that full, free and correct movement of the rudder is available and that the nosewheel steering is functioning correctly.

13 **Turning in a Confined Space** The tail can be made to swing quite sharply through a large angle and the necessity to ensure that there are no obstacles in the path of the tail must be emphasized when turning in a confined space. The student should be told that turning about a locked wheel must be avoided unless the safety of the aircraft is involved.

14 **Leaving Dispersal** The student should have had sufficient practice at taxying away from the dispersal area to become reasonably competent before this part of the exercise is introduced. Immediately the aircraft moves forward the brakes should be applied to test their effectiveness. The aircraft should only be allowed to move slowly before applying the brakes in case they are unserviceable.

15 **Use of Controls** The control column should be held back at all times when taxying, and firmly so in strong wind conditions, to prevent the control surfaces being blown violently against their stops.

16 **Use of the Parking Brake.** Full toe brake pressure should always be applied before engaging the parking brake. With the parking brake engaged, toe brake pressure should be progressively relaxed whilst checking outside to make sure that the aircraft does not move. When releasing the parking brake, the aircraft should always be kept stationary on the toe-brakes thus ensuring that attention is focussed outside the aircraft before movement commences. The parking brake should never be selected when the throttle is displaced from the idle position.

17 **Common Faults** As the student gains experience and confidence there is a distinct tendency to taxi too fast, particularly when solo. Point out the dangers and penalties involved.

EXERCISE 5

AIR EXERCISE

## TAXYING

**AIM:** To teach how to manoeuvre the aircraft on the ground.

### Airmanship

**1 Before taxying**

a Check engine instruments.

b Check brakes on.

c Adjust throttle friction control.

d RT clearance.

e Note wind velocity.

**2 During taxying**

a Brake check (all pedals).

b Check full rudder movement and nosewheel steering.

c Check engine and gyro instruments.

d Lookout.

e Keep control column central to maximise propeller tip clearance. In strong wind keep column fully rear into wind and fully forward downwind.

| SEQUENCY | OBSERVATIONS |
|---|---|
| **1 Starting and Stopping** | |
| When clear of dispersal demonstrate starting and stopping in a straight line | a Starting:<br>1) Throttle closed<br>2) Parking brake released with toe brakes held on.<br>3) Toe brakes off.<br>4) Open throttle.<br>5) Throttle back slightly (effect of inertia).<br>6) Dangers of misuse of power.<br>7) Stick central. |

| SEQUENCE | OBSERVATIONS |
|---|---|
| **3 Starting and Stopping (Continued)** | b Stopping:<br>1) Close throttle.<br>2) Apply both the brakes evenly.<br>3) Danger of braking harshly.<br>4) Apply parking brake when aircraft stationary. |
| **4 Control of Direction and Turning** | |
| a Demonstrate use of nosewheel steering. | Normal radius turns - nosewheel steering. effective - do not use toe brakes alone. |
| b Demonstrate across wind. | a Weathercock tendency.<br>b Turns into wind tend to tighten.<br>c Aircraft is less willing to turn downwind. |
| **5 Control of Speed** | a Smooth use of throttle:<br>b Control of speed with:<br>1) Power<br>2) Brake.<br>c Factors affecting speed:<br>1) Surface gradient.<br>2) Nature of surface.<br>3) Wind<br>d Judging speed.<br>e Avoid fast taxying.<br>f Do not use brake against power. |
| **6 Turning in Confined Spaces** | a Low Speed.<br>b Use of toe brakes tightens turn slightly.<br>c Small radius turns.<br>d Ensure that the tail is clear of obstacles. |
| **7 Leaving Dispersal** | a Checks.<br>b Throttle closed before chocks away.<br>c Enough power to start moving - close throttle.<br>d Brakes tested.<br>e Marshaller's signals - captain's responsibility.<br>f Dismissing marshaller. |
| **8 Post-Flight Discussion** | |

**EXERCISE 6**

**INSTRUCTIONAL GUIDE**

# STRAIGHT AND LEVEL FLIGHT

**AIM:** To teach how to fly the aircraft accurately in a constant direction at a constant height in balance.

## General

1 Accurate straight and level flight is required at some stage for most types of operation; therefore the student should ultimately be required to attain a high standard.

## Before Flight

2 **Preparatory Instruction**

a Forces acting on an aircraft in flight.

b Control of attitude in all planes.

c Balanced flight.

d Trim

e Effect of power.

f Stability.

## During Flight

3 **Airmanship** Stress again the importance of a good lookout. Introduce the clock system of reporting aircraft and ask the student to report the position of other aircraft by using this system. Start him off on regular FEDRA checks.

4 **Orientation** Point out local landmarks and their position in relation to base.

5 **Straight and Level Flight at Cruising Power** Pay attention to the following points:

a The student should concentrate initially on judging the aircraft attitude by the position of the nose in relation to the horizon and then use that attitude to fly straight and level.

b The student should be shown how to choose a reference point on which to keep straight and how to bring the aircraft back to the point if the direction alters.

c The inherent stability of the aircraft in straight and level can be demonstrated by trimming the aircraft accurately and then releasing the controls.

d After the student has become fairly proficient at achieving the straight and level attitude he should be given ample opportunity to practise making the small corrections necessary to maintain accuracy.

e Marked slip can be readily detected by the sensations experienced; the unusual attitude and falling airspeed if straight and level flight is maintained; and by the slip indicator. Slight slip, however, is more difficult to detect and the slip indicator must be used. Demonstrate unbalanced flight by applying considerable rudder and banking the aircraft in the opposite direction to prevent yaw. Point out that straight and level flight can be maintained but the feeling of slipping and loss of airspeed (or loss of height if airspeed is maintained) indicate inefficient flight. Recover by levelling the wings and correcting the yaw with rudder, using outside references. Point out that reliance upon poor external references may result in slight residual inbalance. Show that, in these circumstances, the slip indicator must be used to attain completely balanced flight. Show him also that if the aircraft heading keeps wandering off in the same direction it is probably due to slip.

6 **Straight and Level Flight at Various Power Settings**

a It is important that the correct technique for changing power is fully understood by the student before beginning this exercise.

b When settled in straight and level flight, an increase in power causes the aircraft to accelerate and climb and a decrease in power causes it to decelerate and descend. To maintain level flight the correct technique is therefore to adjust the attitude progressively while the speed is changing.

c The correction for the yaw which occurs during the power change is a point that requires careful instruction to bring it home to most students. Changing rudder effectiveness as speed changes has also to be emphasized.

d It is a good practice to associate airspeed with MAP during this exercise and thus provide a basis for interpolation when flying at selected airspeeds.

e The student should be given plenty of practice at this and the next exercise as they provide good trimming experience.

f The speed range of the aircraft with variations of power should be shown.

## 7 Straight and Level Flight at Selected Airspeeds

a The student should be made to change the airspeed of the aircraft from one pre-determined figure to another. Special emphasis should be placed on the co-ordination of the power and the elevators to give the required airspeed in level flight. Any movement of one of these controls necessitates movement of the other in order to maintain a constant flight path.

b Although only two airspeeds are mentioned in the sequence, the student should be made to fly at any airspeed within the range of the aircraft.

c As the student gains experience he should be taught to use full throttle for large speed increases, reducing power as the required speed is approached.

### Common Faults

8 Difficulties encountered in eliminating yaw are usually due to the following causes:

a Aircraft is not laterally level.

b As speed changes, no compensation is made for changing rudder effectiveness.

c Student very tense and pushing both rudder bars

9 Despite careful instruction and warnings to the contrary, some students tend to develop the habit of using the trimmer to change the attitude. This fault is not always easy to detect and should be watched for very carefully.

EXERCISE 6

AIR EXERCISE

## STRAIGHT AND LEVEL FLIGHT

**AIM:** To teach how to fly the aircraft accurately in a constant direction at a constant height in balance.

**1 Airmanship**

a Lookout - Clock code
b Check - Fuel.
Engine instruments (to include vacuum gauge).
Direction indicator synchronised.
Radio - Correct frequency.
Altimeters - Correctly set.

| SEQUENCE | OBSERVATIONS |
|---|---|
| **2 Straight and Level Flight at Cruising Power** | |
| a Demonstrate using 2400 RPM and 100K. | a Lookout.<br>b Show visual attitude.<br>c Lookout and attitude check - inter-related.<br>d Point out instrument indications:<br>1) ASI - speed.<br>2) Altimeter and VSI indicate constant height, but altimeter to be used in preference.<br>e Stability when trimmed. |
| b Change attitude and show how to achieve straight and level flight. | a Aircraft disturbed in pitch<br>1) Select pitch attitude - elevators.<br>2) Trim.<br>3) Check altimeter, adjust attitude if necessary and retrim.<br>b Aircraft disturbed in roll and yaw<br>1) Select wings level - ailerons.<br>2) Correct yaw with rudder.<br>3) Check constant direction by visual reference. |

| SEQUENCE | OBSERVATIONS |
|---|---|
| 2 **Straight and Level Flight at Cruising Power** (continued) | c Aircraft disturbed in pitch roll and yaw.<br>1) Select wings level.<br>2) Select pitch attitude.<br>3) Correct yaw.<br>4) Trim.<br>5) With wings level check constant direction by visual reference.<br>6) Check altimeter, adjust attitude if necessary and retrim.<br>7) With practice, observations 1) to 3) are co-ordinated. |
| c Show exaggerated and slight degrees of slip by the co-ordinated application of bank and opposite rudder. Maintain height. | a Note airspeed in balanced flight.<br><br>b Exaggerated slip identified by:<br>1) False attitude for straight and level flight.<br>2) Physical sensation.<br>3) Reduction in airspeed - inefficient flight.<br>4) Slip indication.<br><br>c Regain balanced flight:<br>1) Level wings.<br>2) Correct yaw.<br><br>d Slight slip identified by slip indicator which must be included in lookout/instrument scan.<br><br>e Regain balanced flight:<br>1) Level wings<br>2) Correct yaw |
| d Demonstrate and practise maintaining straight and level flight. | a Lookout extended to include overhead arc and horizontal scan tailplane to tailplane.<br><br>b Required altitude regained by adjusting pitch attitude.<br><br>c Required direction regained by lowering wing in direction of reference point. |

**SEQUENCE** | **OBSERVATIONS**

**3 Straight and Level Flight at Various Power Settings**

a Demonstrate the effect of reducing MAP by 4" from straight and level flight at 2400 RPM and MAP to give cruising speed.

a Lookout.

b Attitude and airspeed at cruising power.

c Decrease RPM while maintaining attitude and direction - aircraft descends - importance of adjusting attitude as the power is decreased.

d Adjust attitude and trim for straight and level flight:
1) Higher position of nose.
2) Note decreased airspeed.

e Further decreases in MAP
1) Still higher position of nose.
2) Further decreases in airspeed.

f Eventually aircraft cannot maintain height if power is reduced further.

b Demonstrate the effect of increasing to cruise power from the power setting at completion of 3a

a Lookout

b Attitude and airspeed at selected power.

c Increase RPM while still maintaining attitude and direction - aircraft climbs - importance of adjusting attitude as power is increased.

d Adjust attitude and trim for straight and level flight:
1) More nose-down attitude.
2) Note increased airspeed.

**4 Straight and Level Flight at Selected Airspeed**

a With 2400 RPM selected, demonstrate how to reduce from cruising speed to exactly 70K.

a Reduce MAP to approximate required setting.

b Aircraft decelerates:
1) Inertia.
2) Maintain balance.

c Maintain level flight - gradual raising of nose as the speed decreases.

| SEQUENCE | OBSERVATIONS |
| --- | --- |
| **4 Straight and Level Flight at Selected Airspeed** (continued) | d Allow speed to settle.<br>e Adjust MAP to give exact speed.<br>f Need for progressive Trimming. |
| b With 2400 RPM selected, demonstrate how to increase from 70K to cruising speed | a Increase MAP to required setting.<br>b Aircraft accelerater<br>1) Inertia<br>2) Maintain balance<br>c Maintain level flight - gradual lowering of nose as speed increases.<br>d Allow speed to settle<br>e Adjust MAP to give exact speed<br>f Need for progressive trimming |
| c Demonstrate a rapid decceleration cruising speed to 70K by closing throttle. | observations as in 4a (a - c) but occur more rapidly than:-<br>d Anticipate opening throttle to achieve 70K MAP to 70K.<br>e Allow speed to settle<br>f Adjust MAP to give exact speed.<br>g Need for progressive trimming. |
| d Demonstrate quickest method of accelerating from 70K to cruising speed by increasing to full throttle | observations as in 4b (a - c) but occur more rapidly than:<br>d Anticipate closing throttle to achieve cruise MAP at cruising speed.<br>e Allow speed to settle.<br>f Adjust MAP to give exact speed.<br>g Need for progressive trimming. |

**EXERCISE 7**

**INSTRUCTIONAL GUIDE**

# CLIMBING

**AIM:** To teach how to climb the aircraft at recommended airspeeds.

## General

1 For maximum efficiency an aircraft is climbed at the airspeed recommended in Pilot's Notes. Although flaps are not normally used during the climb, the considerations for raising flap during the climb after a baulked landing or touch-and-go are included in Exercise 13.

## Before Flight

2 **Preparatory Instruction**

a Changing power settings.

b Recommended airspeeds.

c Effect of flap.

d Engine handling.

e Effect of altitude.

## During Flight

3 **Airmanship** A good lookout should cover the whole area around the aircraft, but during the climb it is especially important that a good lookout is maintained above and behind and in the area covered by the nose. In order to clear this area, the heading should be changed at intervals.

4 **Normal Climb**

a Remind the student of the correct method of changing power. (Rev up, throttle back).

b To conserve engine life, a climb power setting of 2500 RPM and 27 MAP should be used. The student should be aware of the necessity to increase the throttle setting with height in order to retain the nominated MAP and that, when full throttle and 27 MAP coincide, any subsequent increase in height will result in a reduction of MAP. It must be emphasised that these settings are good airmanship but that he should not hesitate to use full power if required i.e. after a balked landing obstacle avoidance etc. After selecting climbing power, the aircraft is put into the approximate climbing altitude. When the speed has settled small adjustments are made to the attitude to obtain the correct climbing speed. Unless this method is used the student tends to chase the airspeed.

c Engine instrument readings should be frequently checked. Initially this may be done at regular height intervals but later by frequent monitoring.

5 **Levelling Off** Initially the student should be taught the mechanics of levelling off. As he becomes proficient he should be taught to level off at specified altitudes.

**Common Faults**

6 Students often fail to anticipate and correct yaw after changing power. They should also be aware of the changing rudder effectiveness with changing airspeed.

7 Students tend to neglect engine instruments when concentrating on flying the aircraft. They should be reminded of the vital importance of keeping within engine limitations.

8 Students often experience difficulty with the progressive attitude change required to maintain constant height as the speed increases during the level off; they frequently throttle back too soon and are left with a long trim change as the aircraft slowly accelerates.

EXERCISE 7

AIR EXERCISE

## CLIMBING

**AIM:** To teach how to climb the aircraft at recommended airspeeds.

**1 Airmanship**

a Lookout. Before and during the climb.
b Engine instruments. At least every 1,000 feet.
c Altimeter settings.

| SEQUENCE | OBSERVATIONS |
| --- | --- |
| **2 The Normal Climb** | |
| Demonstrate climb using full power. Climb at 80K. | a Lookout.<br><br>b Assuming climb:<br>1) Power - max RPM then full throttle - prevent yaw.<br>2) Attitude selected and held constant.<br>3) Trim.<br>4) Wings level - balance<br>5) Check speed<br>6) Adjust attitude<br>7) Retrim.<br><br>c In climb.<br>1) Instrument indications.<br>2) View ahead - weave.<br>3) Control of engine temperatures.<br>4) Throttle movement<br>5) IAS reductions (5K at 5,000 feet)<br><br>d Rate of climb decreases as altitude increases. |
| **3 Levelling Off** | |
| Level off from a normal climb at a pre-determined height. | a Anticipation of height 10% of rate of climb (about 50 feet at low altitudes)<br><br>b Attitude changing with speed - inertia of aircraft.<br><br>c Reduction of RPM and MAP at cruising speed. |

| SEQUENCE | OBSERVATIONS |
| --- | --- |
| 3 Levelling Off (continued) | d Prevent yaw. |
| | e Wings level - balance. |
| | f Trim. |
| | g Check height/speed. |
| | h Adjust attitude/power. |
| | j Retrim. |
| 4 Post-Flight Discussion | |

EXERCISE 8

INSTRUCTIONAL GUIDE

# DESCENDING

**AIM:** To teach how to descend at given airspeeds, rates of descent, and in the approach configuration.

## General

1 An accurately controlled descent involves five variables which must be correctly related to obtain the required conditions for the descent. The variables are:

a Airspeed.

b Power.

c Flap setting.

d Rate of descent.

e Sideslip.

Since all these variables assume added importance on the final approach it may be advisable to practise this exercise immediately before teaching landings.

## Before Flight

2 **Preparatory Instruction**

a Effect of power.

b Recommended airspeeds.

c Effect of flap.

d Engine limitations.

e Effect of wing.

f Sideslipping.

g Wind gradient.

## During Flight

3 **Airmanship** the following points have particular significance to the exercise:

a During a long descent the heading should be changed at intervals so that a lookout can be maintained in the area into which the aircraft is descending.

b At 1,000 feet intervals during a glide descent the throttle should be fully opened to clear the engine. The student should be taught how to keep the airspeed constant by raising the nose at the same time while maintaining balanced flight.

c At the transition level the aerodrome QFE or the Regional Pressure Setting should be set on the altimeter.

4 **The Glide** The following points are important:

a To establish the glide throttle back and delay assuming the gliding attitude until the speed approaches the desired gliding speed, then lower the nose to the gliding attitude.

b The student may encounter some difficulty in judging the gliding attitude since the nose is below the horizon. However, the instructor must persevere until the student can determine the correct attitude quickly and clearly. Accurate trimming is important. As early as possible the student should be made to cross-refer to the instruments.

5 **Effect of Flap** When lowering the flaps the nose-down change of trim and the drag increase should be anticipated and sufficiently countered to maintain the desired airspeed for the descent.

6 **Effect of Power** To ensure that the student becomes generally proficient at descending under defined conditions he should be given frequent practice at varying the rate of descent while at a constant airspeed. The student will gain much valve from practising descents towards ground features, adjusting power in order to maintain a constant angle of approach.

## Common Faults

7 The student does not allow enough time for the airspeed to stabilize and consequently chases the needle.

EXERCISE 8

AIR EXERCISE

DESCENDING

AIM: To teach how to descend at given airspeeds, rates of descent and in the approach configuration.

1 Airmanship

a Lookout. Before and during descent.
b Clearing engine. At least every 1,000 feet of glide.
c Altimeter settings.

| SEQUENCE | OBSERVATIONS |
|---|---|
| **2 The Glide** | |
| Demonstrate how to enter and maintain a glide at 80K from straight and level flight | a Lookout.<br>b Assuming the glide:<br>1) Close throttle - prevent yaw.<br>2) Allow speed to fall - inertia.<br>3) Attitude selected and helf constant.<br>4) Trim.<br>5) Wings level - balance<br>6) check speed.<br>7) Adjust attitude<br>8) Retrim.<br>c In the glide:<br>1) Instrument indications.<br>2) Engine limitations.<br>3) Blind spot.<br>4) Set regional pressure setting at the transition level (aerodrome QFE if rejoin initiated)<br>5) Warm the engine every 1,000 feet. |
| **3 Levelling Off** | |
| From the glide at 80K level off at a predetermined height. | a Anticipation of height.<br>b With 150 feet to go, apply cruise power to increase speed to 100K on level off.<br>c Adjust attitude to straight and level.<br>d Trim.<br>e Wings level - slip indicator.<br>f Adjust attitude/power to maintain height-/airspeed.<br>g Trim. |

| SEQUENCE | OBSERVATION |
|---|---|
| **4 Effect of Flap** | |
| When gliding at 80K demonstrate effect of flap. | a Attitude and rate of descent for the straight glide.<br><br>b Takeoff flap:<br>1) Initial decrease in rate of descent.<br>2) When settled - lower nose position, higher rate of descent at same airspeed.<br><br>c Landing flap:<br>1) Need to lower nose still further to maintain 80K: greater rate of descent. |
| **5 Effect of Power** | |
| a Demonstrate a descent from the glide at using intermediate throttle increases of 200 RPM for a governed 2400 RPM. | a Attitude and rate of descent in the 80K glide.<br><br>b RPM increased by throttle by stages up to 2400 RPM. At each stage:<br>1) Higher nose-up attitude.<br>2) Rate of descent decreased. |
| b Demonstrate how rate of descent can be varied at constant speeds, clean and in the approach configuration, by use of power. | a Elevators control airspeed.<br><br>b Power controls rate of descent.<br><br>c Relevance to final approach. |
| **6 Controlling Descent Path on Simulated Approach.** | |
| a Descend towards a ground reference point the approach configuration. Demonstrate the descent path can be assessed and then varied by the use of power with airspeed constant. | a Note position of the reference point in in wind-screen and/or aspect of runway how on correct approach.<br><br>b Vary throttle setting to show the movement of the reference point and/or changing aspect of runway in undershooting/ overshooting cases<br><br>c To regain position of reference point and/or aspect of runway power must be adjusted. |

| SEQUENCE | OBSERVATIONS |
| --- | --- |
| **6 Controlling Descent Path on Simulated Approach** (continued) | |
| b Overshoot from Simulated Approach. | |
| 1) Demonstrate and practise overshooting from simulated approach. | a Carry out Finals Checks.<br>b Open throttle fully; prevent yaw.<br>c Level wings.<br>d Adjust attitude to give 65K with landing flap and 70K with takeoff flap.<br>e Trim.<br>f Lookout.<br>g Flap raised in stages at a safe height and speed trim.<br>h Climb at 80K. |
| **7 Powered Descent** | |
| a Demonstrate how to enter a 100K powered descent from straight and level flight at cruising power. | a Lookout.<br>b Simultaneously:<br>1) Throttle back.<br>2) Select attitude and hold constant.<br>c Trim.<br>d Aircraft settled, check speed.<br>e Adjust power/attitude.<br>f Trim. |
| b Maintain a powered descent at 100K. | a Instrument indications.<br>b Engine limitations (engine clearing not necessary).<br>c Blind spot.<br>d Altimeter setting.<br>e Progressive throttle closing as MAP tends to increase with decreasing height. |

| SEQUENCE | OBSERVATIONS |
|---|---|
| **7 Power Descent (continued)** | |
| c Level off at a predetermined height from a powered descent at 100K. | a Anticipation of height.<br>b Simultaneously:<br>1) Increase power to cruise power.<br>2) Adjust to level attitude and hold.<br>c Trim<br>d Check height |
| **8 Sideslipping** | |
| a At 100K. | a With 10° bank apply enough opposite rudder to stop nose tracking round horizon.<br>b Speed fall - inefficient. |
| b At 80K gliding speed. | a Note rate of descent.<br>b Apply ¾ rudder and enough bank to stop yaw.<br>c Adjust attitude to hold 80K.<br>d Note rate of descent. |
| **9 Post-Flight Discussion** | |

EXERCISE 9

INSTRUCTIONAL GUIDE

# BASIC TURNING

**AIM:** To teach how to turn onto a specified heading using medium angles of bank (up to 30°).

## General

1 For the purpose of this exercise the amount of bank used should not exceed about 30°. Turns using higher angles of bank are considered as steep turns.

2 All types of basic turns should be taught before starting circuits.

## Before Flight

3 **Preparatory Instruction**

a Principles of turning.

b Use of controls when turning.

c Use of power.

d Climbing and descending turns.

## During Flight

4 The initial emphasis should be placed on the correct judgement of attitude and angle of bank through the use of the horizon as an external reference. As the student becomes more proficient he should be made to cross-refer to the instruments to achieve greater accuracy. Early emphasis should be placed on not trimming into the turn.

5 The student should be able to enter and leave the turns smoothly before progressing to sustained turns through large changes of heading.

6 With side-by-side seating it is best to teach the mechanics of turning in one direction initially. Later the direction of turn should be alternated so that the student obtains practice at turning in both directions.

7 **Airmanship** The student often forgets to maintain a good lookout while concentrating on flying accurately. He should be told that a good lookout is very important before and during a change of direction, particularly on the side towards which he is turning. During the exer cise the student should be required to orientate himself at intervals so as to develop his sense of direction.

8 **Level Turns** The following points should be remembered while teaching level turns:

a The student should be taught to be systematic and apply the following basic check to all turns:

1) Lookout.

2) Angle of bank and balance.

3) Attitude and height.

b In an accurate turn the airspeed settles at a slightly lower figure than that realised in level flight at the same power. When the aircraft is in a steady turn the airspeed should not fluctuate.

c The side-by-side seating arrangement of the aircraft makes it more difficult to judge the nose position. Demonstrate that the nose position appears lower to the student when turning to starboard than when turning to port.

9 **Climbing Turns** The handling technique is the same as for level turns but the speed is adjusted and maintained by pitch attitude adjustment. The angle of bank should be kept comparatively moderate to avoid a substantial fall in the rate of climb.

10 **Descending Turns**

a Handling technique for entry and recovery is the same as for climbing turns.

b Although the consideration of steep descending turns is covered in Exercise 15, the student should be told at this stage that high angles of bank have the effect of increasing the rate of descent and stalling speed, and that more power, or a higher airspeed or a combination of both, is required to counter these effects.

c Effects of power and flap settings are the same as for a straight descent.

**Common Faults**

11 Most faults stem from the lack of co-ordination of the controls. It should be made clear to the student that a correction to any one of the variables involved in the turn will necessitate adjustment of the others. Co-ordination can be improved by getting the student to maintain height and balance while rolling from a port turn directly into a starboard one and vice-versa.

12 Faulty turns often result from inaccurate flying and trimming just before entering the turns.

13 Some students become confused over the function of the controls when the aircraft is banked. It should be made clear that the controls still retain their basic functions when the aircraft is banked, viz:

a Ailerons control roll and thus are used to change the angle of bank.

b Elevators raise and lower the nose and thus control the pitch attitude in a medium turn.

c Rudder moves the nose left or right and thus controls the yawing plane - slip or skid.

EXERCISE 9

AIR EXERCISE

## BASIC TURNING

**AIM:** To teach how to turn onto a specified heading using medium angles of bank.

**1 Airmanship**

- a Lookout - on entry, during the turn and on roll-out.
- b Orientation - radio bearings/visual references.

| SEQUENCE | OBSERVATIONS |
|---|---|
| **2 Level Turns Entered from 100K** | |
| a Turn at a medium angle of bank using cruising power. | a Airspeed before entry.<br>b Lookout.<br>c Entry:<br>1) Control co-ordinator<br>2) Aileron and rudder together.<br>3) Pitch attitude controlled with elevator.<br>d In the turn:<br>1) Maintain correct bank with aileron.<br>2) Adjust pitch attitude to maintain. height.<br>3) Balance with rudder - slip indicator.<br>4) Instrument indications.<br>5) Note slightly lower airspeed<br>6) Lookout.<br>e Recovery:<br>1) Control co-ordination<br>2) Aileron and rudder together.<br>3) Pitch attitude controlled with elevator.<br>4) Check straight and level. |
| b Turn in opposite direction. | |
| c Carry out turns onto pre-selected points and headings. | a Anticipation of recovery.<br>b Relevance to circuit. |
| **3 Climbing Turns** | |
| a Climbing turn (20 degress bank) using 2500 RPM and 27 MAP (if available) commencing from a straight climb at 80K | a Rate of climb before entry.<br>b Lookout. |

| SEQUENCE | OBSERVATIONS |
|---|---|
| **3 Climbing Turns** (continued) | c Entry and recovery is similar to level turn but elevators are used to maintain airspeed. |
| | d In the turn:<br>1) Maintain a constant angle of bank. Slip indicator.<br>2) Pitch - speed control.<br>3) Instrument indications. |
| | e Check straight climb after recovery. |
| b Demonstrate increase in bank to higher (50°) using full power. | a Marked lower nose attitude - lower angle rate of climb. |
| | b Better rate of climb achieved at low angles of bank. |
| **4 Descending Turns** | |
| a From a straight glide enter a medium gliding turn at 80K. Increase angle of bank to show higher rate of descent. | a Attitude and rate of descent before entry. |
| | b Lookout. |
| | c Entry and recovery similar to that for climbing turn. |
| | d In the turn:<br>1) Maintain a constant angle of bank. Slip indicator.<br>2) Steep pitch attitude - speed control.<br>3) Increased rate of descent.<br>4) Instrument indications. |
| | e Larger angles of bank (50°) cause increased rates of descent. |
| | f Check straight descent after recovery. |
| b Demonstrate effects of power and flap on medium descending turns. (Applicability to finals turn in the circuit). | a Observations as for effect of power and flap on straight descent. |
| | b At a constant power setting:<br>1) Nose is lowered to maintain set speed.<br>2) Increased rate of descent. |
| | c Power may be used to maintain a constant rate of descent. |
| | d Amount of power required to maintain a constant rate of descent increases as angle of bank increases. |
| **5 Post-Flight Discussion** | |

EXERCISE 10

INSTRUCTIONAL GUIDE

STALLING

AIM:

AIM: To teach how to recognise an approaching stall and how to:

a Thus avoid stalling.

b Recover if he does not avoid stalling

c Lose minimum height during a recovery

**General**

1 The ultimate aim of this exercise is to teach the student how to recover with the minimum loss of height; however, this aspect should not be over-emphasized in the early stages of the exercise. The student should first learn the symptoms of a stall. Recovery will, at first, be rather mechanical but, as the student becomes more familiar with the characteristics of the stall, he should be taught to fly the aircraft away from the stall using minimum height loss technique.

2 This exercise cannot be hurried. Although the student must be able to make safe recoveries from full and incipient stalls - both from straight and level and in the approach configuration - he is not expected to perfect minimum height loss technique until later in the course.

3 Frequent dual and solo practice in recoveries from all types of stall should be given throughout the course.

**Before Flight**

4 **Preparatory Instructions**

a Lift, the stalling angle and the stalling speed.

b Function of the stall warning system.

c Characteristic of the stall.

d Factors affecting the stalling speed.

e Attitude and the stall.

f Recovery from the stall - use of power.

g Use of trim.

**During Flight**

5 The student may be a little nervous at first; this is understandable, but he will gain confidence as he himself becomes able to identify and recover from the stall. As soon as possible the student should be allowed to stall the aircraft and recover. He should be given plenty of practice until he becomes thoroughly proficient and confident.

6 In the early stages the student should be watched for symptoms of air sickness and the exercise discontinued if necessary.

7 Principal emphasis must be placed on the recognition of the stall warnings and on the recoveries. In the early stages of training, the student cannot be expected to do recoveries with the same skill as will be expected of him later. Ensure that he re-stalls during his recovery at some time during the exercise; if necessary, get him to do it deliberately, so that he becomes familiar with the symptoms of this second stall. If the particular aircraft drops a wing at the stall, the observations dealing with this additional consideration should be brought in from the start. Stalling in turns and during aerobatics are considered under 'Steep Turns' (Exercise 15) and 'Aerobatics' (Exercise 18).

8 **Airmanship** The checks listed in the Air Exercise must be carried out before commencing any stalling, spinning or aerobatic exercise. In addition to routine lookout, the student should be shown the various clearing turns so that the airspace can be visually cleared prior to the stall, and the aircraft positioned as necessary. The student must appreciate the importance of clearing turns before each stall.

9 **First Stall** The student's first experience of a stall should show him that it is not in any way a frightening experience and should rid him of any false ideas of danger and violent sensations. The first stall is best done at the end of the lesson preceding that on which stalling is to be dealt with in detail. No instruction should be given during the first demonstration but the point of stall and the commencement of recovery should be indicated. During the subsequent post-flight discussion, the stall, as demonstrated, should be discussed and the student's questions answered; in this way the student is better prepared for the detailed lesson on stalling.

10 **Signs of Approaching Stall** A high nose-up attitude is not always a fundamental sign of an approaching stall. The nose-up attitude should only be pointed out when it is a valid indication that a stall is imminent. The student must be given plenty of practice at approaching the stall and detecting the signs for himself.

11 **Stall Symptoms** The student should become thoroughly familiar with all of the symptoms of the stall itself. The stall warner must not be solely relied on as it, like all things mechanical, can suffer from damage or failure and can be mandible under some conditions. In addition the student should eventually be taught that although the stall warner may aid recognition of the stall, it should not be used as an aid in the recovery. Least height loss occurs when recovery is flown just on the light buffet threshold and the stall warner does not cease its audio tone until speed is 5 - 10Kts above this value.

12 **Effect of Power on Recovery** The much smaller amount of height lost by using power in the recovery should be emphasized. Point out to the student that although practices are carried out at idling RPM an accidental stall can occur at any setting and full throttle should always be used in the recovery.

13 **Recovery When the Wing Drops** The student should be told that the use of aileron will not always raise a dropped wing and will aggrevate the situation under certain circumstances. Therefore, because of this possibility, ailerons are not used in the standard recovery. The student should not be taught to raise a wing using rudder since the object is to recover from the stall - not prolong the stalled state.

14 **Recovery from the Incipient Stall** An incipient stall is a condition where symtoms of an approaching stall are becoming apparent but the full stall has not developed. "An incipient stall" is therefore a condition where one or more stall symptoms are apparent. An unintentional stall should always be stopped at the incipient stage. Therefore, the emphasis should be placed on quick recovery action as soon as any stall warning signs are recognised. The student should be given ample practice in recovering from an incipient stage of all types of stalls.

15 **Stall under Approach Conditions** Initial demonstrations should be as realistic as possible. Show how lack of attention to accurate flying can lead to a stall when concentrating on the approach to land. Before circuit consolidation, demonstrations and practices should be done from a simulated circuit, starting on the downwind leg. Not only will the student associate the recovery techniques with flying in the approach configuration, but he will gain useful circuit flying practice.

16 **Stall at High Speeds** The student should be under no doubt that the aircraft can be stalled at any speed and power. He should understand that the more extreme cases cannot be demonstrated because of the possibility of over-stressing the aircraft. Before going solo the student should be aware that stalling speed increases with bank. This is particularly relevant during the finals turn when speed and power settings are low.

**Common Faults**

17 Students often have difficulty in estimating the amount of control column movement required to recover from the stall. Frequent practice and advice from the instructor is needed until the student becomes proficient. When the instructor is demonstrating the recovery, the student should be allowed to rest his hands and feet on the controls.

18 When a wing drops at the stall, the student tends to correct by instinctive use of the ailerons. Only by practice and experience can the proper method be learned.

19 When power is applied during recovery, the throttle movement is often hesitant or slow. If this is so, the student should be told that the amount of height lost and the rapidity with which control is required both depend on the prompt use of high power.

## EXERCISE 10

## AIR EXERCISE

## STALLING

**AIM:** To teach how to recognise an approaching stall and how to:

- a Thus avoid stalling.
- b Recover if he does not avoid stalling.
- c Lose minimum height during a recovery.

**Airmanship**

1 Checks. Carry out the checks before stalling, spinng and aerobatics (HASELL checks).

2 Check position frequently during the exercise.

3 Synchronise gyro on completion of exercise.

| SEQUENCE | OBSERVATIONS |
|---|---|
| **4 Student's First Stall** | |
| Stall and recover from straigh and level flight | a Not violent or unpleasant.<br>b Control easily regained. |
| **5 Symptoms of the Stall** | |
| Demonstrate a stall from straight and level flight, and detail symptoms. Select max RPM. | a Entry:<br>1) Close throttle and prevent yaw.<br>2) Progressive backward movement of control column to maintain height.<br>3) Trim to 70K<br><br>b Symptoms prior to the stall:<br>1) Decreasing airspeed.<br>2) Decreasing effectiveness of controls<br>3) High nose attitude.<br>4) Stall warning light and horn.<br>5) Possible buffet.<br><br>c Symptoms at the stall:<br>1) Stall warning<br>2) Buffet<br>3) Nose drop<br>4) Possible wing drop<br>5) Aircraft descends<br>6) Rearward movement of the control column does not raise the nose. |

**SEQUENCE** | **OBSERVATIONS**

## 6 Recovery from Stall

a Demonstrate a stall from straight and level flight; recover with throttle closed. Select max RPM.

a Note stalling height and speed.

b Recovery with throttle closed:
1) Control column centrally forward to unstall wings and stop stall warning.
2) Level wings with aileron if necessary.
3) Gain adequate flying speed.
4) Prevent further descent, note height loss.
5) Apply power as nose rises through the horizon and establish climb.

c If no engine power available, gliding attitude selected.

b Demonstrate a stall from straight and level flight; recover using full throttle. Select max RPM.

a Note stalling height and speed.

b Recovery using full throttle:
1) Simultaneous movement of control column centrally forward to unstall the wings and application of full power and use of rudder to prevent yaw.
2) Level wings with aileron if necessary.
3) Adequate flying speed regained more quickly.
4) Prevent further descent, note height loss.
5) Establish climb.

c Note smaller control column movement required when using power.

d Compare the height lost during this exercise with the height lost during recovery with no power.

c Demonstrate a stall with wing drop. USE STANDARD STALL RECOVERY.

a THIS IS THE STANDARD STALL RECOVERY: Simultaneous use of full power, control column sufficiently far forward to unstall the wings, and rudder to prevent the yaw caused by the power increase.

b Control regained - level wings with aileron, prevent further descent and establish climb.

| SEQUENCE | OBSERVATIONS |
| --- | --- |
| **7 Recovery from Incipient Stall** | |
| Demonstrate recovery from the light buffet threshold | a Note stalling altitude.<br>b Apply full power and move control column centrally forward only sufficiently to eliminate buffet.<br>c Very small control movement required and small attitude change.<br>d Little or no height loss. |
| **8 Effect of Power on the Stall** | |
| Demonstrate using 2600 RPM throttled to 1500 RPM. | a Speed decreases slowly.<br>b Control effectiveness - slipstream.<br>c Higher nose attitude.<br>d Shorter duration of stall warning.<br>e Stall symptoms.<br>f Standard recovery. |
| **9 Effect of Flap on the Stall** | |
| Demonstrate stalls with full flap using no power. During recovery take care not to exceed maximum speed for flap (88K). | a Speed decreases rapidly.<br>b Lower nose attitude.<br>c Shorter duration of stall warning.<br>d Lower stalling speed.<br>e Stall symptoms.<br>f Standard recovery.<br>g Greater height loss than when clean. |
| **10 Stall under Simulated Approach Conditions** | |
| a Demonstrate using 2600 RPM throttled to 1500 RPM and full flap (straight flight).<br>b Repeat whilst turning. | a Large nose up asttitude.<br>b Control effectiveness<br>c Low stalling speed.<br>d Standard recovery<br>e Importance of recovery in the incipient stage. Danger of stalling on the approach. |

| SEQUENCE | OBSERVATIONS |
| --- | --- |
| **11 Stall at Higher Speed** | |
| a Demonstrate as a badly executed recovery from a normal stall by moving the control column back harshly when recovering from the dive (about 65K). Do not flick - you will frighten the student. | a Stalling speed higher.<br><br>b Standard recovery.<br><br>c Small control column movement to regain control. |
| b Demonstrate increase in stalling speed during sideslip commencing at 80K. | a Aircraft stabilised at 80K, ¾ rudder and enough bank to stop yaw.<br><br>b Progressively raise nose to reduce airspeed.<br><br>c Recover at incipient stage noting airspeed. |
| **12 Post - Flight Discussion** | |

EXERCISE 11

INSTRUCTIONAL GUIDE

SPINNING

**AIM:** To teach the student the characteristics of a spin and to recover from incipient and developed spins with the minimum loss of height.

## General

1 Although it is not unusual for the student to be somewhat nervous during the first spins, there may be some doubt as to his suitability for further training if he continues to be apprehensive.

2 The student should clearly understand the differences between a spin and a spiral dive.

3 Practice spins should be done at intervals throughout the student's training.

4 The T67 spin is conventional although the rate of rotation is fairly high in the developed spin. Dynamic entry is recommended to ensure a clean entry. The aircraft will roll with the nose near the horizon for about one turn before it drops into the developed spin. The ASI reads about 75K in a spin to the left and 63K in one to the right. The propeller may stop in long spins in some aircraft but will normally restart on the pull out from the dive after recovery. If not, it can be restarted using the starter motor.

5 The instructor must ensure that the student has studied the relevant paragraphs of the Aircrew Manual and the Student Study Guide and that he understands the likely causes of a spin and how to identify it. He must emphasize that normal recovery action is effective in all cases, but that reverse recovery action (stick BEFORE rudder) may lead to a continued stable spin: hence the secondary "non-standard recovery".

6 Spinning is the most frequent cause of air sickness and the lesson should be discontinued if any signs of air-sickness appear.

## Before Flight

7 **Preparatory Instruction**

a Regulations and height restrictions laid down in the Company Flying Order Book.

b Causes, stages and characteristics of the spin.

c Standard recovery action.

d Non - standard recovery.

e Engine handling.

f Inverted spinning (inverted spinning is not demonstrated but the student should be briefed on the recovery action before starting solo aerobatics).

**During Flight**

8 The points of difference between a spin and a spiral should be made clear; the spiral is recognized principally be an airspeed which is significantly above the basic stalling speed. The standard recovery action is effective in both cases but the recovery from a spiral is much quicker. It is important to ensure that spins are practised regularly during training.

9 In later stages of training, spins should be demonstrated off the more extreme attitudes such as those encountered in poorly executed aerobatics. These spins should have been practised before the student's first solo attempt at aerobatics.

10 **Airmanship** To avoid the chance of misunderstanding during recovery, the words "Recover now" should always be used when telling the student when to recover. The student should acknowledge with "Recovering now" when he starts the recovery.

11 **The Student's First Spin** The considerations are the same as those for the student's first stall (Exercise 10) and the first spin should therefore be done at the end of the lesson before that on which spinning is to be taught. The spin should consist of not more than two or three turns.

12 **Recovery from Full Spin** The student should be told to locate the horizon and use it for a datum when levelling the wings after recovery, especially after a prolonged spin. Prolonged spins should not be done until the student has some experience of spins of shorter duration. He should be prepared for the aircraft to continue rotating for up to 3 turns after taking recovery action and that during this period the rate of rotation increases and the angle steepens before the spin stops. If he experiences any dizziness the student should be told that this is not unusual. The significance of a reverse recovery (ie stick forward before applying rudder) must be briefed fully.

13 **Recovery at the Incipient Stage** When the student has mastered the recovery from fully developed spins the emphasis should be placed on early recognition of the various conditions that can lead to a spin and the quick and clean recovery from the incipient stage. An unintentional spin is usually the result of an uncorrected or undetected stall, but in most cases the warning symptoms are so clear that the impending spin can be recognised and corrected before it reaches an advanced stage. The height lost during recovery from an incipient spin will be affected by the use of power. If the nose is above, or near the horizon, full power should be applied immediately as a part of the recovery actions. If the aircraft nose is appreciably below the horizon, the throttle should be closed until recovery has been effected otherwise excessive height loss will occur.

14 **Delayed Spin Recovery Action** The student is to be briefed on the delayed spin recovery actions. If the aircraft shows no sign of recovery after recovery action has been maintained for three turns it is probable that the controls have been mishandled. Carry out the following actions:

a Re-check the turn co-ordinator.

b Ensure that FULL rudder to oppose the turn needle is applied and maintained until the spin stops.

c Maintain the control column fully forward, ailerons neutral.

d Centralise the controls immediately the spin stops.

e Level the wings and ease out of the dive.

**Inverted Spinning**

15 Intentional inverted spinning is prohibited.

16 The direction of a spin is dictated by the direction of yaw, and whilst in a normal spin this is in the same direction as the roll, in an inverted spin the yaw is in the opposite direction to the roll. The instructor should use a model aircraft to demonstrate this. He should also explain that the pilot will normally be far more conscious of the direction of rotation, or roll, than of the direction of yaw, and therefore the correct rudder for recovery will seem most unnatural when related to normal spin recovery action. For this reason the correct rudder to use should aleays be decided after reference to the turn co-ordinator: i.e. apply full rudder on the same side as the ball.

17 The standard recovery action for the inverted spin is:

a Full rudder to oppose the direction of yaw as indicated by the turn needle.

b Control column moved smoothly back until the spin stops.

c Immediately the spin stops centralize all controls and recover from the ensuing dive.

**Common Faults**

18 The student often attempts to identify the behaviour of the aircraft from the position of the controls. It should be impressed on him that the position of the controls is not a reliable indication of whether a spin has occurred or the nature of the spin. The spin should be identified from:

a Flight conditions obtaining immediately before the suspected spin: e.g. proximity to the stall.

b Attitude of the aircraft and the characteristic spinning motion.

c A high rate of descent with the airspeed remaining at a low figure.

19 Students may not always use full control deflection on entry. This may lead to a spiral dive or may cause initial rates of yaw and roll in the spin to vary until full pro-spin elevator and rudder is applied. If the aircraft enters a spiral dive the speed builds up rapidly: no attempt should be made to apply full pro-spin controls, as it is likely to end in a "flick" entry. When full pro-spin control is applied the aircraft takes up the normal erect spin characteristics after 2-3 turns. If full pro-spin control, particularly elevator, is not maintained a high rotational spin may develop. The aircraft will then adopt a steeper nose down attitude and the rate of roll and yaw will increase; the increased rate of roll is very apparent to the pilot.

20 The spin recovery actions are effective. However, the student should be carefully monitored to ensure that he maintains the forward movement of the control column until the spin stops. Only then should the controls be centralised. If, during a standard recovery, the control column is moved forward too slowly the spin recovery may be delayed, whilst failure to move it sufficiently far forward may well prevent recovery. As a guide, the forward movement of the control column from the fully aft to the fully forward position should be achieved within three seconds, although recovery is normally effected between these two positions.

21 Initial spinning exercises are academic and are carried out from level flight. As soon as the student has gained confidence and is familiar with the recovery technique he must be taught spinning from manoeuvre. It is important that the student is familiar with the instrument indications in the spin, and it is essential that he identifies the direction of the spin by reference to the turn needle.

22 The student should understand that spinning is practised in order that should an inadvertend spin occur he will be able to identify and recover from the situation with minimum loss of height. It is also necessary that the student is made aware of his height above ground during recovery and the method of abandoning the aircraft.

EXERCISE 11

AIR EXERCISE

## SPINNING

**AIM:** To teach the student the characteristics of a spin and how to recover from incipient and developed spins with the minimum loss of height.

### Airmanship

1 Checks. Before each spin carry out the checks before stalling, spinning and aerobatics (HASEL checks), listed in the Flight Check Cards.

| SEQUENCE | OBSERVATIONS |
|---|---|
| 2 **Spiral Dive** | a Recognition points. Speed, G, no stall symptoms. |
| 3 **Student's First Spin** | |
| Demonstrate a 2 or 3 turn spin and recover without detailed instruction. | a Ease of recovery. |
| 4 **Spin from Level Flight** | |
| a Demonstrate entries in both directions with engine idling. | a Checks before spinning.<br>b Normal entry:<br>At stall warning positively apply full rudder and move control column fully back. (PRO-SPIN CONTROL). |
| b In the spin with full pro-spin control applied. | a Incipient stage.<br>b Developed spin.<br>1) Steady low airspeed.<br>2) High rate of descent.<br>3) Turn needle indications. |

NOTE: The instructor must ensure that the student keeps the controls fully deflected while in the spin.

| | |
|---|---|
| c Standard recovery. | a Recovery:<br>1) Throttle closed - flap up.<br>2) Check direction of rotation - turn co-ord. Apply and maintain full rudder to oppose yaw.<br>3) Immediately full rudder is applied, move the control column smoothly and firmly forward until the spin stops, ensuring that the ailerons are neutral throughout.<br>4) When the spin stops centralize the rudder.<br>5) Level the wings and ease out of the dive.<br>6) Apply power as nose approaches horizon.<br>7) Height loss - associate with number of turns. |

**SEQUENCE** | **OBSERVATIONS**

**4 Spin from Level Flight** (continued)

d Delayed recovery.

a Do not attempt to enter high rotation spin - rebrief importance of correct recovery action and cover delayed recovery action.

**NOTE:** If the engine stops in the spin it will normally restart in the recovery from the dive. If the propeller is still stationary when the level flight attitude has been reached, restart the engine using the drill contained in FRCs.

**5 Recovery at the Incipient Stage**

Demonstrate spin entries in both directions, recovering before the spin has stabilized.

a Checks before spinning.

b Entry as for normal spin.

c Importance of prompt recognition of spin condition.

d Recovery:
1) Control column and rudder central.
2) Power as required (see para 12 of Instructional Guide).
3) Level wings and ease out of any dive.

e Rapid recovery.

f Small height loss.

**6 Spin from Manoeuvre**

a During an aerobatic manoeuvre(eg Roll off the top), at the normal spin entry speed, apply full rudder and move the control column fully back until the aircraft spins.

a Checks before spinning.

b Danger of misusing the controls at low speed.

c Aircraft spins in direction of yaw.

d Standard spin recovery.

b Demonstrate recovery at the incipient stage of the spin after control is lost during manoeuvre.

a Checks before spinning.

b Use incipient spin recovery technique.

c Use standard spin recovery technique if the aircraft fails to recover from the incipient stage.

**7 Post Flight Discussion**

EXERCISE 12

INSTRUCTIONAL GUIDE

# TAKE-OFF AND CLIMB

**AIM:** To teach the techniques of taking-off, entering the climb and positioning the aircraft on the downwind leg of the circuit.

## General

1 Before first solo the student should be able to take-off in both into-wind and crosswind conditions and have practised the procedure to be used if the engine fails after take-off.

## Before Flight

2 **Preparatory Instruction**

a Use of elevators, rudder and nose wheel steering.

b Effect of crosswind.

c Use of power.

d Engine failure.

e Drills and circuit procedure.

f Factors affecting length of ground run.

g Airfield control and RT procedure.

## During Flight

3 **Airmanship**

a **Lookout** The instructor must stress the paramount importance of a good lookout and demand a high standard from his student.

b **Checks** The student must be taught to complete his checks before take-off thoroughly and in the correct sequence. The instructor must insist on accuracy and attention to detail and ensure that the student understands the importance of the checks.

c **RT Procedure** By first solo the student must be completely familiar with the circuit RT procedure and action in the event of radio failure. Because the degree of concentration required during the early stages of circuit practice is high few students are able to maintain a good listening watch.

4 **Take-off into Wind**

a If the student has difficulty taking-off unassisted, it may be necessary to let him use each control in turn, the instructor handling the others. As the student gains proficiency he should be allowed to take over other controls until he can complete the take-off unaided.

b Wherever possible the first demonstration and practices should be made into wind.

c The student should be told to choose a point well ahead of the aircraft to assist him to maintain direction.

d When lining up on a runway tell the student to put himself on the centre line rather than make an allowance for offset seating.

e After "brakes off" engine instrument readings should be checked - especially RPM for governing.

f In strong winds the aircraft may be climbed straight ahead to circuit height. This will give the student a longer downwind leg to complete the prelanding checks.

g Flapless takeoffs need pre-briefing on the increase in takeoff run and stalling speed.

h Ensure that the student positively stops braking when applying rudder during takeoff.

5 **Crosswind Take-off**

a Unless the crosswind is strong enough to give a convincing demonstration, the lesson should be postponed until more suitable conditions prevail.

b The student should be shown that the aircraft is flown off cleanly at a slightly higher airspeed so that there is no danger of touching down again once the aircraft has acquired drift.

c After leaving the ground the student should take up a heading to make good a track along the extended centreline of the runway.

6 **Engine Failure After Take-off**

a It is most important that the instructor briefs the student before practice EFATOs that he does not actually switch off fuel or ignition when emergency drills are simulated.

b Demonstration engine failures after take-off should be made from a height and position that allows the instructor time to make his observations and give full effect to the lesson. The instructor must ensure no other aircraft are below on starting his demonstration and above on climbout.

**6 Engine Failure After Take-off** (continued)

c A turnback is practicable in many circumstances as a 45° banked gliding turn through 180° results in only a 275 ft height loss. However, in the early stages, the students analysis and decision making process will be slow and for this reason students should be taught to consider turnbacks only if the aircraft is above 500 feet. See paragraph 7. A convincing demonstration of the factors involved in attempting a turn back can be made in the low flying area.

d If the engine fails during the take-off run or when the aircraft is just airborne, the procedure is governed by the circumstances prevailing. It may be necessary to turn sharply on the ground to avoid striking obstacles.

e Until the student has been shown the forced landing technique, he should be told to take the following actions if the engine fails in the circuit:

1) Make a MAYDAY call.
2) Land on the airfield as near as possible into wind. In practice, this may not be possible.

7 **Turnbacks** Turning back to the airfield following an engine failure after takeoff is a manoeuvre which requires considerable skill and judgement. Fortunately, the T67 has a high aspect ratio wing and loses comparatively little height in a gliding turn if flown properly; thus, dependent on the skill and speed with which the aircraft is handled, it may be practicable to turn back following an engine failure after takeoff. The minimum height from which one should be attempted is 500 ft and unless the airfield is small and the surface wind light, it should be practicable to land back from this height. The decision on whether to turn back or not requires a lot of thought and could not be safely made in a hurry in the air; thus the airfield conditions should be carefully considered before takeoff and decisions made on the plans to be followed if the engine should fail. The following actions are a general guide but may need varying to suit the circumstances:

a Select the gliding attitude and achieve 80K.

b Turn (into wind if there is any crosswind) using 45° bank.

c Plan the approach.

d Make an emergency call.

e Carry out forced landing checks.

f Carry out final approach and landing.

**Common Fault**

8 Overcontrolling and lack of co-ordination are usually caused by muscular tenseness on the controls induced by the high amount of concentration required in the student's initial attempts. The student can be helped to relax if his responsibility is at first limited as described in para 4a.

EXERCISE 12

AIR EXERCISE

## TAKE-OFF AND CLIMB

**AIM:** To teach the techniques of taking-off, entering the climb, and positioning the aircraft on the downwind leg of the circuit.

### Airmanship

1 The instructor should brief the student on the following:

a Note direction of take-off and circuit.

b Run-up into wind.

c At the holding point check that:
1) The aircraft is positioned so that its slipstream is not directed toward aircraft following and there is no danger of running into aircraft ahead.
2) The parking brake is applied.
3) The RPM is set to 1200.
4) The checks before take-off are completed.

d The action to be taken in the event of an engine failure occurring during or shortly after the take-off.

e Check the approach is clear and call for take-off. When cleared, take-off with minimum delay.

| SEQUENCE | OBSERVATIONS |
|---|---|
| **2 Take-off into Wind Using Half Flap** | |
| a Lining up and take-off run. | a Lining up - nosewheel straight.<br>b Brakes off - toes off brake pedals.<br>c Take-off run:<br>1) Control column held central.<br>2) Look well ahead to assist in keeping straight.<br>3) Open throttle smoothly to full power.<br>4) Check engine rpm and instruments.<br>5) Control direction by nosewheel steering. At 45K raise nosewheel and adopt take-off attitude, keeping straight with rudder. |
| b Becoming airborne and climbing away. | a Becoming airborne:<br>1) Hold the take-off attitude and the aircraft will become airborne at 52K.<br>2) Wings level.<br>3) Gradually assume climbing attitude. |

| SEQUENCE | OBSERVATIONS |
| --- | --- |
| 2 **Take-off into Wind using Half Flap** (continued) | |
| | b Climbing away:<br>1) Apply toe-brakes<br>2) Allow speed to increase to 70K.<br>3) Climbing attitude.<br>4) Trim.<br>5) At 300 ft and at correct speed (70K) raise flaps - increase speed to 80K.<br>6) Checks after take-off.<br>7) Turn not below 500 feet.<br>8) Allowance for drift.<br>9) Allowance for strong headwinds.<br>10) Levelling off.<br>11) Trim.<br>12) Position to turn downwind. |
| 3 **Crosswind** | Observations as for take-off into wind except:<br><br>a Prevent weathercock tendency.<br><br>b Apply aileron into wind to stop wings lifting.<br><br>c Clean fly-off at 50-55K - centralise ailerons and rudder.<br><br>d In strong crosswinds do not raise nosewheel - rotate to takeoff attitude at takeoff speed.<br><br>e When airborne allow for drift by co-ordinated use of rudder and aileron. |
| 4 **Engine Failure after Take-off** | |
| Demonstrate simulated engine failure after take-off from about 400 feet. | a Gliding attitude and speed - 80 kts.<br><br>b Choose landing area - alteration of heading of more than 30 degrees is not advisable.<br><br>c Use of S turn to adjust approach path.<br><br>d Flap as required.<br><br>e "MAYDAY" call on frequency in use if time permits.<br><br>f Drills as contained in Cards. |
| 5 **Turnbacks** | a Leave until after demonstration of height loss on low flying.<br><br>b Emphasize need for planning before takeoff.<br><br>c Cover significances of downwind landing. |
| 6 **Post-Flight Discussion** | |

## EXERCISE 13

## INSTRUCTIONAL GUIDE

## APPROACH AND LANDING

**AIM:** To teach the correct method of rejoining the circuit, and various types of approaches and landings.

### General

1 After the introductory air work, the student will find the intensive circuit sessions a great deal more hurried and demanding. It is imperative, therefore, that he should know all the checks, settings, and speeds before serious instruction in the circuit is attempted; for this purpose circuit diagrams should be displayed in crewrooms.

2 As soon as the student is reasonably competent at straight and level, turning, climbing and descending, he may be progressively familiarized with circuit procedures at the end of the details preceding the circuit lessons.

3 Revision of descending in the approach configuration, and the overshoot procedure, should be practised at medium altitudes during the detail preceding the start of concentrated circuit instruction.

4 Before the first solo flight, the student should be able to make competent engine-assisted approaches and landings and also be able to go round again safely. The glide approach and landing should also have been demonstrated sufficiently for the student to be able to attempt a landing in the event of engine failure.

### Before Flight

5 **Preparatory Instruction**

a Circuit approach and landing.

b Effect of windspeed.

c Use of nosewheel steering

d Effect of crosswind.

e Effect of gusty conditions.

f Use of brakes on landing.

g Going round again.

h Consideration for short landings.

i Airfield control and RT procedures.

j Lookout and listen out.

**During Flight**

6 Many students have difficulty in mastering the landing and, although the instructor's advice and guidance is of help, proficiency is obtained mainly through practice. In the early stages, the emphasis should be placed on safe flying and the fostering of the students' confidence rather than on a polished performance. It is important to ensure, before the first solo, that they can recognise and correct any errors that may occur.

7 **Airmanship**

a The large number of aircraft that may be in the circuit requires a particularly careful lookout and a high standard should be demanded.

b The student must learn and understand the significance of all the visual signals that are used by aerodrome control for the control of aircraft.

c Turns in the circuit should be limited to medium angles of bank unless an emergency arises.

8 **Joining the Circuit** Always ensure that the student completes the FEDRA 'rejoin checks'. Impress upon him the importance of good lookout at all times and the need to locate all other aircraft in the circuit. Show him how the RT calls of the other aircraft can provide guidance on where to look, but point out that he must not rely solely on these calls. He should be aware that the circuit rules may be broken at the pilot's descretion in an emergency, but due regard must be given to the risk of collision and ATC informed of any departure from normal procedure. Point out that there are three areas where collision risk is greatest: on the dead side between aircraft joining and aircraft overshooting; at the start of the downwind leg where joining aircraft may conflict with those approaching the downwind leg after a roller; and on the finals turn.

9 a **The Rejoin Overhead** The student should be taught to fly overhead the airfield above the ATZ (2000 ft AGL), letting down in a curve on the dead side of the airfield to circuit height at 85K, entering the circuit pattern by crossing the upwind end of the runway, tracking at 90° to it. This pattern enables an unhurried join into the circuit whilst maintaining a safe lookout. During this exercise the student should note the wind speed and direction and be able to position the aircraft sensibly spaced from other circuit traffic. The descent to circuit height must be completed during the turn so that the area beneath the aircraft may be continually checked for other aircraft.

b **Procedural Join** The various types of joining procedure in use should be discussed with the student at an appropriate stage of training.

10 **Downwind Leg** The student should be shown how to judge and maintain the correct distance from the landing path. At the correct distance out, the landing path should appear at the junction of the flap and aileron. The downwind checks should be done at the beginning of the downwind leg so that full attention can be devoted to correct tracking. Emphasize to the student the need to adjust the length of the downwind leg to allow for wind drift during the base leg turn for different wind conditions. It is vital that the student understands he must not commence his descent onto finals until he has seen all the aircraft ahead.

11 **Base Leg Turn** The student should be shown how to assess the wind strength in order that a turn onto the centre line may be correctly judged. Emphasize the need to trim in the descent at the correct speed. This will enable an accurate assessment of the power required to maintain a correct approach to be made. The student should be told to look out for aircraft that are making their final approach, especially those making a long final approach. The RT call should be made when established on final approach.

12 **Engine Assisted Approach**

a Engine assisted approach and landing is the basic technique and all others are variations of it.

b The turn on to final approach should, ideally, be made with a constant angle of bank. The student should be shown how to adjust the bank to roll out on the runway extended centre line.

c The student should be shown that, if he maintains the same attitude the airspeed will hold 70K in the turn.

d Once on the final approach the student should be shown how to achieve the correct approach speed in trim once full flap has been selected.

e With wings level, the final checks should be done and a positive effort made to ensure that the toes are off the brakes.

f The final approach should be straight in from 400 ft. The power required will vary with wind conditions. It should be pointed out to the student that the change of aspect, and the relative movement of a selected point, are the primary guides to assessing the approach path.

g To maintain a constant speed approach to threshold, the student should understand that airspeed is controlled by attitude and the rate of descent is controlled by power adjustments. Emphasize the need for coordination of attitude and throttle adjustments and point out that only small movements of the control column and throttle are required.

h It should be stressed that a good landing is most easily made from a good approach, which requires being at the correct speed and approach angle with the aircraft trimmed.

13 **Landing** A slight back pressure applied to the control column as the threshold is approached will taper the speed to the correct value as the threshold is crossed. Roundout should be a progressive backward movement on the control column and a smooth reduction in power, aimed at progressively reducing the rate of descent until it is almost zero as the mainwheels touch some 5-10K below threshold speed. The student should appreciate that the roundout must be commenced at a height which will allow a controlled change in the rate of descent. The landing attitude should be judged by looking towards the far end of the runway and avoiding any tendency to look at the runway surface immediately ahead and to the side of the nose of the aircraft. After touchdown, the nose attitude must be controlled to allow the nosewheel to lower gently onto the runway under little load. The brakes should not be applied until all three wheels are fimrly on the ground, the first application being gentle and the pressure increased as necessary to bring the aircraft to a safe taxi speed before reaching the turn-off point. The student should be shown that directional control is easily maintained by the use of rudder and nosewheel steering. Any tendency to turn off the runway at excessive speeds must be prevented and he should be made aware of the strain that is imposed on the undercarriage by fast cornering. The aircraft should be stopped when well clear of the runway, the parking brake applied and the after landing checks carried out.

14 **Going Round Again**

a **Abandoned Approach** The student should be taught to overshoot from a badly executed approach by 200 ft. When going round again, the wings should be levelled and full power applied simultaneously. When a climb is established, at a minimum of 65K and 100ft, flaps should be raised to the take-off position and speed increased to 70K. Flaps should be raised fully at 70K at 300ft, and increased to 80K. The importance of a good lookout when going round again should be stressed, particularly if overshoot action has been initiated after a collision warning. When settled, and if local conditions permit, a gentle turn should be made towards the dead side of the circuit so that the climb is not carried out over the runway but parallel to it. After overshooting, delay the upwind turn until reaching the upwind end of the runway and use this turn to position the aircraft clear of other aircraft in the circuit.

b **Touch-and-Go Landing** After touchdown the student should be taught to use the normal take-off technique, ie apply full power, keep straight with rudder, keep the nosewheel off the runway in the take-off attitude and at 50K allow the aircraft to fly off the ground. For a flapless touch-and-go a liftoff speed of 55K should be used.

c **Porpoising** Over-controlling near the ground can result in the student inducing a pitch oscillation, bounce, or porpoise motion. The corrective action is to hold the control column slightly aft of central in the take-off position, whilst opening the throttle fully, keeping the wings level, and overshooting. It should be emphasized that attempts at corrective action by elevator and/or throttle movements will only aggravate the porpoising motion of the aircraft and ultimately result in damage to the nosewheel assembly.

15 **Glide Circuit** The circuit should be taught as an exercise in judgement which will have an application to the practice forced landing. Whilst flying downwind, two reference points on the runway are chosen; these are called the 'Initial Aiming Point' and the 'Selected Point of Touchdown'. The Initial Aiming Point should be some easily recognised feature (marker board, runway intersection, etc) about ⅓ up the runway and it is the point at which the aircraft would land if full flap was not available. The Selected Point of Touchdown is where the pilot wants the aircraft to land using full flap, and should be some easily recognizable point a little distance up the runway from the threshold to allow room for slight undershoots. The turn onto the base leg should be judged with reference to the wind conditions. The throttle should be closed abeam the selected touchdown point. During early practices (dual) the student will not know how good his judgement of the initial approach is unless he is allowed to continue his approaches without using full flap and is able to see whether or not he achieves his initial aiming point. Students should be shown how corrections can be made to undershooting/overshooting errors by varying the angle of bank used in the finals turn, so varying the flight path to maintain a constant sight line angle. The aircraft is said to be maintaining a constant sight line angle when the angle subtended between the horizontal and the line of sight between the pilot and the initial aiming point is constant. Periodic revision of this training may well be necessary, and is customarily introduced by denying the student the use of full flap without prior warning. When his judgement of the finals turn is reasonable, the student should be shown how selection of full flap is used to bring the actual touchdown point back from the initial aiming point to the selected point of touchdown. It must be emphasised that minimum speed with full flap selected is 65K. Students should also be made aware of the inherent danger of late full flap selection at a low airspeed. The emphasis in this exercise should be on accuracy of judgement and the student should be corrected if he deliberately aims to overshoot and then relies on the early selection of full flap to achieve the selected touchdown point. The student should be aware that 80K must be maintained in the initial stages of a glide approach because:

a The speed gives safety and manoeuvrability in the finals turn.

b Flying a constant speed is essential when judging the approach.

Because of the higher rate of descent and greater attitude change required, roundout must be started earlier and at a higher airspeed than for a powered approach. The dangers of rounding out too sharply (causing a 'g' stall), and/or of allowing the speed to decrease too much (with the associated high sink rate), should be pointed out.

16 **Flapless Landing** This landing is taught as a solution to the unlikely problem of flap malfunctions and also to increase the student's experience of alternative landing patterns. The need to extend the downwind leg to accommodate the shallower approach angle should be stressed. The final turn should be made at the same height as for a normal circuit and the aircraft should be lined up with the runway at 400ft AGL. The distance from the threshold will be greater and the approach path flatter. The importance of maintaining the correct approach speed of 70K using the elevators should be emphasized. The student should be made aware of the reduced drag experienced on the final approach when flapless and the need to anticipate power requirements. The higher nose attitude may encourage the student to believe that the aircraft is descending less rapidly than it really is. It should be stressed that only by monitoring the runway aspect and controlling the rate of descent by power changes can the correct approach path be achieved. The attitude change at roundout is small and the landing run will be longer. Because of the danger of touching the tail, the aircraft should not be "held off" but should be landed at 55K.

17 **Short Landing** The aim of this exercise is to achieve minimum ground roll. Before being taught short landings, students should have achieved a high standard of accuracy in normal circuits and landings. The short landing approach needs particularly fine judgement in a T67 as there is no "back side" to the drag curve; this makes it difficult to get the speed back to 55K at the treshold without ending up with a glide landing. The selected touchdown point should be nominated when the aircraft is on the downwind leg. Base leg technique is the same as for the normal circuit. As soon as the wings are levelled after the final turn, full flap is selected and the speed reduced to 65K. The importance of accurate trimming should be emphasized. At the recommended approach speed, more frequent small adjustments of nose attitude and power may be required to maintain the necessary accuracy. As the threshold is approached, speed should be reduced to 55K. The attitude change at roundout is small and the throttle should be closed as the aircraft touches down. Steady continuous braking should be commenced as soon as all three wheels are on the ground. Although students should be instructed in the correct braking technique for short landings, to avoid excessive wear on aircraft components, short landings may be practised without employing maximum braking.

18 **Crosswind Landing** In the early stages, students will have difficulty in the detection and assessment of drift. Therefore, the initial demonstration and practice of crosswind landings should be carried out when there is a moderate, but not excessive, crosswind component on the runway. The student should be told always to check the windsock before take-off and when joining the circuit in order to make the appropriate allowances in good time, but he should appreciate that the wind at circuit height is different from that at the surface. An allowance for drift is made to fly the downwind leg parallel to the runway. The student should be told to look for changes in the position of the wing in relation to the runway and to make appropriate corrections to maintain a parallel track. On the base leg, depending upon the direction of the crosswind, there will be either more or less time to lose height before the final turn, and power should be adjusted to vary the rate of descent accordingly. The student should be taught to vary the position at which the final turn is commenced in order to achieve the runway extended centre line without excessive bank. There are two recognized methods of achieving crosswind landings - the Crab Technique and the Wing Down Technique. The crab technique is the standard method and should be taught to the student. The large wingspan and low wingtip position on the T67 make, the wing down technique a potentially hazardous practice and it is not taught.

a **Crab Technique** On final approach the drift allowance should be made by heading slightly into wind so that the aircraft tracks along an extension of the landing path. As height is reduced, the drift may change and small turns should be made to maintain the aircraft on the centre line and to adjust the drift allowance. The drift allowance should be maintained throughout the round out; then, before the aircraft touches down, rudder is used to yaw the aircraft into line with the landing path. As the nosewheel lowers to the runway, snatch may be felt on the rudder pedals and, thereafter, direction is maintained by nosewheel steering. Aileron may be used after touchdown to prevent lifting of the into-wind wing.

19 **Bad Visibility Circuit** This circuit should be practised in the bad visibility configuration, ie take-off flap and 70K. Students should be impressed with the overriding need to maintain orientation and should be shown how the use of the DI, ground features and airfield lighting can contribute to this. The configuration of takeoff flap and 70K provides more time and adequate speed and power margins to avoid obstacles. The lower nose attitude improves forward visibility.

20 **Low Level Circuit** This circuit is for use when the cloudbase is low but visibility below cloud is good. A normal circuit pattern is flown and the student should be taught the new visual cues to establish his position downwind at 500 feet (simulating a 700 feet cloud base). Height is maintained during the finals turn until the aircraft intercepts the normal circuit pattern, when descent is commenced. The remainder of the circuit is the same as the normal circuit.

21 Both the Bad Visibility and the low level circuit are practiced at 500 feet circuit height. The student should be made aware that, under real conditions, the circuit height will be decided by the necessity to keep 200 feet vertically from cloud at least 500 feet above ground and the visibility available. Thus circuit height will never be less than 500 feet and never more than the normal circuit height.

Common Faults

22 The usual causes of bad landings are:

a Failure to roundout sufficiently due to too steep an approach - probably caused by an initial tendency to overshoot.

b Rounding out too high. This is sometimes caused by fear of getting too near the ground; the fault can often be cured by a clear demonstration of the roundout height - done by flying the aircraft across the airfield in the appropriate attitude and at the roundout height.

c Erractic bad judgement of the roundout height and poor control of direction during the roundout; this is usually caused by looking at the ground too close to the aircraft and becoming tense on the controls.

d Not keeping the wings level. This is often caused by looking at the ground too close to the aircraft and then leaning over to improve the view ahead.

e General difficulty with all stages of the landing up to the touchdown. This trouble can often be traced to:

1) Faulty approaches at too high or too low speed caused by incorrect trimming or failure to select a specific landing area early in the approach.

2) Poor power and pitch coordination on the final approach.

f Inadvertent application of brake when applying rudder.

23 Do not attempt to analyse the student's difficulties until he has had a fair amount of practice at landing. Until he has had this practice, the errors are likely to be of a random nature while he is becoming accustomed to the appearance and feeling of a good landing. After the student has grasped the basic requirements, any errors will normally form a consistent pattern which can easily be recognized and analysed. During the initial period, when the student is feeling his way, the instructor should help by demonstrating landings when necessary and then guiding and advising the student during his own attempts. Beware of the student losing concentration after touchdown, and avoid too many consecutive roller landings or the student will lack practice in controlling the landing run.

**EXERCISE 13**

**AIR EXERCISE**

**APPROACH AND LANDING**

**AIM:** To teach the various techniques of approaching and landing.

1 **Airmanship**

a Basic procedure for joining the circuit:
1) Complete the rejoin checks (FEDRA).
2) Ensure that you are above the airfield ATZ.
3) Check windsock.
4) Lookout - Listen out - note position of other aircraft in circuit.
5) Curved letdown on dead side of circuit.
6) Cross upwind end of runway at circuit height.

b Alternative joining procedure:
1) Complete the rejoin checks.
2) Rejoin at circuit height as directed by ATC.
3) Join circuit pattern as directed by ATC.
4) Stress lookout and listen out.

| SEQUENCE | OBSERVATIONS |
|---|---|
| 2 **Downwind Leg** | a Distance from landing path. |
| | b RT Call. |
| | c Adjust power to hold 85K. |
| | d Downwind checks. |
| | e Keep track parallel to landing path, use of DI. |
| | f Correct height. |
| | g Monitor airspeed, adjust power as necessary. |
| | h Position at which to turn for type of approach intended, and allowance for wind. |
| 3 **Engine-assisted Approach and Landing** | |
| a Finals turn. | a Reduce power to 10 - 12" MAP |
| | b Lower Takeoff flap. |
| | c Reduce to 70K - Trim and start descending turn. |
| | d Importance of lookout on finals. |
| | e Judge turn onto final approach ensure a straight approach from 400 feet. |
| | f Radio Call. |

| SEQUENCES | OBSERVATIONS |
|---|---|
| **3 Engine-assisted Approach and Landing** (continued) | |
| b Finals. | a Commence from at least 400ft AGL: lower full flap as required, when turn completed.<br>b Reduce airspeed to 65K.<br>c Final checks - toe off brakes.<br>d Appearance of landing path when on correct approach.<br>e Maintain correct approach path at 65K by co-ordinated adjustments of power and pitch attitude. |
| c Landing. | a Approaching threshold hold 65K.<br>b Judging round out.<br>c Start round out and slowly close throttle - speed 60K at threshold.<br>d Allow aircraft to touchdown on mainwheels at 50K.<br>e Nosewheel lowered gently on to the runway if not doing a touch-and-go. |
| d Landing Run. | a Look well ahead to assist in keeping straight.<br>b Control column just aft of central.<br>c Use nosewheel steering to keep straight.<br>d Check brakes - use as necessary.<br>e When clear of landing path, stop and complete checks before taxying in. |
| **4 Touch-and-go landing** | a Hold nosewheel off the runway .<br>b Smoothly apply full power<br>c Keep straight with rudder.<br>d When safely airborne and at 65K, raise full flap.<br>e At 70K and 200 feet raise take off flap and allow speed to increase to 80K.<br>f Trim<br>g Check aircraft is flying up extended centre-line |

| SEQUENCES | OBSERVATIONS |
|---|---|
| **5 Going Round Again** | |
| Demonstrate and practise at altitude before practising in circuit. | a Open throttle fully; prevent yaw.<br>b Adjust attitude to give 65K with full flap or 70K with take-off flap.<br>c Trim.<br>d Lookout.<br>e Turn towards dead side of runway if necessary.<br>f Flap raised in stages at a sfae height.<br>g Climb at 80K. |
| **6 Glide Approach and Landing** | |
| Demonstrate and compare with engine-assisted approach | a Select initial aiming and touchdown points.<br>b Close throttle abeam selected touchdown point.<br>c Select 80K attitude<br>d Trim<br>e Commence final turn<br>f Check approach to initial aiming point.<br>g Adjust bank angle if necessary<br>g Finals call<br>i Assess landing point<br>j Use flap to make the selected touch down point (minimum 65Kts)<br>k Steeper angle of approach, higher rate of descent<br>l Roundout started higher because of larger attitude change.<br>m Application to forced landings. |
| **7 Short Landings** | |
| Demonstrate and compare with engine-assisted approach. | a Position at which to turn.<br>b Base leg turn as for normal approach.<br>c Full flap on finals. Reduce speed to 65K.<br>d Descent regulated with power. |

| SEQUENCES | OBSERVATIONS |
| --- | --- |
| 7 **Short Landings** (continued) | e Pre-selected touchdown point.<br>f Constant speed approach initially at 65K for a 55K threshold.<br>g Higher nose attitude; hardly any round-out.<br>h Touch down and close throttle at the same time.<br>j Use of brake.<br>k Short landing run.<br>l Application to restricted landing areas. |
| 8 **Flapless Landing** | |
| Demonstrate and compare with engine-assisted approach with flaps. | a Position at which to turn onto base leg.<br>b Less drag; smaller throttle movement needed.<br>c Flatter approach path, higher nose attitude. Speed 5K above normal circuit speed.<br>d Smaller roundout because:<br>1) flatter approach.<br>2) Danger of touching the tail.<br>e Longer landing run.<br>f Application to flap failure. |
| 9 **Crosswind Landing** | |
| Demonstrate using crab technique | a Drift allowance on downwind leg.<br>b Wind effect on turn onto finals.<br>c Avoidance of full flap in gusty or very strong wind conditions.<br>d Drift allowance on final approach path.<br>e Use of rudder to align aircraft with landing path just before touchdown.<br>f Nosewheel snatch on touchdown.<br>g Weathercock tendency on landing run, and tendency for into-wind wing to lift - use of aileron into-wind. |

**SEQUENCE** | **OBSERVATIONS**

**10 Bad Visibility Circuit**

Demonstrate at 70K with take-off flap.

a Circuit height according to cloud base and visibility.

b Fly along intended landing path and note heading on DI.

c Note any useful landmarks especially on circuit side of landing path.

d Turn through 180 degrees onto downwind leg; use DI to check heading.

e Aim to keep landing path or transient landmarks in view; adjust downwind leg heading as necessary.

f At a suitable position begin a continuous turn onto final approach maintaining height until aircraft intersects normal approach path.

g If too close to threshold on final approach, overshoot and use knowledge so gained to adjust next circuit.

h Straight in approach from 400 feet AGL.

**11 Low Level Circuit**

a Height 500ft AGL for initial practice.

b Normal checks.

c Changed perspective from downwind.

d Position to turn.

e Height maintained until aircraft intercepts normal approach path.

f Straight in approach from 400ft AFL.

**12 Post Flight Discussion**

EXERCISE 14

INSTRUCTIONAL GUIDE

# FIRST SOLO

1 A successful first solo flight, free from incident, gives the student added confidence which is often apparent as an improvement in his flying ability. The first solo flight is an important occasion for the student, and the instructor must do all he can to ensure that the student starts the flight with the knowledge that he is fully competent to do so.

2 The flying instructor makes his most important decision in the training of a student when he decides to send him solo for the first time. One of the main problems of basic instruction is the recognition or selection of the right time to send the student on his first solo flight. At the one extreme, if he is sent solo before he is sufficiently competent and confident the result may be a poor flight and a loss of confidence; at the other, if the first solo is delayed until after the appropriate moment, the result is often a deterioration in his flying skill, a loss of interest and a loss of confidence.

3 The main requirements to send a student solo are general competence, safety and the ability to recognize and correct faults. Polished flying cannot be expected at this stage. The instructor must be reasonably sure that the student can take appropriate measures promptly in emergency and should closely observe his reaction during preceding flights.

4 A guide to what constitutes an acceptable standard of flying for the first solo flight is given in the following sub-paras:

a **Airmanship** The student should maintain a good lookout without reminders from the instructor. He should be able to maintain a listening watch and to make the appropriate RT calls. All checks and drills should be faultless. There should be no doubt as to his ability to avoid other aircraft and to overshoot in good time should his approach and landing be baulked.

b **Take-off and Climb** The student should be able to line up and maintain direction on the take-off run and should fly the aircraft off at a safe speed and not hold it on the ground until an excessive speed is reached or try to haul it off in an exaggerated nose-up attitude. The initial climb should be at a safe angle and a good lookout maintained whilst completing the after take-off checks.

c **Circuit** Although his circuit need not be precise in all respects, the student should be consistent in maintaining satisfactory headings and in judging the positions at which to turn. Angles of bank should be reasonably accurate and he should not be in the habit of overbanking. Variations in altitude are acceptable provided that he corrects them; however, the variations should not be large enough to cause marked difficulty on the approach.

4 d **Approach** The student should have good control of the speed, particularly during the final turn and on the last stages of the approach. He should be able to assess the correct approach path, recognise the variations from it and thus anticipate the need for corrections to power settings and must appreciate when it is necessary to go round again. It is important that these decisions are not left until the last moment.

e **Landing** The main consideration is the safety of the landing. There should be no consistent fault such as holding off high. A series of good landings is not necessarily proof of readiness for solo; the student must have demonstrated that he can go round safely from ground level and knows that he must do so when in trouble and that he is able to correct a mislanding.

f **Emergencies** The student must have had practice at engine failure after take-off and should be tested for knowledge of emergency drills. He should have been briefed on the action to be taken in the event of engine failure in the circuit and have had a glide landing demonstrated to him.

g **Confidence** The instructor will have noted and taken steps to correct any tendency towards under-confidence or over-confidence during pre-solo instruction. True confidence is the ability to meet difficulties with assurance and the student should display the ability to keep calm and react sensibly to unusual situations. The pilot who is unaware of his limitations is no more reliable than the one who allows himself to be overwhelmed by them and both invite trouble through either ignorance or panic. When the student is ready for solo he should be able to make safe and reasonable corrections on his own initiative and generally handle the aircraft in a manner which inspires trust.

## Before Flight

5 The instructor must ensure that he is qualified to authorize a first solo flight in accordance with the relevant regulations.

6 The pre-flight briefing should be short and simple. The student may be somewhat excited and unable to absorb detailed instructions. It is sufficient to brief him to take-off, complete the circuit and land, with a reminder that it is better to overshoot from an unsatisfactory approach rather than risk a poor landing. Mention should be made of any special air traffic instructions. Last minute briefings on emergency drills and procedures are a complete waste of time. Weather conditions must obviously be suitable. If possible, traffic density should be low and ATC warned that the flight is a first solo.

7 It will often be appropriate to send the student solo immediately after a dual sortie without prior completion of the relevant documentation: the instructor must ensure that his operating procedures allow him to do this.

**After Flight**

8 The instructor must watch early solo flights in order to note progress and any signs of over-confidence or excessive timidity.

9 After his first solo the student may have a strong sense of achievement; any comments on his performance should be carefully measured against his temperament and it should be made clear that the first solo is merely a step to more serious training and not regarded as an end in itself.

10 During the subsequent circuit consolidation period the student should be given practice at glide and flapless landings in his dual checks before solo and, when competent, authorized to carry them out solo, providing that conditions are suitable.

EXERCISE 15

INSTRUCTIONAL GUIDE

# ADVANCED TURNING

**AIM:** To teach turning at high angles of bank and how to obtain maximum turning performance.

## General

1 Since the steep turn, particularly at maximum rate, has important practical uses, the student should be given enough practice to reach a high standard. Steep turns give valuable practice in co-ordination of control movements and, when done at maximum rate, give the student confidence in handling the aircraft at its limits.

## Before Flight

2 **Preparatory Instruction**

a Use of power.

b Effect of 'g' on the stall.

c Significance of the stall warning - comes before the stall.

d Considerations for maximum rate and minimum radius turns.

e Use of controls.

## During Flight

3 **Airmanship**

a Emphasize the importance of a good lookout before and during a rapid change in direction, particularly on the inside of the turn and on the outside of the turn after recovery.

b Students may become disorientated after a number of steep turns. They should be reminded of the importance of keeping a periodic check of their position and of the likelihood of unreliability of gyro compasses due to tipping during steeper turns.

c When possible, steep turns should be demonstrated and practised at about 2,000 to 3,000 feet. At higher levels it may be necessary to restrict the bank angle in order to maintain speed because of the power loss with height.

4 **Steep Level Turns**

a Steep turns should first be done at an angle of bank of about 45 degrees; as the student becomes proficient the bank should be increased to about 55 degrees.

b Good practice in co-ordination can be obtained from turning in alternate directions and making the change as a smooth continuous movement.

c During steep turns in each direction the side-by-side seating has a greater effect on the apparent nose position than in medium turns.

5 **Stalling in the Turn**

a This lesson should be thoroughly learnt before the student does a solo practice involving steep turns.

b Before demonstrating stalling in a turn the student should be told what to expect.

c When recovering from a stall in a turn, full power must be applied unless the nose is well below the horizon.

6 **Maximum Rate Turn** The demonstrations should be done at the lower altitudes. At high altitudes the lack of power does not sufficiently emphasize the difference between use of full and reduced power to make a convincing demonstration.

7 **Steep Gliding Turns** The nose down attitude causes difficulty in estimating the gliding attitude; cross reference to the instruments is required to ensure accuracy. It should be pointed out that this exercise has obvious application to the final phase of the forced landing pattern it is useful to show the student what angle of bank he can use at gliding speed before the stall warning operates and thus show why gliding speed must be increased before using more than 45 degrees bank.

**Common Faults**

8 The student often fails to appreciate that, while the aircraft is steeply banked, the use of the elevator to control the height also causes the turn to tighten. To avoid a possible cause of unintentional stalling when practising 60° banked turns, the student should be told to reduce the amount of bank before making corrections for high descent rates.

9 Students often have difficulty initially in holding the aircraft in the buffet in the max rate turn and controlling the height with bank. Practice at lower speeds with less than full power may help them master the technique.

## EXERCISE 15

## AIR EXERCISE

### ADVANCED TURNING

**AIM:** To teach turning at high angles of bank and how to obtain maximum turning performance.

**1 Airmanship**

a Lookout. Through top of canopy during turns.
b Orientation.
c Aircraft "g" limitations

| SEQUENCE | OBSERVATIONS |
|---|---|
| **2 Steep Level Turns** | |
| a Demonstrate steep turns in each direction using power as required to maintain speed. Angle of bank should be about 45 degrees initially and increased to about 55 degrees as the student becomes proficient. | a Lookout.<br>b Entry as for medium turns but:<br>1) Open throttle progressively as bank increases.<br>2) Progressive backward pressure on the control column.<br>c In the turn:<br>1) As for medium turns.<br>2) High rate of turn.<br>3) Airspeed same as on entry.<br>4) Instrument indications.<br>5) With maximum RPM, reduce angle of bank to maintain speed, if necessary.<br>d Recovery as for medium turns except that power is progressively reduced at the same time as bank. |
| b Demonstrate entry into a spiral dive by overbanking, allowing nose to drop and using elevators in an attempt to raise nose. | a Use of elevators to raise nose has effect of increasing rate of turn and loading.<br>b Possibility of unintentional stall.<br>c Importance of reducing bank first and then raising the nose when large descent rates are experienced at banks in excess of 45 degrees. |
| **3 Stalling in the Turn** | |
| Carry out steep turns from straight and level flight at 80K; do not increase power. | |

| SEQUENCES | OBSERVATIONS |
| --- | --- |
| **3 Stalling in the Turn** (continued) | |
| a Tighten turn to buffet and demonstrate recovery with elevators only. | a Usual pre-stall checks.<br>b Note airspeed at stall warning.<br>c Relax pressure on control column to recover.<br>d Small height loss.<br>e Turn can then be continued. |
| b Tighten turn past stall warning to buffet. | As for (a) but note speed at buffet. |
| c Tighten the turn beyond buffet by moving control column fully back to ensure that aircraft is fully stalled. | a Pre-stall checks.<br>b Aircraft stalls; note airspeed.<br>c Recovery:<br>1) Relax back pressure on control column and simultaneously apply power if required.<br>2) Level aircraft.<br>3) If inverted, move control column to minimise height loss; roll to nearest horizon. |
| c Tighten the turn to buffet again to demonstrate normal recovery with minimum loss of height from incipient stage. | a Pre-stall checks.<br>b Buffet.<br>c Recovery - relax back pressure on control column; at the same time apply full power.<br>d Aircraft recovers with minimum loss of height. |
| **4 Turning Limitations in Level Flight** | |
| a Demonstrate a turn at low IAS (about 65K) and medium power. Tighten the turn to the threshold of the stall. | a 1) Angle of bank and rate of turn.<br>2) Airspeed and attitude at which buffet occurs.<br>b If turn is tightened beyond buffet, rate of turn decreases.<br>c Maximum rate of turn for that speed, therefore, just at light buffet.<br>d Height maintained by bank angle adjustment while holding light buffet. |

| SEQUENCE | OBSERVATIONS |
|---|---|
| **4 Turning Limitations in Level Flight (continued)** | |
| b Demonstrate a further turn at medium power entering at 65K. When turn stabilised at light buffet threshold gradually increase power to maximum at the same time tightening the turn to keep aircraft on light buffet. This is a maximum rate level turn. | a Buffet IAS increases.<br>b Increased back pressure needed.<br>c Higher angle of bank.<br>d Higher rate of turn.<br>e Amount of power determines IAS obtainable which governs.<br>1) Maximum angle of bank.<br>2) Maximum rate of turn.<br>f Higher 'g' loading. |
| **5 Maximum Rate Level Turns** | |
| a Demonstrate maximum rate level turns entering at speed at which aircraft stabilised in 4b | a Lookout.<br>b Entry:<br>1) Initially as for steep turns.<br>2) Increase to full power.<br>3) Increase bank and back pressure until buffet occurs, then relax slightly.<br>c In the turn:<br>1) Maintain full power.<br>2) Note stabilized airspeed.<br>3) Maintain back pressure to keep aircraft on light buffet.<br>4) Use bank to adjust nose attitude to maintain height, while holding light buffet.<br>d Recovery as for steep turns throttling back to maintain stablised maximum rate speed.. |
| b Demonstrate maximum rate level turns entering at 100K. | a Bank must be reduced as IAS decreases.<br>b IAS will eventually stabilise as in Sequence 5a.<br>c After rolling out full power is held to allow the aircraft to accelerate to cruise speed before power is reduced. |
| **6 Emergency Break** | |
| Demonstrate how to change direction as quickly as possible through a minimum turn of 90 degrees using full power. Practise from both low and high speeds. | a As rapidly as possible co-ordinate the following:<br>1) Maximum power.<br>2) High angle of bank. Rudder to balance when ailerons deflected.<br>3) Maximum back pressure within stall limitation.<br>b Back pressure more important than accurate bank.<br>c Use in emergency. |

| SEQUENCE | OBSERVATIONS |
| --- | --- |
| **7 Steep Descending Turns** | |
| Compare gliding turns at 80K with turns at higher speed and power. | a At 80K:<br>1) Buffet occurs at about 60 degrees angle of bank. |
| | b At higher speed:<br>1) Higher angles of bank obtainable.<br>2) Rate of turn increased.<br>3) Higher rate of descent. |
| | c With power:<br>1) Rate of descent loss.<br>2) Pitch attitude flatter.<br>3) Rate of descent can be controlled by power adjustments. |
| **8 Post Flight Discussion** | |

EXERCISE 16

INSTRUCTIONAL GUIDE

# LOW FLYING

**AIM:** To teach how to fly the aircraft near the ground with confidence and safety.

## General

1 Although the student should fly confidently and with the requisite amount of dash, the instructor should immediately curb any tendency towards over-confidence or disregard of regulations. Low flying requires a high standard of both flying ability and self-discipline. The student should be taught to approach this exercise with these points in mind.

## Before Flight

2 **Preparatory Instruction**

a Regulations governing low flying and the circumstances in which it is necessary.

b Effect of wind.

c Effect of turbulence.

d Effect of aircraft momentum.

e Flying over contours.

f Obstructions.

g Navigational problems.

h Bad visibility configuration

## During Flight

3 In the early stages the lessons should not be too long because of the intense concentration required from the student. The length and difficulty of the task should be increased progressively until the student learns his safe limits.

4 **Airmanship**

a The student should have marked low flying restrictions on his map before starting the first lesson.

b Although accurate flying is important near the ground, this must not be to the detriment of a good lookout. The student should be warned that there may be other aircraft low flying at the same time and all at the same height.

c The FEDRAV checks must be done prior to descent to low level and the aircrafts flight path must be constantly checked for conflictions.

5 **Familiarization at Low Level**

a The first task should be simple and the student should be allowed to handle the controls as much as possible.

b Point out the danger of relying on the altimeter when close to the ground. The correct height should be demonstrated and the student told to pay particular attention to the appearance of the ground at that height.

c Point out the necessity of anticipating changes in power when flying over marked changes in contour.

6 The position should be frequently checked. This practice also serves as an introduction to low-level navigation.

7 **Effect of Wind** The visual impact of drift at low level should be shown by flying the aircraft along a line feature at right angles to the wind. A pattern at right angles to the feature will shown wind effect upwind, downwind and in the turns. The displacement of the aircraft due to wind should be shown by flying the aircraft down the line feature and then completing an accurate 30° banked turn through 360°. The student may then be taught how to compensate for the wind in a turn by varying the angle of bank. Throughout this part of the exercise it must be emphasised to the student that, not only is he doing a normal lookout, but must also clear the area into which the aircraft will drift for potential obstacles. This is especially important when turning into wind as the aircraft is drifting "belly blind".

8 **Low Flying in Bad Visibility**

a The first demonstration and practice should be done in good visibility. Later lessons can be given in poor visibility.

b The instructor should ensure that the student uses the correct technique when suitable conditions arise at any time during his flying.

c For a given bank angle the reduced turning radius resulting from the lower speed can be convincingly demonstrated by comparing 180° turns at high and low speeds.

EXERCISE 16

AIR EXERCISE

## LOW FLYING

**AIM:** To teach how to fly the aircraft near the ground with confidence and safety.

### Airmanship

1 **Planning** Check on area to be used and restrictions in force.

2 **Weather** Forecast and actual conditions should be within safe limits. Note wind velocity and visibility.

3 **Descent** Prior to descent into the low flying area complete the following checks, which are based on the rejoining checks:

| | |
|---|---|
| F - Fuel | Contents, sufficient. |
| E - Engine instruments | Check mixture fully rich. Temps and Press correct. |
| D - Instruments | DI synchronized with compass. |
| R - Radio | Operating authority informed if necessary.<br>Regional pressure setting (RPS) obtained.<br>Listen out on appropriate frequency. |
| A - Altimeter | Appropriate pressure indicated. |
| V - Visor | Visor down in case of bird strike |

| SEQUENCE | OBSERVATIONS |
|---|---|
| **4 Descending into Low Flying Area** | |
| Descend into area and level off at 500ft AGL. | a Cruising speed.<br>b Moderate rate of descent.<br>c Gentle turns to clear blind spot.<br>d Importance of lookout.<br>e Increasing impression of speed.<br>f Changing aspect of ground features. |
| **5 Familiarization at Low Level** | |
| Fly at an estimated 500ft AGL. | a Lookout.<br>b Trim for level flight.<br>c Cruising power.<br>d Assessment of height - altimeter of little use.<br>e Increased turbulence.<br>f Maintain a mean height above ground level over normal contours. |

| SEQUENCES | OBSERVATIONS |
|---|---|
| **5 Familiarization at Low Level** (continued) | g To maintain height over large contours:<br>1) Use power as necessary.<br>2) Anticipate power changes to overcome aircraft inertia and effect of wind.<br><br>h Landmarks obstacles and hazards (power cables etc).<br><br>j Boundaries of low flying area.<br><br>k Importance of position check.<br><br>l Avoidance of animals and buildings as required by regulations. |
| **6 Effect of Wind** | |
| a Fly at right angles to wind along a straight line feature (road or railway). Demonstrate in moderate wind conditions. | a Wind direction.<br><br>b Drift more apparent than at altitude.<br><br>c Drift allowance to maintain track.<br><br>d Drift allowance to avoid obstacles. |
| b Fly into wind and turn accurately through 180 degrees. Fly downwind then turn accurately through 180 degrees. Maintain a constant air speed. Demonstrate in moderate wind conditions. | a Into wind:<br>1) Airspeed.<br>2) Note low ground speed.<br>3) Not necessary to increase power.<br><br>b While turning downwind:<br>1) Drift gives appearance of slip.<br>2) Check for slip or skid.<br>3) Danger of drifting into obstacles.<br><br>c Downwind:<br>1) Airspeed.<br>2) Higher ground speed.<br>3) Must not decrease power.<br><br>d While turning upwind:<br>1) Drift gives appearance of skid. Correction dangerous.<br>2) Check for slip or skid.<br>3) Danger of drifting into obstacles. |
| c Demonstrate low flying patterns. Students must be proficient at low-level steep turns before practising this exercise. | a Adjust bank to compensate for drift to avoid obstacles. |
| **7 Low Level Steep Turns** | |
| Power setting as for normal steep turns. | a Importance of lookout for other aircraft, changing contours and obstacles.<br><br>b Aircraft inertia during entry - danger of drifting into obstacles.<br><br>c Need for accuracy - constant height over ground. |

| SEQUENCE | OBSERVATIONS |
| --- | --- |
| **8 Bad Visibility Low Flying** | |
| Demonstration at 70K with and without take-off flap. | a Need to fly slowly.<br>b Note pitch attitude at 70K without flap.<br>c With take-off flap:<br>1) Slightly lower nose attitude.<br>2) Lower safe speed - lower stalling speed - smaller turning radius at same bank angle.<br>3) Increased drift apparent owing to low speed.<br>4) Maximum angle of climb to clear obstacles is achieved at 70K and full power. |
| **9 Engine Failure at Low Level** | |
| Demonstrate and practise simulated engine failure at 500ft AGL and 100K. | a Convert speed to height.<br>b Very limited time to select landing area and carry out drills in FRCs.<br>c Similarity to EFATO. |
| **10 Post Flight Discussion** | |

## EXERCISE 17

## INSTRUCTIONAL GUIDE

## FORCED LANDINGS WITHOUT POWER

**AIM:** To teach how to make an approach and landing after partial or complete engine failure.

### General

1 The student must have attempted this exercise before leaving the circuit on solo flights. The student should be given dual and solo practice at forced landings at intervals throughout the course.

### Before Flight

2 **Preparatory Instruction**

a Forced landing procedure.

b Factors governing the choice of landing area.

c Actions after landing.

### During Flight

3 The exercise is best taught in 3 stages:

a From the end of the downwind leg.

b From the High Key position.

c From any position

Initially left-hand patterns should be taught until the student has mastered the basic technique as this will enable him to keep the landing area continuously in sight.

4 When the student reaches a suitable standard from the High Key position, the practice can be made more realistic by the instructor closing the throttle without warning at various altitudes and under different conditions. The student should say which field he has chosen so that the instructor can assess the procedure.

5 **Airmanship** This exercise is continued below 500ft AGL only in authorized areas or on the airfield. Since several aircraft may be engaged on the exercise a good lookout is required at all times during the practice; the student's lookout tends to suffer because he is concentrating on the planning.

6 During practice forced landings the engine should be cleared at intervals of not more than 1000 feet to prevent the plugs from oiling up. The last such clearance should be completed before turning into the crosswind leg to avoid interference with the critical judgement required during final approach.

7 The committal height, defined as the height below which the pilot commits himself to complete the forced landing, is 2000 feet AGL. Below this height the pilot must make a final decision whether or not to switch off the fuel and ignition. The decision whether or not to switch off the engine (in the real emergency) is governed largely by the following considerations:

a If the failure is mechanical and the engine has definitely broken down, it should be switched off immediately anyway.

b If the failure is partial, resulting in reduced power or intermittent running, the engine may be used at the pilot's discretion but he should remember that the windmilling engine may pick up temporarily or fail again at a critical stage and so spoil the approach. In such a case it may be best to assume a total failure and not rely on the faulty engine; however, only the pilot can decide which is the best course for a particular set of conditions.

c Whether all the appropriate drills have been carried out in an effort to regain engine use.

8 It is most important that the student is carefully briefed before practising forced landings to ensure that he does not actually switch off fuel or ignition when drills are being simulated.

9 **Suitability of Field** The five 'S's, surface, size, shape, surrounds and slipe are the five factors your student will probably not have thought of for himself.

10 **Choice of Field**

a When the ground can be seen, it is best to choose a field as soon as the aircraft is trimmed in the glide and before the range decreases with altitude. An imaginary circle drawn on the ground through the wingtips provides a guide to gliding range in still air. If a strong wind is blowing, the range into wind will be reduced and range downwind will be increased.

b The choice of field may be restricted by the nature of the surface below the aircraft but where the choice is wide and altitude is sufficient it may be better to glide towards a suitable area initially, leaving the final choice until details of the fields are discernible.

c When gliding towards the selected field, note whether the sightline angle is steepening. If it is, the field is within reach.

11 **Initial Descent**

a The plan depends upon height in hand. If sufficient height is available to carry out the full pattern from above 1500 feet AGL, decide first the direction of landing and then the direction of the circuit. Normally it is advisable to fly directly to High Key once a selection of field has been made. Height can then be lost if necessary to between 1500 feet AGL and 2500 feet AGL before commencing the pattern. In an 80K gliding orbit through 360° the Firefly loses 750ft at 30° bank and 500ft at 45° bank. In the event of actual engine failure the height losses will be greater.

b The exact height of the ground does not matter as the height over the High Key position is not critical. A successful pattern may be completed from any height above 1500 feet AGL at the High Key position wing the same basic technique, though above 1500ft it is simpler to orbit until a High Key of 1500ft to 1800ft is obtained. The High Key position should be progressively raised as wind increases.

c If, on reaching the field, there is insufficient height for a full pattern, the aircraft should be flown to intercept the pattern at an intermediate stage,

d Many factors may affect the course of action and some of these are listed for discussion with the student:

1) Height above the ground.
2) Position of suitable fields.
3) Wind strength and direction.
4) Weather.
5) Whether engine has failed partially or completely.
6) Pilot experience.
7) Heading of aircraft in relation to wind.

12 **Checks** When the student is sufficiently competent at forced landings he should be required to give the forced landing checks verbally on every practice.

13 **Maintenance of Sight Line Angle** Once the turn from the crosswind leg is started the only reference is the selected touchdown point. The student should be taught to maintain the line of sight line angle by adjusting bank. Providing that the line of sight line angle is maintained a position will be reached approximately 90° from the landing path which is coincident to that seen from a glide circuit in similar wind conditions.

14 **Selection of Flap** Although experienced at glide approaches the student may have initial difficulty in deciding when to select full flap. This will inevitably be because the fields being used are much smaller than the runways he has been used to so far. The student should be taught that an accurate pattern results in a late selection of full flap and on accurate touchdown point. Early selection of full flap to overcome the inaccuracies of an poorly flown pattern make assessment of the touchdown point progressively more difficult as the selection height increases. It follows that the student should delay the selection of take-off flap until he is satisfied that the sight line angle is correct for the prevailing conditions.

15 **Sideslipping** Sideslipping is a very effective means of losing height but is no substitute for a correctly flown pattern. Sideslipping should be demonstrated and practiced during forced landings as a means of bringing the touchdown point closer as apposed to making the original touchdown point from a badly judged patter (unsuitability of original touch down point at last moment). The dangers of increased stalling speed and crossed controls must be emphasised and the instructor must be satisfied that the closeness of the ground and concentration on the sight angle will not detract from the student's awareness of these considerations before allowing him to practice solo.

16 **Final Approach**

a It is not necessary to continue the approach to almost ground level as the success or failure of the practice can be gauged from a safer height. Overshoot action should be taken as laid down in current instructions.

b The amount of field taken up by the round out should be demonstrated on the airfield. Frequent practices on the airfield will enable the student to see the results of his efforts. Some feature on the landing path should be nominated as the beginning of the forced landing field.

**Common Faults**

17 Many students concentrate on the checks at the expense of judgment. By example and teaching an instructor must endeavour to inculcate a sensible division of attention.

18 Many students concentrate on the pattern at the expense of flying accuracy and can end up using large angles of bank at low speed.

19 Students often have difficulty in estimating the minimum overshoot height with reasonable accuracy. Descending too low could jeopardise safety or conflict with regulations, too high makes it difficult to judge the success of the exercise. Again the only solution is by example and practice.

**EXERCISE 17**

**AIR EXERCISE**

## FORCED LANDINGS WITHOUT POWER

**AIM:** To teach how to make an approach and landing after partial or complete engine failure.

1 **Airmanship**

a Lookout.
b Low Flying Area or Practice Forced Landing Area for practices.
c Minimum height to be used for overshoot on practice.
d Engine handling/drills

| SEQUENCE | OBSERVATIONS |
|---|---|
| 2 **Choice of Field or Area** | a Within circle through wingtips; effects of strong wind.<br>b Size, surface, shape, slope, surrounds, undershoot, approach path, alternate areas. |
| 3 **Descent Plan** (heights approximate)<br>Fly at 80K. | a Less than 600ft AGL - as for EFATO<br>b 600-1000 ft AGL - if downwind select field under blue wing stripes and intercept normal pattern; otherwise turn into wind and proceed as for EFATO.<br>c 1000-1500 ft AGL - Turn downwind and intercept normal pattern unless more suitable area ahead of aircraft.<br>d 1500-2000 ft AGL - Turn into wind to attain high key position.<br>e Above 2000ft AGL<br>1) Check RPS set: estimate height of ground<br>2) Estimate wind velocity and direction<br>3) Select suitable landing area<br>4) Select circuit direction.<br>5) Fly to high key. |
| 4 **Check for Cause of Failure** | As contained in Cards. |
| 5 **Mayday Call** | Selection of frequency. |
| 6 **Committal Height** | Decision to remain with the aircraft to be made by 2000ft AGL. |
| 7 **Crash Check**<br>(Warm engine in practice case) | a Drills as contained in Cards. (verbal for practice)<br>b Pre-landing checks for practices. |

**NOTE:** During practice forced landings the fuel and ignition switches must remain on.

| SEQUENCE | OBSERVATIONS |
| --- | --- |
| **8 Pattern from High Key** | **a At High Key, into wind, abeam touchdown area, touchdown area just in sight between engine cowling and leading edge on live side.** |
| | **b Glide into wind until touchdown point appears behind trailing edge.** |
| | **c Turn crosswind using 30° of bank to make good a 90° track.** |
| | **d When the touchdown point appears behind the** trailing edge (5 or 7o'clock) turn to establish a "downwind" leg and continue until the touch down point is abeam the wing tip. Commence a descending turn to intercept the extended centre-line of the intended landing path. |
| | e Closely monitor sightline angle between aircraft and initial aiming point; adjust bank to maintain angle constant. |
| | f Careful control of speed. |
| | g Curved approach with short, straight descent as per glide approach. |
| **9 Further Methods of Adjustment** | a Varying approach path, 'S' turns. |
| | b Changing landing path or direction. |
| | c Sideslipping |
| 10 Post Flight Discussion | |

EXERCISE 18

Instructional Guide

## PILOT NAVIGATION

**AIM:** To teach pilot navigation techniques under all conditions of flight.

### General

1. The student should understand that the ability to navigate an aircraft is part of the pilot's normal duties. For this reason the techniques used are simple, and navigational activity in the air is kept to a minimum by sound flight planning.

2. The following aspects of navigation should have already been introduced during earlier general handling sorties:

a. Use of local features for orientation.

b. Map orientation.

c. Simple map reading.

d. Estimation of headings and distances to reach base or chosen points.

e. Use of compass and maintenance of headings.

f. Use of radio for steers and bearings.

g. Use of VOR/DME for fixes and point-to-point homings.

3. Although the student should ultimately be able to navigate by using a combination of the most suitable aids and methods, it is necessary to introduce the various considerations progressively to ensure that he obtains a firm grasp of the fundamental principles. (Navigation exercises should start with simple map-reading and exercises at 3000 to 5000 ft in VMC, and the further aspects of pilot navigation introduced by stages during succeeding sorties to increase the student's ability and confidence.) All should be planned to introduce or revise some particular aspect or consideration. The instructor should refer to the relevant paragraphs of the Instructional Guide and the Air Exercise, and to the syllabus.

4. The varying techniques of pilot navigation are broadly classified in the following sub-paragraphs; although the basic principles remain the same, the relative importance of some aspects change with height and conditions:

a. Navigation at medium level in visual contact with the ground.

B. Navigation at medium and high levels out of sight of the ground.

c. Low-level navigation.

d. Navigation at night.

## Before Flight

5. Preparatory Instruction

a. Meteorological forecasts.

b. Map preparation.

c. Estimation and computation of headings, groundspeeds, ETAs and Satety Altitudes.

d. Pilot navigation techniques.

e. Uses and limitations of radio aids.

f. Air traffic regulations in VMC and IMC.

g. Distress and lost procedures.

h. Diversions.

j. Range and endurance flying.

k. Use of flight planning tables and fuel required calculations.

6. Pre-flight Briefing. The student should be helped with the preparation of flight plans for his early navigational exercises and his working of the computer checked. He should also be assisted in the preparation of his map and advised on the choice of check points and positions for obtaining bearings. Any other aids available for the exercise, or particular techniques to be used, should be discussed before flight. The instructor should insist on meticulous planning and route study before dual and solo exercises.

## During Flight

7. Airmanship

a. Lookout must not be neglected while the pilot is engrossed in navigational matters: any laxity by the student should be checked at once.

b. The importance of frequent fuel checks (especially when low flying) and comparison with planned consumption should be stressed. Checks of temperatures pressures, oxygen, etc must be carried out at 10–15 mins intervals.

c. If it is necessary to descend below Safety Altitude to retain sight of the ground, Safety Altitude must be regained without delay, should the aircraft enter cloud.

8. Setting Heading. Early exercises should be planned to commence overhead the nav. start point at the planned altitude/flight level. Climbing on track is more economical and should be used on high-level cross-countries. The student should be taught to make a commonsense check of his heading by use of his knowledge of local features, or by a true bearing soon after setting heading. This avoids the possibility of gross errors, such as flying a reciprocal or setting the airspeed as a heading.

9. In Transit.

a. The attention devoted to flight plan computations is pointless if the flying is not sufficiently accurate. In particular, headings and airspeeds must be correct. Small height variations will have little effect on navigation but air traffic regulations call for accurate height keeping to provide quadrantal separation.

b. The value of DR, supported by careful planning and accurate flying, as the basis method of pilot navigation should be demonstrated whenever possible, eg when the ground is obscured by cloud. The student should occasionally be asked to work out DR positions by consulting his watch and time marks on the map.

c. The vital importance of flying according to the flight plan when pinpoints or other fixing aids are not available must be emphasized in the air and during briefings.

d. The log card which was used extensively during the pre-flight planning stage, should be carried as an aide memoire. Important information (eg heading, altitude, time, and safety altitude) should be displayed neatly on the map.

10. Map Reading

a. The value of map orientation will already have been shown to the student, and should be re-emphasized en route.

b. The great importance of the clock or watch, used in conjunction with time marks on the map to anticipate features, should be pointed out.

c. The value and reliability of a pinpoint depends on its uniqueness, size and contrast in relation to the surrounding area. The value of certain types of pinpoint may change with the angle of observation and with seasonal or weather variations, eg higher ground is not so readily apparent from high altitude, small rivers may have flooded in winter, etc.

d. Attempting to correlate an excessive amount of detail will often lead to confusion. The student should be told to use only the major features in conjunction with planned check points and DR calculations, avoiding continuous map reading and the identification of numerous minor pinpoints.

e. When in continuous visual contact with the ground, the correct technique is to read from clock to map to ground, using the watch and time marks to anticipate the selected features. At other times, when the ground is visible only periodically, or when uncertain of position, a circle of uncertainty should be estimated and the ground features identified on the map, ie clock to ground to map.

11. Navigation Technique

The two basic considerations affecting pilot navigation are revisions of headings and ETAs. To these must be added the more advanced requirement of the estimation of heading and time to reach a diversion airfield or alternative target. It is important, particularly at high speeds, that the methods used be as simple as possible to reduce the mental effort, and be capable of quick application. Lengthy and complicated calculations are valueless if by the time they are worked out the aircraft has travelled so far that the correction is no longer applicable.

12. Revision of Heading. Although the experienced is capable of accurate visual estimations, these are beyond the powers of the student pilot.

and it is therefore necessary to provide him with guidance. Of the two methods in common use the New Track Reference Method is the easier, combined with 5 degree Closing Angle lines from the destination. Some students may initially find difficulty with this method. In order to overcome this, the instructor must ensure that adequate pre-flight practice is given, using hypothetical examples.

13. Revision of ETA. The two principal methods - proportional distance scales and time scales - rely on ETA revision by fractional proportion. The time scale method is the more useful, since DR positions can be easily interpolated, whilst the proportional-distance method relies on fixes being available at specific distances. When radio cross-bearings are used as ETA checks, the rate of change of bearing should be pre-computed.

14. Fixing Position. The principal methods of fixing position are:

a. Visually:
   (1) Pinpoint.
   (2) Visual crossbearings from line features and relative bearings.
   (3) Visual bearing and estimated distances.

b. Radio cross bearings:

   (1) VOR.
   (2) DME.
   (3) RT True bearings.

In many cases, a single bearing or range, used in conjunction with a DR position gives sufficient information to enable a revision of heading or ETA to be made.

15. Use of Radio Aids. Some cross-country exercises should be flown in conditions necessitating navigation entirely by radio aids. Ideal conditions exist when the exercise can be flown in the clear above continuous cloud cover. Attention to the instruments under actual conditions would limit the student's ability to absorb instruction during the early exercise. The technique used is similar to that already taught except that positions are fixed by means of radi aids. The uses and limitations of the available aids should be fully discussed before flight, and radio bearings to be obtained should be carefully planned before flight so that each is useful. Selected bearings and ranges should be plotted on the map, and the frequencies and callsigns or identification of the aids noted. Bearings and positions obtained, together with the times, should be noted as a precaution against forgetfulness. All bearings obtained should be checked for their validity, especially when they indicate a marked variance from the flight plan.

## Low Level Navigation

16. The main difficulties associated with low-level pilot navigation are:

a. Restricted field of view.

b. Identification of ground features complicated by the low perspective and their limited time in sight.

c. Range and accuracy of radio aids seriously reduced.

d. Concentration required to fly the aircraft.

Careful flight planning and thorough map study are essential in order to reduce these difficulties and to minimize mental effort. Check features should be chosen for their uniqueness and ease of recognition at low level.

17. Low-level navigation depends entirely on map reading and the technique calls for a sensible combination of DR and feature tracking. Anticipation of features is essential. The tendancy of students to map-read continuously must be discouraged. Correction to track should be made either visually, at pre-selected fix points or prominent features close to planned track, or by use of the Standard Closing Angle method. Unlike medium level and radio aids navigation, ETA at low level should be maintained. The student should be taught to revise the IAS, and thus ground speed, by covering time error at fix features to a proportionate alteration of IAS.

18. If a check point is missed, the flight should continue according to the flight plan and the next check point anticipated; but if a series of features is missed, or if it is apparent that the aircraft is off track, the student must gain height (on flight plan heading) to find his position and let down again only when track is regained.

19. There is no need to prepare a log card. The essential information (headings, times, safety altitudes, and, in certain circumstances, IAS) should be marked on the map so that it is clearly legible when the map is correctly orientated. Log-keeping must not be attempted, except that it is advisable to note the time of setting heading.

20. During the first low-level cross-country flight the instructor should fly the aircraft for the early part of the exercise so that the student may devote his entire attention to navigational matters. General aspects such as lookout, trim, wind effect, anticipation of obstacles, and especially the increased fuel consumption, should not be neglected.

Weather Avoidance at Low Level

21. Despite pre-flight briefings, unexpected weather deterioration below the minima laid down may be encountered. The instructor should take every opportunity to teach his student the most relevant method of avoiding bad weather. The student should be taught that safety is of paramount importance, and an early decision on the action to be taken will help him achieve this aim. The method selected to avoid bad weather will depend on many variables, such as height of the ground, airways and controlled airspace; and, therefore, the need for thorough map study and route planning should be emphasised.

22. The approved methods of weather avoidance in basic flying training are:

a. Lateral avoidance, using the 30°, 45° or 60° dog leg technique.

b. Vertical avoidance; climb, maintaining track and ground speed.

c. Turning back; an early decision is paramount in order to complete the turn in VMC.

D. Emergency pull-up/abort climb.

23. It should be stressed that safe vertical distance from both cloud and ground should be maintained throughout the diversion. QFI's may execute a diversion and; solo students, provided they have been

cleared by their instructor, may execute a diversion but must plan to remain within 6nm of planned track.

## Medium-level Navigation

24. The following additional factors must be considered when navigating at medium level:

a. Difficulty in the accurate prediction of winds.

b. Navigation in prolonged climbs.

c. Map reading often restricted by clouds.

d. Altered perspective for map reading and difficulty in obtaining accurate pinpoints.

e. Increased range of radio aids.

25. Although the basic principles of navigation remain unaltered, radio aids replace map reading as the main means of fixing position; when above cloud this requires additional flight planning and air activity. Pre-flight planning should be thorough to reduce calculations in the air:

a. Heights to fly should be selected, as far as possible, to take advantage of favourable winds and weather.

b. At selected intervals, along track bearings, ranges and positions at the top of the climb and descent should be pre-computed and marked on the map.

c. Turning radius must be taken into consideration. The distance covered in the turn should be added to the next leg.

26. The climb should be commenced immediately after take-off, turning onto track as required by air traffic control regulations, and the correct heading checked by reference to local landmarks. The position two (2) minutes after the planned top of climb should be noted and subsequent heading revisions based on the track made good from this fix.

27. Once level, the aim is to obtain reliable checks of track and ETA at suitably planned intervals. Because of the difficulty in obtaining accurate pinpoints, the accent should be placed on the full use of the radio aids.

28. The planning should take into account the possibility of having to use an ATC directed recovery to base.

## Night Navigation

29. Owing to the difficulty of map reading at night, greater emphasis should be placed on thorough flight planning and the use of radio aids. Under favourable conditions map reading is possible, but only prominent features are identifiable - eg coastlines, large towns, rivers, and identification beacons. Visibility and identification of some features, particularly water, is usually considerably better up-moon. Distances are particularly difficult to judge at night.

30. In addition to the pre-computed bearings, identification beacons and their

morse characteristics should be marked on the map. Colours used for map markings should be carefully selected since some (notably red) are difficult to see in cockpit lighting. The procedure at night resembles that already taught for day navigation: use of radio aids, supplemented by map reading where possible.

## Lost Procedure

31. Full use of the emergency organization should be made when a pilot becomes lost, and prompt action is essential. Delay will reduce the time available for the ground organization to fix and home the aircraft to a suitable airfield and may result in the aircraft running out of fuel before a landing is made. The procedure should already have been demonstrated during a general handling detail by simulating shortage of fuel and uncertainty of position, and making a practice emergency call on the distress frequency. It is imperative that the student's knowledge is revised before each solo navigational exercise. The importance of making a 'Pan' call as soon as it is apparent that the pilot is lost cannot be over-stressed.

32. In the unlikely event of experiencing complete failure of both main and standby radio sets, the action to be taken will depend on numerous factors, including weather, terrain and endurance. No hard and fast rules can be laid down. It is vital, however, to adhere to the flight plan until a definite plan of action has been formulated. The first actions should concern the safety of the pilot and aircraft, followed by endeavouring to discover why you are lost - eg check the accuracy of the heading, speed, time, wind velocity, and any calculatio A plan of action should then be made, bearing in mind the conditions at the time.

## Diversions

33. It may be necessary to divert to another airfield at any time during a cross-country flight. The student should be asked occasionally to select suitable alternatives and to calculate the heading, time and fuel requirements.

## Range and Endurance

34. The general principles will already have been taught during handling details, but the considerations should be revised. A suitable cruising speed should be selected for the exercise, bearing in mind weather and work load. The student should be made aware of the benefit of flying at the correct range speed; he should have a thorough understanding of range flying and be fully competent in the use of flight planning charts and tables.

## Common Faults

35. Most faults are of a randon nature and do not form a consistent pattern. Their origin usually lies in overhasty DR calculations and carelessness in applying corrections, or jumping to conclusions over pinpoints. Remind the student of the importance of adhering to the flight plan until a reliable fix shows that the aircraft if off track.

36. Some students attempt too much air activity - continuous map reading and calling for unnecessary bearings are examples - with the result that flying or airmanship accuracy suffers. A cycle of activity which allocates time for obtaining navigation information and calculating corrections, carrying out airmanship checks, and correcting flying errors, will help overcome such a tendency.

37. It is desirable that the student be left, within the bounds of safety, to discover and rectify any mistakes he may make. He will often learn more from such errors than from a flight which proceeds exactly as planned and requires little in the way of heading or ETA revision.

EXERCISE 18 (Cont)

## Air Exercise

### PILOT NAVIGATION

**AIM:** To use pilot navigation techniques under all conditions of flight.

### Airmanship

1. a. Before starting - check equipment:

(1) Map.
(2) Log card.
(3) Pencils.
(4) Watch.
(5) Aerad supplement.

b. Before taking off or setting heading - check:

(1) Heading to be flown set on compass, and compared with flight planned heading.
(2) Altitude to fly.
(3) Time of setting heading, and note.

c. After setting heading - check:

(1) Fuel against planned total.
(2) Heading correct - cross check with E2B compass.
(3) Altitude correct.
(4) Radio call to base if required.
(5) Time - clock started and running; time noted.
(6) Flight instruments erect; engine instruments within limits.
(7) Oxygen contents sufficient and flowing.

| SEQUENCE | OBSERVATIONS |
|---|---|
| 2. Setting Heading. | a. After take off:<br>(1) Plan the climb to arrive overhead the start point on heading at the correct height and airspeed, or -<br>(2) Climb away from base on the first heading. |
| | b. Carry out set heading checks. |
| | c. Calculate ETA. |
| | d. Carry out after-set heading checks. |
| | e. Concentrate on accurate flying until the first check point. |

3. In Transit.

a. Lookout and normal checks.

b. Heading revision made only after a reliable fix.

c. ETA revision.

d. Make note of:

(1) Revised ETAs.
(2) Pinpoints and times.
(3) Fixes and times.

e. Fixes.

f. DR positions.

g. Airways crossing procedure.

4. Heading Revision.

a. Assessment of Closing Angle/Track Error. — Use of 5° lines.

b. Calculation of heading alteration. — Use of New Track reference method.

5. ETA Revision.

Use of fractional proportion to revise ETA by:

(1) Time marks.
(2) Distance scale.

6. Location of Destination/Turning Point.

a. Large heading changes may be necessary.

b. Use of funnel features.

c. Having located turning point, carry out set heading checks.

7. Use of Radio Aids.

a. Setting Heading:

(1) Use of radio aids to set heading overhead if required.
(2) Use of radio aids to climb out on heading or proceed up the climbing lane

b. Climb as planned, making first alteration of heading based on information received at TOC + 2 min fix.

c. ETA checks from bearings/DME ranges with good cut across track.

d. Position fixed by:

(1) Bearings and DME range.

(2) Two or more bearings.
(3) Two DME ranges.

e. Times of bearings and fixes noted.

f. Fixes obtained as planned.

g. Revision of heading and ETA as necessary.

h. Turn on ETA if positive fix not possible.

i. Recovery plan.

8. <u>Procedure When Lost</u>.

a. Use of 'Training Fix' and 'Pan' call.

b. Use of standby radio.

c. If no radio or VOR/DME available, select SSR Mode A Code 7600, and adopt uncertain of position procedure.

d. If position still uncertain, consider flyin radar triangle until fuel exhausted.

9. <u>Low-level Navigations</u>.

a. Low level authorization.

b. Importance of flight planning and pre-fligh map study.

c. Allowance for turning radius in planning.

d. Fuel planning - higher consumption at low level.

e. Maintenance of track - methods of regainin track.

f. Check features with good vertical extent a more important at low level.

g. Limited field of view - need for:

(1) Anticipation
(2) Accurate timing and flying.
(3) Quick recognition - thorough pre-fligh map study.

h. Height maintenance - contour flying.

i. Low level emergencies.

j. Lost procedure.

k. Importance of lookout for aircraft and oth hazards.

l. Weather avoidance at low level.

10. Medium-level Navigation.

a. Climb on track or as required by departure procedure.

b. Use true bearing to establish error in a long climb if required.

c. Fix position two (2) minutes after planned top of climb.

d. Heading and ETA revisions are calculated from the fix at top of climb.

e. Difficulty of visual pinpointing.

f. Estimation of distance deceptive.

g. Reliance upon radio aids for position lines and fixes.

h. Normal navigational procedures.

j. Airways crossing procedure.

k. Turning points:

(1) Allowance for turning radius in planning
(2) Carry out set heading checks.
(3) Turn on ETA if definite fix not possible
(4) Carry out after-set heading check.

l. Recovery planning.

11. Night Navigation.

a. Lookout.

b. Limited map reading.

c. Distances deceptive.

d. Prominent ground features:

(1) Idenfitication beacons.
(2) Large towns
(3) Coast lines, rivers etc under suitable conditions.
(4) Major roads.

e. Better visibility up-moon.

f. Reliance on radio aids, supplemented by map reading when possible.

g. Normal navigational procedures.

12. Range and Endurance

a. Application en route.

b. Use of FRCs.

**POST-FLIGHT DISCUSSION**

EXERCISE 19

INSTRUCTIONAL GUIDE

INSTRUMENT FLYING

**AIM:** To teach the student to fly by sole reference to instruments.

**General**

1 The student who has completed his PFT will only have done some four hours instrument flying total to give him the bare requirement for his UK PPL. He has probably never flown "actual" - dual or solo - and his previous experience can effectively be disregarded except that his rate of progress should reflect his previous training.

2 The student should regard instrument flying as a natural development of general flying training and care must be taken to ensure that he does not consider it to be a completely different method of flying. The instructor will have made some reference to instruments during exercises in visual flight and in this way will be developing a student's interpretation of attitude and performance as indicated by the instruments.

3 The new procedures and the application of greater mental discipline by the student is best learnt by a gradual teaching process. The various sequences introduce the use of instruments progressively until at the end of the instrument flying phase he should be competent to fly the aircraft and operate all its aids without visual assistance.

4 The use of the instrument flying visor should be introduced once the student has developed his new found skill to fly a manoeuvre or procedure smoothly. Too early an introduction can have a claustrophobic effect and delay progress.

5 Faster progress will be made in the long term if the student receives thorough instruction in each aspect. The aim should be to extend the student during each phase but not to saturate or discourage him.

**Before Flight**

6 **Preparatory Instruction**

a Instruments:
   1) Control and Performance relationships. Importance of balance.
   2) Indications and interpretation.
   3) Limitations and errors.

b Method and rates of scan.

c Physiological considerations.

d Weather procedures.

**During Flight**

7 **Selective Radial Scan** The student study guide contains detailed information on selective radial scan.

a By emphasizing the 2 or 3 instruments necessary for each manoeuvre in addition to the AH (Artificial Horizon), the student's task will become greatly eased. It cannot be over-emphasized that the scan should be restricted to those specific instruments essential to achieve the manoeuvre.

b The student should be convinced that any flight path can be achieved by using certain attitude indications on the AH combined with the necessary power changes if the aircraft is in balance. However, the final accuracy can only be obtained by using information gleaned from performance instruments. Therefore, teach the technique of reliance on the AH as the primary instrument and the correct selective radial scan of the performance instruments to support it.

c During the early part of each exercise, and whenever a student experiences scan difficulties, get him to call out each instrument as he includes them into his scan. Students returning to full panel after a period of limited panel work tend to rely on performance instruments and exclude the AH from their scan. Using the "call out" method the student has his attention drawn to the correct instrument and it is then relatively easy to check that he is correlating the information correctly.

8 **Trimming** The importance of correct trimming should be emphasized throughout and a constant watch kept for bad technique. The student should realise that bad trimming makes tasks such as synchronizing the Directional Indicator (DI) with the compass much more difficult and can lead to early fatigue.

9 Limited Panel

a Instruction on limited panel (LP) is taught as an emergency or standby system of operation. Experience of limited panel improves the student's appreciation of performance instruments but can also tend to disrupt his development of a full selective scan.

b In dealing with changing attitude without direct indication the student should be taught to assess attitude change by interpreting instrument indications with due allowance for lag and aircraft momentum. Emphasize the need for small unhurried smooth control movements. If he becomes tense, overcontrols and gives no indication of improving, demonstrate and let him practise similar attitude changes, cross-referring with visual references.

c The student should be shown that, as to maintain an attitude, only 2 instruments are required to maintain an accurate basic manoeuvre, providing occasional glances are made at the altimeter when climbing or descending or the DI when turning.

9 d The low rate of instrument unserviceabilities leads to the possibility of such failures being overlooked. Discussion and practise of various failure situations in later sorties will build an awareness that will help throughout his flying career. A toppled artificial horizon is a common occurance and a failed suction pump is another event which could lead to the need to use limited panel.

e Unusual attitudes and disorientation exercises must be practised in VMC conditions with sufficient clearance from cloud to prevent going IMC inadvertently.

10 **Spatial Disorientation**

a The student must appreciate that the physiological effects of flight can give rise to false impressions of attitude and performance. The senses used for maintaining equilibrium and orientation are: sight, the vestibular sense and muscle sense. These senses work well on earth but their limitations may be extended in flight leading to a number of illusions or even disorientation.

b The student should be given some simple demonstrations of sensory illusions to illustrate the need to rely on his instruments regardless of his physiological sensations. These should be limited to false attitude sensations and false feelings of turning. It is important that the student's confidence should not be undermined by over-enthusiastic demonstrations at an early stage of his training. Some suggested sequences are included with the Air Exercise which will be more convincing if not carried out in direct sunlight: this prevents moving shadows on the instrument panel. Include them at relevant times. The more advanced Coriolis effects, for example, should be covered during the introduction to unusual attitudes.

c The student should understand that the chances of disorientation can be reduced by avoiding large or rapid movements of the head, by making all changes or corrections to aircraft attitude slowly and smoothly, and by restricting activities, when on instruments, to one at a time. Lack of flying practice increases the risk of disorientation.

d An unusual position covers any case when the aircraft is not in the attitude the pilot thought it to be in. It does not necessarily mean the aircraft is in an extreme attitude. The student must learn to control his aircraft by relying on the sense of sight and the flight instruments. He must learn to ignore or control the urge to believe any false sensations perceived from the supporting senses. Should he become disorientated or begin to disbelieve his instruments he should be briefed to recover to straight and level flight using the standard UP (unusual position) recovery. Since students have found themselves in this predicament when flying both dual and solo, it is necessary to ensure that he is able to execute the procedure safely before authorizing solo flight. Moreover, he should be made to realise that even if he suspects instrument malfunction or disorientation he should immediately initiate the UP recovery and not delay the recovery hoping to analyse the trouble.

10 e The student should be given every opportunity to practise transition from visual flight to flight on instruments. This may be done during controlled descents on practice IF sorties as well as at other times.

**Common Faults**

11 On full panel, the common fault is failure to carry out the correct selective scan:

a **Insufficient Reference to the Control Instruments** If the control instruments are not included in a scan there could be an incorrect attitude on the AH or an incorrect power setting. It is usually accompanied by over-controlling and needle-chasing.

b **Too Much Attention to AH** If the performance instruments are not used to support the AH, a small erection error, or a small error in the attitude adopted, can cause a large error to develop slowly, as indicated by the performance instruments. For example, if there was a small AH bank error of just a few degrees and the student adopted the wings level indication, the aircraft could turn through a large angle before he would notice the error on the DI.

c **Becoming Engrossed in One Instrument** Probably the most common error is a student becoming engrossed in one instrument. It can be identified in one of two ways. Firstly, it can show as an error in one of the other planes; if he becomes attached to the ASI he may turn, or if he chooses the VSI he may overshoot a level off height. Secondly, it may show in the form of needle chasing when an instrument is made to hunt around but never settling on a reading.

d **Scanning Too Slowly** If other than small attitude adjustments have to be made, the scan is too slow.

e **Superficial Scan** If the scan is too fast, correct information cannot be obtained from the instruments. Thus haphazard changes in attitude or control movements can be expected.

f **Poor Balance** If the aircraft is not in balance, it may not follow the flight path normally associated with the attitude indicated on the AH and the power selected.

12 **Control Technique**

a **Trimming** Trim-chasing is another common error. It is caused, usually, by students guessing the amount rather than relieving the pressure.

b **Excessive Control Movements** There are 2 ways in which excessive control movements can be made. Firstly, if the control is deflected for too long, it usually results in the aircraft hunting about an attitude. Secondly, if the control deflection is too large, corrections are rapid and finish with a jerk.

c **Throttle** Throttle errors can be caused either by not knowing the required setting (interrogate student to confirm) or omitting the power instruments from the scan.

EXERCISE 19

AIR EXERCISE

INSTRUMENT FLYING

**AIM:** To teach the student to fly by sole reference to instruments.

**1 Airmanship**

a Avoidance of icing conditions.
b Quadrantal height system.
c Communications failure procedures/Use of transponder.
d Controlled airspace.
e IFR.

| SEQUENCE | OBSERVATIONS |
|---|---|
| **2 Introduction to AH** | |
| Compare the AH with the true horizon by adopting positive climbing and descending attitudes, some including bank. Return to straight and level attitude after each demonstrate using the AH. | a AH gives a miniature presentation which can be used in the same manner as the real horizon in visual flight. |
| | b Datum on AH should be adjusted before flight to give "aircraft" on the horizon when actually in normal level flight; it must not be re-adjusted to zero in other flight positions as difficulty may then be experienced in regaining level flight. |
| | c No change in technique required. |
| | d Use smooth co-ordinated movements. |
| | e Direct reading of pitch and bank. |
| | f Pitch angle measured in bar widths. |
| | g Angle of bank easily read. |
| | h During a turn, pitch attitude made easy to assess by centre orange dot. |
| | j Unlike real horizon, turn cannot be observed on the AH when aircraft is banked. |
| | k When aircraft is properly trimmed the AH presentation remains steady. |
| | l For accurate flight, information must be supported by performance instruments. |

| SEQUENCE | OBSERVATIONS |
|---|---|
| **3 Straight and Level** | |
| a Demonstrate selection of <u>level</u> flight from various pitch attitudes. | a Adopt level flight attitude on AH.<br>b Check altimeter.<br>c Adjust AH using half bar widths to stop altimeter moving.<br>d Hold attitude constant and trim. |
| b Demonstrate selection of <u>straight</u> flight from various banked attitudes. | a Level wings on AH.<br>b Check DI.<br>c Check balance.<br>d Possible for AH to be wrongly erected to show slight bank when wings level. |
| c Demonstrate how to maintain <u>straight</u> and <u>level</u> flight. | a Deviations from level flight of less than 200ft/min are not easily seen during normal scan of the altimeter; therefor, scan VSI.<br>b Any application of bank in balanced flight will cause a turn; therefore, monitor DI.<br>c Straight and level selective scan is AH-VSI-AH-DI-AH etc, with less frequent checks of altimeter.<br>d All corrections are made by appropriate attitude changes on the AH. |
| d Regain a specified flight level by flying 50ft above, then below, demonstrating correct procedure. | a Use "achieving level" techniques and scan.<br>b Altimeter moves slowly, VSI confirms trend.<br>c Fractionally before the Flight Level is reached, raise (lower) the nose to the level attitude.<br>d Adopt straight and level scan. |
| e Regain a specified heading by flying 20° either side and demonstrate correct procedure. | a Apply half the error as bank on the AH.<br>b Monitor VSI for level flight.<br>c As heading is reached level wings.<br>d Check DI for accuracy of heading.<br>e Once student progresses, increase bank to equal error. |
| **4 Medium Level Turns** | |
| a Demonstrate an entry from straight and level at cruising speed. | a Apply 15° bank on AH and control back pressure to keep the centre dot of AH on the horizon bar.<br>b VSI is main support instrument. |

| SEQUENCE | OBSERVATIONS |
| --- | --- |
| **4 Medium Level Turns** (continued) | |
| b Demonstrate maintaining the turn. | a Maintain angle of bank on AH.<br><br>b Pitch attitude maintained on AH, but turning errors make it necessary to cross check with VSI and less frequently with altimeter.<br><br>c Despite turning errors pitch changes can still be made on AH.<br><br>d Corrections to flight level as for straight and level. |
| c Demonstrate rolling out on specified headings. | a DI progressively included into scan as desired heading is approached.<br><br>b Anticipate heading; roll out on AH, applying elevator to maintain orange dot on horizon bar.<br><br>c Monitor VSI and revert to straight and level scan as wings are levelled. |
| **5 Climbing** | |
| a Demonstrate entry to a climb from straight and level at cruising speed. | a Apply full power, keeping straight on DI.<br><br>b Select climbing attitude on AH and trim.<br><br>c As airspeed is settling, scan for straight flight.<br><br>d Airspeed corrections made by adjusting AH up or down as appropriate.<br><br>e Ensure correct trim technique is used. |
| b Demonstrate maintaining a climb. | a Selective scan is now AH-ASI-AH-DI.<br><br>b Speed corrections by adjustment to AH.<br><br>c Importance of accurate trimming before carrying out cockpit tasks.<br><br>d Progressive inclusion of altimeter as desired flight level is approached. |
| c Demonstrate levelling off at 100K. | a Anticipate flight level - select straight and level, using normal techniques and scan - balance.<br><br>b Allow speed to increase then select approximate power and then adjust to achieve 100K. |

| SEQUENCE | OBSERVATIONS |
|---|---|
| **6 Climbing Turn** | |
| a Demonstrate a climbing turn, rolling out on a stated heading. | a Apply 10° bank on AH.<br>b No change in climbing scan or speed adjustment techniques.<br>c Anticipate heading.<br>d As wings are levelled on AH, scan for straight climb. |
| **7 Descending** | |
| a Demonstrate from straight and level to a 100K descent using 2000 RPM and 14" MAP | a Simultaneously, reduce power to 2000 RPM and 14" MAP and select descending attitude on AH.<br>b Check balance.<br>c Speed adjustment using AH.<br>d Selective scan is AH-ASI-AH-DI-AH-Altimeter<br>(Note increased importance of the altimeter during a descent in cloud.) |
| b During a descent, demonstrate a descending turn on to a stated heading. | a Select 15° bank on AH.<br>b No change in descending scan or speed adjustment techniques.<br>c As wings are levelled revert to straight descent scan. |
| c Demonstrate levelling off at 85K. | a Anticipate height or flight level.<br>b Select and resume straight and level using normal techniques and scan, simultaneously applying cruising power to achieve 100K. |
| **8 Straight and Level at Various Airspeeds** | |
| a Demonstrate a reduction of speed from 100K to 70K. | a Reduce power.<br>b Maintain straight and level scan.<br>c Progressively include ASI into scan and adjust power to achieve 70K. |
| b Demonstrate an increase of speed from 70K to 100K. | a Apply power.<br>b Maintain straight and level scan.<br>c Include ASI into scan.<br>d Adjust power to achieve 100K.<br>e Trim |

EXERCISE 20

INSTRUCTIONAL GUIDE

# NIGHT FLYING

**AIM:** To teach how to control the aircraft at night on the ground and in the air.

## General

1 Before starting night flying the student must be competent at instrument flying and particularly at taking-off and going round again on instruments. Some day practice at instrument circuits using the night flying procedures is desirable before the first lesson.

## Before Flight

2 **Preparatory Instruction**

a Airfield lighting

b Aircraft lighting and procedure for start up etc.

c Procedure for taxying, take-off, circuit, landing and going round again.

d RT procedure, lamp signals, and pyrotechnic signals.

e Marshalling signals.

f Emergency procedures.

3 **Pre-flight Briefing** The pre-flight briefing is additional to the night flying briefing and should cover the considerations of the lesson about to be taught. Additionally:

a The airfield lighting and the use of runway lights should be explained with the aid of models and diagrams.

b The student should be checked by day to ensure he is fully conversant with the aircraft lighting and the position of relevant lights and switches.

c The instructor should explain night adaptation to the student and encourage him to remain in subdued lighting for 30 minutes proceeding take-off. Use of the torch should be discreet and cockpit lighting kept to an acceptable minimum.

## During Flight

4 **Airmanship**

a The instructor should emphasize the need for extra caution when taxying and tell the student to stop if he is doubtful about the taxi path and his distance from obstructons.

b The procedure for joining the circuit is the same as the basic procedure used by day but greater caution is required.

c All RT calls should be made at the standard positions in the circuit so that the air traffic controller and other pilots have reliable indication of the aircraft's position.

d A serviceable torch should be carried to assist with external checks and in case of emergency.

e The anti-collision light is an excellent aid to aircraft indentification, both on the ground and in the air. When flying in or near cloud, the reflection from this light can be very distracting and in these circumstances it should be switched off.

5 **Familiarization**

a The familiarization lesson should be used to give the student confidence and familiarize him with the new environment.

b The instructor should avoid giving the impression that night flying is any more difficult than flying by day. Indeed, in many respects it is simpler, since the number of aircraft in the circuit is carefully limited depending on the conditions and the approach path is easier to judge because of the assistance given by the approach lighting.

c The student should be allowed to fly the aircraft for a short period when clear of the circuit.

d The instructor should point out that night flying is a combination of visual and instrument flying and that a sensible balance depends on the visual cues available. Most changes of flight path should be made on instruments but the importance of a good lookout must be emphasised.

6 **Flarepath Demonstration** The object of the flarepath demonstration is to show the appearance of the runway lights in the undershooting, correct and overshooting cases, and to demonstrate the visual cues (spacing of runway lights and perspective) used in judging the approach. It is vitally important that the instructor checks on obstructions before attempting this exercise since the intention is to deliberately fly well below the glide path.

7 **Night Disorientation** No attempt should be made to demonstrate spatial disorientation at night since this could lead to apprehension and underlines the different night flying environment. Instead students should be comprehensively briefed on their symptoms of spatial disorientation and their subsequent actions. By teaching them to revert to instrument techniques, they will be moving back into a regime which by now should be familiar to them.

8 **Emergencies** There are two emergencies which need comprehensive briefs with respect to night flying:

a **Engine Failure** Outside gliding range of the airfield and above 2000 ft AGL the student must abandon the aircraft; below 2000 ft he must use whatever visual cues are available to land the aircraft. Emphasis must be placed on an informative emergency call, heading the aircraft into wind and completing the crash actions. The Battery Master must remain on so that the landing lights may be used and should be switched off only when damage to the aircraft is inevitable or the aircraft has stopped. You should demonstrate forced landings at night on the airfield so that the student appreciates the validity of the day-time technique. Irrespective of other considerations an engine failure means that the gyro instruments will run down. If the aircraft cannot be landed within 5 minutes, it must be abandoned.

b **Total Electrical Failure** Provided the student has a serviceable torch there is no critical time element. Circuit procedures should be covered and practiced prior to solo. The need for good cockpit management and the fact that torchlight will degrade night vision should be emphasised.

**Common Faults**

9 The most common fault is concentrating on instruments to the detriment of lookout. This is most obvious in the circuit where the student misses visual cues and does not see other aircraft. Other faults are:-

a **Shallow Initial Climb.** Rotation of the aircraft to the take -off attitude results in a significant loss of visual cues. The instinctive tendency is to lower the nose with a resulting shallow initial climb and relatively high speed. Biasing the student's attention towards the instruments at this stage should cure the fault.

b **Cross - Wind** In the initial circuits, the student will be anxious to regain his main visual cue, i.e. the runway lights as soon as possible. The instructor should watch for any tendency by the student to concentrate his attention inside the circuit to the exclusion of a good all round lookout. This is especially important as he approaches the downwind leg where other aircraft may be joining.

c **Downwind** Poor height control is usually caused by over concentration on visual cues.

9 d **Base Turn** Some students have genuine difficulty in flying the descent at this stage since the flight path is taking him into an area where there are little or no visual references. The tendency is to be too high on joining the final approach path and the cure is accurate flying using the instruments and sight angle to judge the aircraft's path.

e **Final Approach** The closer the aircraft gets to the runway, the greater the change in pespective caused by deviations from the constant angle approach. Inaccurate initial control of the flight path may therefore be associated with an extended downwind leg or inaccurate base turn.

f **Round Out** The visual sensation of the runway lights passing at the level of one's ears during the landing phase produces a tendency to round out too high. The instructor should allow plenty of opportunity for the student to assimilate the correct sight picture by demonstration.

EXERCISE 20

AIR EXERCISE

NIGHT FLYING

AIM: To teach how to control the aircraft at night, on the ground and in the air.

1 **Airmanship**

a Check of navigation, strobe and landing lights.

b Check and correct use of cockpit lighting.

c Check personal torch.

d Signals on ground:-
1) Aircraft Manned - navigation lights on.
2) Start engine - flash landing light.
3) Chocks away - flash navigatin lights.
4) Ready for take-off strobe light on.

e Run-up in dispersal.

f Taxy with caution.

g Concientious instrument checks.

h Concientious RT procedures.

| SEQUENCE | OBSERVATIONS |
| --- | --- |
| 2 **Taxying** | a Distances are deceptive especially from light sources.<br>b Judging speed.<br>c Instrument checks in clear area.<br>d Use landing light or stop if position in doubt<br>e Ensure aircraft has stopped and brakes fully on before commencing pre-take-off checks. |
| 3 **Familiarisation** | |
| a On the ground | a Marshalling signals.<br>b Taxiway and airfield lighting. |

**Familiarisation** (continued)

b Leave circuit and climb to about 2000ft AGL

a Airfield lighting.

b Sensible division of attention between instruments and visual horizon.

c Other aircraft

d Local features

4 **Approach Path Demonstration**

a Undershooting:-
1) Close spacing of runway lights.
2) Approach angle indicators.

b Correct approach path:-
1) Optimum spacing of runway lights.
2) Approach angle indicators.

c Overshooting:-
1) Wide spacing of runway lights
2) Approach angle indicators.

5 **Take-off**

a RT clearance

b Line aircraft up in centre of runway and allow student to note the relative position and aspect of runway lights as an aid to judging the round-out.

c Take-off normally initiated with minimum delay.

d Use of runway lights to keep straight.

e Select take-off attitude and transfer attention to instruments.

f Importance of attaining positive rate of climb and correct climbing speed.

6 **Climb to Downwind**

a Fly on instruments and maintain a good lookout.

b Turn not commenced until aircraft has reached 500 ft.

c Level-off and note relative position of flare-path as aid in judging correct distance out downwind.

7 **Downwing leg**

a "Downwind" call made abeam upwind end of runway lights.

b Track parallel to runway lights - use of compass.

| | |
|---|---|
| **7 Downwind Leg** (continued) | c Downwind checks. |
| | d Lookout and listening watch. |
| | e Position for commencing base turn. |
| **8 Base Turn** | a Sensible division of attention between instruments and sight angle. |
| **9 Approach and Landing** | a RT call |
| | b Use of runway lights and approach angle aids. Landing light as required. |
| | c Selection of touchdown point |
| | d Judgement of roundout height by use of runway lights. |
| | e Use of runway lights to keep straight. |
| | f Ensure low speed before attempting to turn off runway. |
| | g RT call when clear of runway |
| | h After landing checks. |
| **10 Entering Dispersal** | a Check brakes |
| | b Low speed |
| | c Obey marshalling signals unless safety of aircraft at risk. |
| **11 Overshooting** | a RT call |
| | b Normal procedure for initiating climb then turn onto the deadside. |
| | c Reposition in relation to other aircraft in the circuit. |

EXERCISE 21

INSTRUCTIONAL GUIDE

AEROBATICS

**AIM:** To teach accurate and confident control in all attiutdes, and the ability to fly the aircraft to its limits.

## General

1 Aerobatics are an essential part of pilot's training, for although their practical value is limited, they improve confidence, judgment and co-ordination, and accustom the student to extremes of speed and attitude. Furthermore, they will increase his 'g' tolerance and thus prepare him for more advanced types.

2 Before attempting to teach aerobatics the instructor should accustom the student to the sensations involved by demonstrating loops and rolls. Should he show any sign of air sickness, aerobatic practice should be disco-ntinued; eventually he will become conditioned and able to complete a lengt-hy period of aerobtics without feeling ill.

3 Regular practice is important: frequent brief lessons achieve better results than lengthy concentrated periods at irregular intervals. Most instructional flights give the opportunity for a short aerobatic interlude before landing and this often presents a pleasant way of relieving the tension after any exercise which has required much concentration by the student, although the instructor should not relax the standard of accuracy required.

## Before Flight

4 **Preparatory Instruction**

a Airframe and engine limitations.

b Effect of loading on aircraft and pilot.

c Effect of airspeed on control forces and effectiveness.

d Engine limitations.

e Loop.

f Barrel roll.

g Slow roll.

h Stall turn.

j Roll off the top of a loop.

k Advanced aerobatics.

l Recovery from stalls, including 'g' stalls, spins from manoeuvres and vertical attitudes.

m Regulations and instructions.

## During Flight

5 Initial instruction in aerobatics should be confined to the basic manoeuvres, ie the loop and barrel roll, and further aerobatics introduced as the student becomes proficient and familiar with the sensations and attitudes involved.

6 The 'g' stall is the most common stall encountered during aerobatics and the recovery is effected by releasing the back pressure on the control column. If the stall occurs at very low speeds in a marked nose-up attitude, the recovery should be the same as the recovery from the vertical. Demonstrations of these stalls should be made during instruction on the loop.

7 Placing the aircraft in a vertical attitude at low speed may well result in a tail slide. As the tail slide is a prohibited manoeuvre, demonstrations of the recovery from vertical attitudes must be done from the near-vertical only. The student must by fully briefed on the reason for avoiding the true vertical attitudes during practice.

8 The student should be taught to fly the aircraft through each aerobatic manoeuvre so that he is aware of the amount of control and response that is available at each stage of the manoeuvre. Automatic control movements, done as a drill, indicate that the student lacks the sense of being part of his aircraft.

9 Aerobatics involve large variations in speed and result in changes of control forces and control effectiveness. The aircraft should not be trimmed through aerobatic manoeuvres. The changing stick forces must be held by the pilot. The varying effectiveness of the controls calls for care in avoiding excessive 'g' through large control movements at high airspeeds.

10 Students often have difficulty in continuing control movement when negative 'g' is imposed. It is essential that the harness, particularly the lap strap and the negative 'g' strap, is tight.

11 Flick manoeuvres and aerobatics which involve continuous negative 'g' are not prohibited, but aircraft limitations must be observed.

12 The student should use full throttle during the dive to gain speed for the manoeuvre in order to minimize the height loss.

13 The student's attitude towards aerobatics will be greatly influenced by that of his instructor and he will be readily affected by any sign of apathy. It is therefore very important that the aerobatic exercises are carried out enthusiastically and conscientiously.

14 Within the bounds of safety the student should be allowed to correct his own mistakes. Many who normally carry out good stall and spin recoveries fail to recognize those conditions when they occur unexpectedly during manoeuvres. In such cases the instructor should carefully point out the symptoms which went unheeded and the action that should have been taken.

15 **Airmanship**

The pre-stalling, spinning and aerobatic checks should be carried out before any aerobatic exercise is commenced.

b The airspace around the aircraft must be thoroughly inspected before each manoeuvre to ensure adequate clearance from all other aircraft and clouds. Most aerobatics involve marked and rapid changes of height, heading and position, and the lookout must be continued during the manoeuvre.

c Whenever possible, aerobatics should be carried out looking out of sun, otherwise the blinding effect will hamper accurate flying and may seriously impair lookout.

d As the student increases in proficiency he should be encouraged to enter the manoeuvre from a clearing turn or wingover.

e The student must be taught always to do his FEDRA checks immediately after aerobatics and before "setting off home".

16 **Loop** In the loop the aim should be to maintain a constant rate of pitch in the looping plane and positive loading throughout. The control forces vary as the airspeed changes, being greatest at the bottom and least at the top of the loop where the speed is lowest.

17 **Barrel Roll** Positive loading should be applied throughout the barrel roll. The size of the helix described by the aircraft is dictated by the distance the nose is from the reference point along the horizon at the commencement of the roll. The circle described by the nose should be centred on and at a constant distance from the selected point. Thus half the circle will appear to be above the horizon and half below it. The control deflection required to maintain a constant rate of roll will vary as the airspeed changes. A higher entry speed should be used for rolls of larger radius.

18 **Slow Roll** Particular care should be taken to ensure that the student fully understands the co-ordination of rudder and elevator control required to maintain the nose position and attitude during the slow roll. He should appreciate that, when rolling out, the effect of top rudder is to increase the rate of roll unless aileron deflection is progressively reduced. Initially a higher entry speed should be used to obtain better control. As the student gains proficiency the speed may be reduced.

19 **Stall Turn** It is recommended that stall turns to the left are taught first, as stall turns to the right are more difficult because of slipstream effect. The vertical attitude is best judged by looking at the angle of the wing tip to the horizon. In stall turns to the left the throttle is closed as the nose cuts the horizon, but in stall turns to the right the throttle should be gradually closed at the first sign of decrease in the rate of yaw. This is to reduce the slipstream effect whilst retaining rudder effectiveness.

20 **Roll off the Top of a Loop** Two methods of rolling out are given in the Air Exercise. The first method is easier and the student should use it for his first attempts. Ultimately he should be capable of using both methods.

21 **More Advanced Manoeuvres** When the student is competent in the basic aerobatics, combinations or variations of the basic manoeuvres can be introduced. Most students can be brought to the standard when they are able to complete a sequence of manoeuvres. Particularly able students can be shown Derry turns, 'noddy' stall turns, hesitation stall turns, reverse stall turns, horizontal and Cuban 8. The instructor should ensure that the standard of lookout does not deteriorate when consecutive aerobatics are practised.

**Common Faults**

22 Many students tend to become disorientated during aerobatics and should therefore be encouraged to check their position between manoeuvres. A large, easily identified ground feature to return to is ideal. If the wind is strong, every effort should be made to keep into wind. Teach him to watch out for gyro de-synchronisation.

23 Most faults in handling can be traced to over-controlling at high speed and under-controlling at low speed through failure to appreciate the effects of airspeed on control effectiveness and trim. Some students fail to realize the need for gentle handling when speed is low, for example during the roll off the top of a loop, when harsh aileron and rudder will cause wallowing and possibly an incipient spin.

24 Students should be encouraged to practise manoeuvres in both directions where applicable.

25 General accuracy can be improved by the use of line features and reference points.

EXERCISE 21

AIR EXERCISE

AEROBATICS

**AIM:** To teach accurate and confident control in all attitudes, and the ability to fly the aircraft to its limits.

**Airmanship**

1 a **Checks** Prestalling, spinning and aerobatic checks.
b **Limitations** Max permissible speed and engine RPM limit and airframe G limits.
c **Orientation** Frequent position checks.
d **Post Aerobatic Checks** FEDRA checks.

| SEQUENCE | OBSERVATIONS |
|---|---|
| 2 **Recovery from Vertical Attitudes** | a Care must be taken to avoid the true vertical attitude when practising this manoeuvre.<br>b When the speed is high enough to retain control effectiveness either:<br>1) Look for the horizon and loop or roll the shortest way to it.<br>2) Stall turn.<br>c When the speed is too low to give adequate control:<br>1) Hold the controls firmly central and leave the throttle where it is until the aircraft is in a dive.<br>2) Recover from the dive. |
| 3 **Recovery from Spin Manoeuvre** | See Exercise 11 Instructional Guide, para 13. |
| 4 **Loop** | a Line feature reference.<br>b Lookout.<br>c Straight dive.<br>d Changing rudder and elevator forces as the speed increases - trimmer not adjusted.<br>e Pull up started at 115K.<br>f Check the wings level as the nose cuts the horizon; periodically check until vertical.<br>g Changing rudder forces with decreased speed-balance.<br>h Progressive rearward control column movement.<br>j Decreasing stick force. |

| SEQUENCE | OBSERVATIONS |
|---|---|
| 4 **Loop** (continued) | k Gentle control movements at low speed.<br>l Look "up" to the horizon, level wings before nose cuts the horizon and the reference is lost.<br>m Increasing stick force.<br>n Progressive forward movement of the control column.<br>o Changing rudder loading - balance.<br>p Check direction - line feature.<br>q Climb away. |
| 5 **Barrel Roll** | a Reference point slightly above the horizon.<br>b Lookout.<br>c Straight dive to below reference point to about 110K.<br>d Apply bank away from the direction of roll; allow the speed to increase to 115K.<br>e Pull up to the horizon to one side of the reference point using elevator.<br>f Apply aileron to ensure that the wings are level when the nose is slightly above the horizon; maintain balance with rudder throughout.<br>g Co-ordination of elevator and aileron to circle the reference point on the horizon.<br>h Wings vertical when the nose is above the reference point.<br>j Wings level as the nose is slightly above the horizon on the downward path.<br>k Control deflection increased at lower speeds to maintain a constant rate of roll.<br>l Wings vertical when the nose is below the reference point.<br>m Roll completed when the nose is back on the horizon, wings level.<br>n Positive loading is maintained throughout the roll.<br>o Higher entry speed for rolls of larger radius, greater looping and reduced rolling movement. |

| SEQUENCE | OBSERVATIONS |
|---|---|
| **6 Slow Roll** | a Reference point on the horizon.<br>b Lookout.<br>c Straight dive to about 110K.<br>d Select shallow climbing attitude; nose up movement checked before rolling.<br>e Rolling in (up to 90° bank):<br>1) Aileron - rate of roll.<br>2) Progressive top rudder to maintain the nose above the horizon.<br>3) Elevator to maintain direction and nose position.<br>f From 90° bank to inverted:<br>1) Control column progressively forward to maintain nose position.<br>2) Co-ordination of rudder to maintain direction.<br>3) Attitude required for inverted level flight.<br>4) Continued application of aileron to maintain roll.<br>g Rolling out:<br>1) Co-ordination of rudder and elevator to maintain direction and nose position relative to the horizon.<br>2) Large amount of top rudder required to prevent the nose from dropping.<br>3) Tendency for the rate of roll to increase prevented by opposite aileron.<br>4) Roll stopped when wings level.<br>5) Slightly higher nose position to maintain height at lower speed.<br>h Residual skid removed smoothly.<br>j The aim is eventually to achieve a constant rate of roll in straight and level flight. |
| **7 Stall Turn**<br>a To left. | a Line feature reference.<br>b Lookout.<br>c Straight dive along line feature to about 110K.<br>d Pull up to the vertical as for a loop.<br>e Wing tip angle to the horizon used as a reference for the vertical. Note position relative to the horizon. |

| SEQUENCE | OBSERVATIONS |
|---|---|
| **7 Stall Turn** (continued) | |
| a To left. | f Forward movement of the control column required to maintain the vertical.<br>g Smooth progressive application of rudder.<br>h Roll prevented with aileron.<br>j Pitch attitude controlled with elevators to ensure that the nose cuts the horizon immediately above the position of the port wing.<br>k Close the throttle as the nose drops towards the horizon.<br>l Anticipation of rudder to stop yaw.<br>m Ailerons to prevent roll.<br>n Starboard wing now at reference point.<br>o In the subsequent dive check the line feature.<br>p Ease out of the dive. |
| b To right. | a More difficult owing to slipstream effect.<br>b Careful co-ordination of rudder and throttle required. |
| **8 Roll off the Top of a Loop** | a Line feature reference.<br>b Lookout.<br>c Straight dive to 125K.<br>d Begin as for a loop.<br>e Rolling out, first method:<br>1) Roll started before reaching the inverted level flight attitude.<br>2) Reference point on the horizon.<br>3) Co-ordination of aileron and elevator to bring the nose onto the reference point with wings level.<br>4) Normally used when the speed is low.<br>f Rolling out, second method:<br>1) Loop checked at the inverted level flight attitude.<br>2) Roll completed as for a slow roll.<br>g Large control deflections at low speed require a gentle handling.<br>h Check direction - line feature. |

| SEQUENCE | OBSERVATIONS |
|---|---|
| 9 Half Roll | a Line feature reference.<br>b Speed - 80K.<br>c Lookout.<br>d Entry as for slow roll.<br>e Stop roll when inverted.<br>f Close the throttle.<br>g Pull through the second half of a loop.<br>h Height loss increases with higher entry speed.<br>j May be started from steep climbing attitudes. |
| 10 Aileron Turns | a Lookout.<br>b Entry from stall turn, half roll or loop.<br>c Throttle closed.<br>d Vertical dive, angle of wing tip to the horizon.<br>e Apply aileron to roll - rudder as necessary.<br>f Rapidly increasing airspeed.<br>g Limits - Max IAS.<br>h Large height loss. |
| 11 Derry Turn | a Lookout.<br>b Steep level turn - 110K.<br>c Just before the roll either:<br>1) Reduce bank slightly, maintaining the back pressure, in order to raise the nose.<br>2) Increase the back pressure.<br>3) Apply a little top rudder.<br>d Roll through the inverted, using the slow roll technique, to keep the nose up until the bank is equal to that originally applied in the opposite direction.<br>e Stop the roll use rudder for balance and immediately apply sufficient back pressure to maintain a level turn.<br>f When the roll is stopped do not have more bank applied than in the original turn. |

| SEQUENCE | OBSERVATIONS |
| --- | --- |
| **12 Cuban 8** | a Line feature reference.<br>b Lookout.<br>c 125K.<br>d Entry as for a loop.<br>e Hold momentarily in a 45 degree climb.<br>f Half-roll using rudder to prevent the nose from dropping.<br>g Maintain inverted climb momentarily.<br>h Complete the loop.<br>j Repeat the manoeuvre. |
| **13 Clover Leaf** | a Ideally two line features at 90 degrees to each other.<br>b Lookout.<br>c Entry as for a loop.<br>d Start roll at 60 degrees pitch attitude, maintaining the rate of pitch.<br>e Wings level at 90 degrees to the starting line.<br>f Complete the loop.<br>g Repeat three more times. |
| **14 "Noddy" Stall Turn** | a Line feature reference.<br>b Lookout.<br>c Straight dive along line feature to 115K.<br>d Pull up as for a stall turn but not quite to the vertical.<br>e Use rudder to yaw 20 degrees left; prevent roll with aileron.<br>f Reverse rudder; yaw 20 degrees to the right.<br>g Reverse rudder; complete the stall turn to the left.<br>h Ease out of the dive; check line. |

| SEQUENCE | OBSERVATIONS |
| --- | --- |
| 15 Hesitation Stall Turn | a Line feature reference.<br>b Lookout.<br>c Straight dive along the line feature to achieve 125K.<br>d Pull up as for a stall turn but not quite to the vertical.<br>e Commence stall turn.<br>f Stop yaw momentarily at 45 degrees and 90 degrees positions by centralizing rudder.<br>g Stop the yaw at 135 degrees position by using opposite rudder.<br>h Check vertical dive.<br>j Ease out of the dive checking line. |
| 16 Reverse Stall Turn | a Line feature reference.<br>b Lookout.<br>c Straight dive along the line feature to achieve 115K.<br>d Pull up as for a stall turn.<br>e Immediately when vertical apply rudder; roll prevented with aileron.<br>f When yawed about 45 degrees from the vertical, apply full aileron to roll through 180 degrees, and use rudder to counter adverse yaw.<br>g Complete the stall turn towards the low wing.<br>h Ease out of the dive checking line. |
| 17 Post Flight Discussion | |

EXERCISE 22

Instructional Guide

**FORMATION FLYING**

**AIM:** To teach the student how to fly accurately and confidently in formation, and how to lead.

General

1. Some types of operational flying, and the shepherding of partially unserviceable aircraft, require to be operated in formation. To be effective, a formation must operate as a single unit; this requires not only a high standard of ability, but also excellent discipline and complete understanding between all members. This will only be attained by thorough briefings and sound instruction.

2. The high degree of concentration required during formation exercises is extremely tiring. The early lessons should be of short duration, and the instructor should take over periodically to allow the student time to relax. If found necessary, the spacing between aircraft can be increased to provide respite.

3. Before being authorized to fly solo in formation the student must be competent in joining, breaking formation in emergency, station-keeping, formation changing, and performing stream take-offs and landings.

4. For a variety of reasons, it is often necessary for instructors to fly with students (or lead formations containing students) whose ability is unknown to them. It is, therefore, of vital importance that instructors ascertain the student's ability before the flight to ensure that all manoeuvres to be carried out are within the student's capabilities. It is of equal importance that their progress be carefully and fully recorded in their course record folders. This will ensure that:

a. A student does not fly solo in any exercise until he is competent to do so.

b. All intructors can readily check the student's ability and plan the exercise accordingly.

c. The correct standard is reached by all students.

5. The student will learn mainly by practice, with verbal assistance, and he must be allowed to handle the controls as much as possible without becoming overtired in the early stages. As general proficiency increases, the practices should be made more difficult by steepening the bank in turns, increasing the speed range, and eventually progressing to the more advanced exercise.

6. A student should be told that he may become disorientated when the horizon is obscured. To combat this he must trust his leader, maintain an accurate formation position, and make a conscious effort to relax physically and yet remain mentally alert.

7. One effect of the side-by-side seating in the Firefly is that the student

often has difficulty in flying formation in the No 3 position. It is desirable therefore, that he flies in the No 2 position during the initial demonstrations and practice.

8. Any tendency towards over-confidence, especially by a solo student flying too close in order to impress must be checked immediately.

9. The instructor must insist on the correct handing-over procedure in order to avoid misunderstandings.

Before Flight

10. Preparatory Instruction:

a. Basic formations and positions.

b. Station-keeping.

c. Joining and breaking formation.

d. Formation changing.

e. Formation leading.

f. Taking-off and landing in formation.

g. Hand and RT signals.

h. Tail-chasing.

j. Emergencies.

11. Pre-flight Briefing. Individual briefings should be given to cover the particular aspect of the lesson about to be taught. Full use should be made of diagrams, films, models and, when possible, aircraft on the ground, to demonstrate stations and correct spacing. A formation briefing attended by all pilots involved, must be given before each flight.

During Flight

12. Starting Procedure. All aircraft in the formation should start together to avoid wasting fuel. This can be done on a signal from the leader or, if this is impracticable, at a pre-arranged time. Before taxying, the leader should check RT communication with the formation.

13. Taxying. The aircraft should taxi together in a formation, spaced sufficiently far apart to avoid stones thrown by the propellor of the preceeding aircraft.

14. Stream Take-off. It is customary to line up in VIC formation, but it may be advisable to revise this order in crosswind conditions. The take-off run should commence 10 seconds after the aircraft ahead rolls. The leader should climb straight ahead to 1000ft and then carry out a climbing turn at about 30 degrees bank through 90 degrees and reduce power to allow the formation to join up quickly.

15. Joining Formation

a. The technique of turning inside the leader should be practiced where possible; when the leading aircraft remains stationary relative to the wind-screen the bank is correct. If the leader appears to move ahead, the rate of turn is too low, and vice versa. Bank must be reduced progressively to maintain the relative position of the leader as the closing distance is reduced.

b. A knowledge of the leader's speed and power setting is a great advantage in judging closing speed and settling down quickly.

c. The large throttle and control movements sometimes necessary when joining should be anticipated to avoid over-controlling.

d. The procedure when joining should be to take up the correct vertical and longitudinal positions at about two spans distance and, when settled, move into the correct lateral position by careful use of aileron.

e. The student must realize that use of aileron causes a change of heading and so alters the lateral spacing. When closing in, it will be necessary to bank away from the leader to parallel his heading.

16. Station-keeping

a. Before starting any detailed air instruction in formation, the insturctor should fly the aircraft in formation for a period to accustom the student to the novelty and the appearance of the leading aircraft.

b. Whilst the initial instruction is being given, the leader should maintain straight and level flight for relatively long periods in order to give the studen time to settle down.

c. Any reference points which give early indications of displacement from the correct position should be pointed out, as should the relative size of the next aircraft, which, when kept constant, will ensure a steady spacing.

d. Accurate station-keeping requires anticipation of control movements; these must be small and prompt. The importance of accurate trimming, thus making full of the aircraft's natural stability, should be stressed. Smooth formation flying will only be achieved if the pilot remains mentally alert and physically relaxed.

e. To avoid confusion in the air, the instructions that are given to correct errors in position must be completely standardized. Longitudinal corrections should be given as 'forward' or 'back', vertical as 'up' or 'down' and lateral spacing corrections as 'in' and 'out'.

f. The main control of lateral spacing is by use of ailerons. The student must realize the importance of gentle control movements when close to other aircraft and also that, when aileron is used to reduce the distance, corrective bank must be applied in good time to avoid harsh last-minute corrections which may result in losing sight of the leader.

g. Changes in the longitudinal position must be corrected immediately, otherwis the greater will be the throttle movements required to correct the error. As th correct position is being regained, the further throttle movement necessary to maintain it must be anticipated. Any delay in the correction of errors will usually result in over-controlling and the student will have difficulty in holdi a steady position.

h. During early formation practice, the student should increase his lateral separation before checks of fuel, temperatures, etc are made. As the student becomes proficient, however, these checks may be carried out in station, but the student must check each instrument singly as it takes several seconds to locate and read an indicator correctly. Attention must be diverted from the leader for the shortest possible time.

17. Breaking and Rejoining Formation

a. When sight of the leader is lost, a positive break into a known clear must be made immediately, and the formation rejoined from a safe distance and at same height. The danger of attempting to rejoin from above should be pointed out. If the formation is overtaken, the same procedure must be followed as it is equally dangerous to attempt to fall back into position, especially on, or just after, take-off.

b. If contact is lost in cloud, the aircraft must be immediately turned away from the formation and the leader informed by RT. The original heading may be resumed after 15 seconds and the leader's airspeed maintained. Rejoining must not be attempted until clear of cloud.

c. The rejoining procedure follows the same pattern as joining the formation outlined in para 15. The student should be given rejoining practice in straight flight and turns.

18. Formation Changes

a. The procedure and order of position changes must be briefed before flight.

b. All formation changes should be made by the aircraft moving behind and below the formation to take up its new position.

c. When moving into line astern the aileron movement required to position the aircraft correctly must be anticipated or an overshoot will result.

d. During all formation changes an aircraft should not be closed to the correct lateral or longitudinal position until the preceding aircraft appears to be settled in position. The student should appreciate, however, that prompt formation changes are essential operationally and a high standard must be achieved.

e. Rapid and efficient formation changes require smooth control handling considerable anticipation of power to avoid lagging.

f. Care must be taken to keep the other aircraft in view as much as possible during position changes.

19. Formation Leading. The student must realize that good leadership is vitally important and can considerably ease the task of the formating pilots. The leader is responsible for the formation briefing before the flight and, in the air, for the overall safety and airmanship of the formation. Particular attention should be paid to the following point:

a. Control and Manoeuvre. All manoeuvres should be carried out smoothly and accurately, and within the capabilities of all the formating pilots. Aircraft farthest from the leader in large formations, particularly in echelon, must make relatively large changes in height and airspeed during turns. Entries and recoveries should be made gently, and bank restricted to moderate angles. Maximum and minimum power settings must never be used by the leader as formating pilots must be allowed a wider throttle range then the leader to maintain position. Similarly, very low speeds must be avoided or aircraft on the inside of turns may lose control.

b. Airmanship. The increased importance of a high standard of airmanship and in-flight planning must be impressed upon the student.

(1) Lookout. In close formation, the attention of formating pilots is concentrated on the leader who must assume the responsibility of lookout for the entire formation, bearing in mind the greater airspace taken up and reduced manoeuvrability of a formation.

(2) Navigation. The leader is responsible for the navigation and use of radio aids. Fuel states must be obtained periodically, and it should be appreciated that the following aircraft will have a higher fuel comsumption than the leader.

(3) Position of the Sun. The leader should avoid, whenever possible, flying so that he is directly up-sun of any member of the formation.

20. Circuit Rejoining

a. The straight approach on the dead side of the duty runway should be of sufficient length to allow the formation to settle down in echelon.

b. The final run-in should be made at 120 knots reducing to 500 feet, the throttle being opened on the break and closed downwind. It is imperative that the exact break procedure be clearly stated during the pre-flight briefing. The accuracy of a level break will be ensured if the aircraft ahead is kept in sight and on the horizon during the turn downwind.

c. The correct spacing should be attained downwind so that normal approach speeds may be used.

d. In marginal weather conditions the final run-up should be at a low safe cruising speed, and a gentle turn made downwind at about 10-second intervals to allow adequate spacing.

21. Stream Landing

a. The effects of crosswind and slipstream from the aircraft ahead should be anticipated and a slightly steeper approach carried out. Long flat approaches, which necessitate high power during the final stages, should be avoided.

b. The student must realize that if he allows himself to get too close to the aircraft ahead, or if he allows the airspeed on finals to get too high, or if the approach is in any way unsatisfactory, he must overshoot.

c. All aircraft in the formation should land on the centre line of the runway and move over to the exit side when they have reduced speed to a fast taxying speed.

d. After landing, the brakes should be used carefully to control the speed. Harsh braking should be avoided if there is another aircraft behind.

22. Tail-chasing. When the student has reached a satisfactory standard in general formation flying he should be introduced to tail-chasing. A high standard will be attained eventually by starting with gentle rolling manoeuvres maintaining slight positive loading, and gradually building up to more advanced looping manoeuvres involving higher loading as the student becomes competent. Before a detail involving tail-chasing takes place, the instructor leading must check on the proficiency of the solo students and plan the exercise accordingly. Prolonged negative g loadings must be avoided. Particular attention must be paid to the following points:

a. Airmanship. Tail-chasing should only be carried out if the weather is suitable for aerobatics. The leader must not fly at an IAS or loading which may result in a follower losing control or exceeding aircraft limitations, and must ensure that the airspace is clear of other aircraft.

b. Spacing. The minimum distance between aircraft should be 100 yards. The appearance of a Firefly at this distance should be pointed out on the ground. The spacing between aircraft following the same flight path will vary as the speed changes in manoeuvre. Adjustments to spacing should be made by adjusting the flight path, keeping throttle adjustments to a minimum. The No 3 aircraft must fly on No 2 and not the leader.

c. Briefing. The briefing before flight should include the sequence of manoeuvres to be carried out and the action to be taken if position is lost. Manoeuvres not included in the briefing should not be attempted.

23. Snake Climb and Descent. During early solo details, before the student is fully competent to formate in actual conditions, it may be necessary to climb and descend singly through cloud. The snake technique can be used and should be demonstrated during a dual detail when suitable conditions arise.

a. Snake Climb. The formation should take off in the correct order at 30 second intervals. The normal instrument climb should be carried out, and particular emphasis given to the importance of accurate power settings, climbing speeds and headings. When above the cloud, the leader should continue climbing until 1000ft clear of cloud. He is then to level out and orbit at a low rate of turn until the formation has joined up. He should watch for the other aircraft breaking cloud and pass his relative bearing in clock code. The climb should not be resumed until the formation is settled in position.

b. Descent. The formation should home in the normal manner and aircraft should be detached at air traffic command. Any aircraft with a low fuel state should be given priority, but under normal conditions the instructor leading should detach solo students in turn for the recoveries and bring up the rear himself. The recoveries, circuits and landings are carried out individually. The importance of accurate power settings, speeds and headings to maintain the separation should again be stressed.

24. Formation take-off. During late dual details, the student's experience can be broadened by introducing formation take-offs. As with other formation exercises, the programme should be arranged so that each pupil has the opportunity to practice both leading and formating. The aircraft should be positioned on

the runway in the correct stations, care being taken to ensure accuracy in lining up with the nosewheel straight. The leader signals an increase in power to 15" and engine temperatures and pressures should be checked. After receiving the 'thumbs up' from Nos 2 and 3 the leader will either call or signal the start of the take-off run. The leader increases power slowly during the take-off run, leaving the runway at a speed slightly higher than normal. The formating aircraft must concentrate on maintaining station relative to the leader and will become airborne at the same time.

25. Formation Landing. When the student has reached a high standard of proficiency in general formation flying, he can be shown the technique used when landing pairs, or when shepherding an aircraft with an unserviceable airspeed indicator. The programme must be carefully planned to ensure that each student has at least one demonstration in each echelon position. Under operational conditions, formation landings are normally made from straight-in approaches; but a circuit with an extended approach may be used during practice. Rapid reduction of speed and/or power should be avoided.

Common Faults

26. Some students fail to make allowance for dihedral with the result that they fly with crossed controls. The flat cross made by the two adjacent wings should be pointed out and, when more proficient, the student should make periodic checks of the slip indicator.

27. Harsh control movements and over-controlling in general are often due to physical and mental tension; the student should be encouraged to make a conscious effort to relax. When these symptoms appear, the instructor should take over control for short periods, while the student rests.

28. Unsteady vertical positioning is often due to poor trimming.

29. If a student is having difficulty, especially in maintaining longitudinal position, he may make faster progress if control is split during an early lesson, the student handling the throttle with the instructor on the flying controls.

30. In line astern, failure to anticipate the levelling of the wings as the correct position is approached results in over-controlling and swinging from side to side. A definite effort must be made to match the wing level of the aircraft ahead, and corrections made by very small alterations in bank.

EXERCISE 22 (CON'T)

Air Exercise

**FORMATION FLYING**

**AIM**: To fly accurately and confidently in formation, and to lead.

| SEQUENCE | OBSERVATIONS |
|---|---|
| 1. Starting and Taxying | a. Start on leader's signal, either by hand or radio, or at a preselected time.<br>b. Leader:<br>(1) RT checks with formation.<br>(2) RT call for taxi clearance.<br>(3) Taxi with consideration for formation.<br>(4) Marshalling point - engine run and normal pre-take-off checks.<br>(5) RT calls for take-off clearance when formation ready.<br>c. Formation:<br>(1) RT checks in numerical order.<br>(2) Taxi in numerical order.<br>(3) Taxi with care and at correct distance; checks of brake pressure.<br>(4) Marshalling point - line up at safe distance - engine run and normal pre-take-o checks.<br>(5) Signal when checks complete. |
| 2. Stream Take-off | a. Leader:<br>(1) Line up and hold as briefed.<br>(2) Check formation in position and ready.<br>(3) Normal take-off.<br>(4) Accurate climb at reduced power.<br>(5) Climb turn, 30 degrees bank through 90 degrees at approx 1000 ft.<br>(6) Call for frequency change as required.<br>b. Formation:<br>(1) Line up as briefed on runway.<br>(2) Signal when ready.<br>(3) Take-off at intervals as briefed.<br>(4) When leader turns, Nos 2 and 3 cut the corner at a safe height.<br>(5) Change frequency when instructed.<br>(6) Maintenance of relative position of leader.<br>(7) Progressive reduction of bank. |

3. Station Keeping

a. Fly vic formation at normal spacing.

a. Appearance of other aircraft.

b. Correct position:

(1) Longitudinal opposite the trailing edge of rudder.
(2) Vertical same height.
(3) Lateral half span between wing tips. Line up the aileron activating bracket with the nose wheel.

c. Attention fixed on leader.

d. Importance of relaxing physically.

e. Difference in No 3 position due to offset seating.

b. Demonstrate the use of controls for station-keeping.

a. Vertical position ('up' or 'down'):

(1) Controlled by elevators.
(2) Small gentle movements essential.
(3) Illusion of leader moving.
(4) Importance of trim.

b. Lateral position ('in' or 'out'):

(1) Ailerons primary control.
(2) Small gentle movements.
(3) Wings parallel to leader's - illusion caused by dihedral.
(4) Anticipation of levelling wings, or corrective bank when closing.
(5) Check no slip or skid.

c. Longitudinal position ('forward' or 'back'

(1) Controlled by throttle.
(2) Small prompt adjustments.
(3) Anticipation required - due to aircra
inertia.
(4) Constant throttle setting aimed for - avoidance of over-controlling.

d. The effects of all controls are inter-rel control movements must be co-ordinated.

e. Importance of corrections immediately a change in relative position is noted.

c. Turns in formation.

a. Attention concentrated on maintaining position relative to leader.

b. Station-keeping as for level flight.

c. Same bank as leader.

d. Anticipation of power changes on entry and recovery.

e. Need for climb or descent on entry and recovery.

4. <u>Breaking and Joining Formation</u>

| | |
|---|---|
| a. Climb to lose sight of the leader, break away and demonstrate rejoining. | a. Positive break into a known clear area.<br>b. Danger of attempting to rejoin from above.<br>c. Locate the leader. |
| b. Joining in straight flight. | a. Knowledge of leader's speed an advantage in judging closing speed.<br>b. Apply full throttle.<br>c. Attain correct vertical position.<br>d. Aim for correct longitudinal position two spans out from lead aircraft.<br>e. Anticipate joining up and decelerate by reducing power.<br>f. Gentle control movements to obtain correct position. |
| c. Joining in the turn. | a. Apply full throttle and turn towards centr of leader's turning circle.<br>b. Adjust power to maintain leader's speed plus 10 knots.<br>c. Attain echelon below the leader using his outside wingtip and tail as reference line.<br>d. Close along the echelon - show how angle of bank controls closure.<br>e. When approaching 3 wing spans separation, descend to deep echelon.<br>f. Demonstrate risk of overbanking (ie risk of losing sight of leader). Show how safe separation can be achieved by reducing bank and passing below and behind leader.<br>g. If joining on <u>inside</u> echelon, stabilize at 3 wing spans separation before joining as in straight join.<br>h. If joining on <u>outside</u> echelon, reduce bank to pass below and behind the leader, move to wide outside echelon, and then join as in straight join. |

j. If joining in the turn after take-off, the leader commences his turn at 1000 ft agl. Do not turn below 500 ft and do not descend below this height.

5. Changing Formation

a. Change in correct order - as briefed.

b. No violent movements.

c. Drop back to clear leader's tail and reduce height to clear prop wash.

d. Maintain half wing span or whole aircraft length between individual aircraft.

e. Anticipation required to avoid over-controlling.

f. RT calls as briefed.

6. Other Formations

a. Line astern

a. Vertical position:

(1) Angle of sight through canopy.
(2) Avoid prop wash of aircraft ahead.
(3) Gentle elevator movements.

b. Lateral position:

(1) Directly astern of aircraft ahead.
(2) Effect of offset seating.
(3) Wings parallel to aircraft ahead.
(4) Position adjusted by small prompt aileron movements.
(5) Small changes of bank produce large lateral displacements.

c. Longitudinal position:

(1) One aircraft length astern - leader's wing span almost fills half end of canopy.
(2) Small displacements difficult to detec
(3) Prompt throttle corrections essential.

b. Echelons of more than 2 aircraft.

a. Formate on neighbouring aircraft, not leader.

b. Importance of steadiness.

c. Larger height and throttle changes during turns.

7. Formation Leading

a. Responsible for safety of the formation:

(1) Lookout.
(2) Fuel checks.
(3) Navigation.
(4) RT procedure.

b. Throttle changes kept to a minimum and made smoothly and slowly.

c. Distinct commands and signals - complete before manoeuvre commenced.

d. Avoid sun dazzle of formating pilots.

e. Climbing - reduced power.

f. Descending - minimum 15" hg.

g. Handing over lead - pass position.

8. Circuit Rejoining and Stream Landing

a. Leader:

(1) Circuit joining instuctions obtained early.
(2) Final descent planned to line up th runway in use.
(3) Echelon formation - away from circuit direction.
(4) Run-in made into wind on the dead side of the runway at circuit height.
(5) RT call for break at upwind end of runway.
(6) RT call downwind.

b. Level or climbing break at briefed intervals.

c. Use of power as briefed.

d. Normal circuit - spacing as briefed.

e. Individual RT call on finals.

f. Land on centre line of the runway. Avoid heavy breaking if possible. Move to exit sid when at fast taxi speed.

g. Last aircraft calls 'clear'.

9. Tail Chasing

a. Leader

a. Constant power setting.

b. Manoeuvres as briefed.

c. Weather minimum.

d. Speed and loading limitations.

b. Formation

a. Spacing as briefed.

b. Last aircraft calls when in position.

c. No 3 flies on No 2 - not on leader.

d. Appearance of aircraft ahead when at correct range.

e. Perpective of aircraft ahead changes as loading varies.

f. When flying along same flight path as the aircraft ahead the range will change as the speed changes in manoeuvre.

g. Adjustments to spacing can be made with small adjustments to flight path.

h. Avoidance of slipstream.

j. Do not hold aircraft ahead in a fixed position in the windscreen - risk of collision or overstress.

k. Avoid large changes in throttle setting.

## POST-FLIGHT DISCUSSION