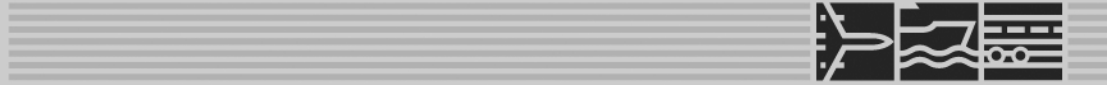




Transport
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TP 11575E
(10/2010)

Instructor Guide

MULTI-ENGINE CLASS RATING

SECOND EDITION

OCTOBER 2010

TC-1004071



Canada

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ISBN 978-1-100-16749-7

Catalogue No. T52-4/59-2010E-PDF

TP 11575E
(10/2010)

TC-1004071

Cette publication est aussi disponible en français sous le titre [Guide de l'instructeur - Qualification sur multimoteurs].

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INTRODUCTION

This instructor guide is intended primarily for instructors providing training for a multi-engine class rating, but can also be used as a reference by students.

The instructor guide has been designed to accompany the "Flight Test Guide - Multi-Engine Class Rating - Aeroplane", TP 219, which for present purposes will be called simply the "flight test guide".

This instructor guide applies to most multi-engine aeroplanes used for training and most cabin-class twins. Since the rating is for a "class" and not a "type", advanced systems should be included in the training when possible; in order to prepare the students for more advanced types that they may encounter later in their careers. For safety, in-flight training is to be in accordance with the Pilot Operating Handbook or manufacturers' recommendations.

It is assumed that candidates have the level of knowledge and skill required for the private or commercial licence, as applicable, prior to commencing training for this rating. To ensure familiarity with the standards, the instructor should review the flight test guide with students before commencing multi-engine training. Discussion of the applicable standards is an integral part of each lesson.

Reference material for the Multi-Engine Class Rating can be difficult to obtain. Articles are available, but caution must be exercised, as some may be misleading. Textbooks may be obtained through suppliers of aviation products. Audio-visual presentations have been developed and may be purchased from industry sources as well. Regional Aviation Safety Officers also have audio-visual material that may be useful to instructors. Instructors should be on the lookout for any such material, which could prove valuable as training aids.

Those wishing to conduct training for the multi-engine class rating must meet the experience requirements outlined as minimum in CAR Standard 425.21(5) of the *Personnel Licensing and Training Standards*. Instructors must be competent, knowledgeable and experienced on the type of aeroplane on which they will be providing training. Avoid situations that could compromise safety either for you or your student.

DEFINITIONS

The majority of the following terms are used in this instructor guide. Others may be encountered in flying various aeroplane types.

APPLICABLE SPEEDS

V_A *Manoeuvring Speed* - the maximum speed at which the application of full available aerodynamic control will not overstress the aeroplane.

V_F *Design Flap Speed* - the maximum speed at which wing flaps may be actuated.

V_{FE} *Maximum Flap Extended Speed* - the maximum speed permissible with the wing flaps in a prescribed extended position.

V_{LE} - *Maximum Landing Gear Extended Speed* - the maximum speed permissible with the landing gear extended.

V_{LO} *Maximum Landing Gear Operating Speed* - the maximum speed permissible for the extension or retraction of the landing gear.

V_{MC} *Minimum Control Speed* - the minimum flight speed at which it is possible to retain control of the aeroplane and maintain straight flight, through the use of maximum rudder deflection and not more than 5 degrees of bank, following sudden failure of the critical engine.

NOTE 1: V_{MC} for an aeroplane type is generally determined under the following conditions:

- all engines developing maximum rated power at the time of critical engine failure
- the aeroplane at a minimum practical weight and with a rearmost centre of gravity; and
- landing gear retracted, flaps in take-off position and the propeller of the critical engine windmilling.

NOTE 2: At speeds below V_{MC} , the aeroplane will yaw and roll towards the failed engine. It cannot be too strongly emphasized that control will be regained only by a reduction in power of the good engine or by increasing airspeed through a change in pitch attitude, or both.

Refer to AC 23-8B – *Flight Test Guide for Certification of Part 23 Airplanes* at the following website:

http://www.airweb.faa.gov/Regulatory_and_Guidance_Library/rgAdvisoryCircular.nsf/MainFrame?OpenFrameSet

V_{SO} *Stalling Speed* - the minimum steady flight speed at which the aeroplane is controllable in the landing configuration.

V_{SSE} *Intentional One Engine Inoperative Speed* - a speed above both V_{MC} and the stall speed, selected to provide a margin of lateral and directional control when one engine is suddenly rendered inoperative. An intentional failing of one engine below this speed is not recommended.

V_X *Best Angle-of-Climb Speed* - the speed that provides the maximum altitude gain for the horizontal distance travelled.

V_{XSE} *One Engine Inoperative Best Angle-of-Climb Speed* - the speed that provides the maximum altitude gain for the horizontal distance travelled with one engine inoperative.

V_Y *Best Rate-of-Climb Speed* - the speed that provides the maximum foot-per-minute altitude gain.

V_{YSE} *One Engine Inoperative Best Rate-of-Climb Speed* - the speed that provides the maximum foot-per-minute altitude gain with one engine inoperative.

COMMON TERMS

Accelerate/Stop Distance - distance required to accelerate the aeroplane to lift-off speed, and on experiencing an engine failure or emergency at that point, immediately discontinue the take-off, and stop the aeroplane on the remaining runway.

Accelerate Stop Distance Available (ASDA) - the length of the take-off run available plus the length of the stopway, if provided.

Critical Engine - the engine that, if inoperative, would most adversely affect the performance or handling qualities of an aeroplane.

Drift-Down Altitude - the altitude to which, following the failure of an engine above the one engine inoperative absolute ceiling, an aeroplane will descend to and maintain, while using maximum available power on the operating engine and maintaining the one engine inoperative best rate of climb speed.

Imminent Stall - the condition in which an aeroplane exhibits symptoms of an approaching stall.

Landing Distance Available (LDA) - the length of runway declared available and suitable for the ground run of an aeroplane landing.

One Engine Inoperative Absolute Ceiling - maximum density altitude that an aeroplane is capable of attaining, at gross weight, clean configuration while using maximum available power on the operating engine and maintaining the one engine inoperative best rate of climb speed.

One Engine Inoperative Service Ceiling - maximum density altitude at which an aeroplane is capable of climbing at 50 feet per minute, at gross weight, clean configuration, while using maximum available power on the operating engine and maintaining the one engine inoperative best rate of climb speed.

Pilot Operating Handbook (POH) - Manufacturer's operating manual for a particular make and model of aeroplane. POH is a generic term applying to publications that manufacturers have designated as containing operating information relevant to a particular aeroplane type.

Take-off Distance Available (TODA) - the length of the take-off run available plus the length of the clearway, if provided.

Take-off Run Available (TORA) - the length of runway declared available and suitable for the ground run of an aeroplane taking off.

Take-off Safety Briefing - the briefing in which, prior to take-off the pilot reviews his intentions regarding the procedure for take-off and departure, including plans for actions to be taken in the event of an emergency.

Zero-Fuel Weight - the weight of the aeroplane with passengers and baggage, but without usable fuel. All weight in excess of a published maximum zero fuel weight must be in the form of fuel.

Zero-Thrust Power Setting - manifold pressure and RPM setting used to simulate a failed engine with the propeller feathered.

ORGANIZING THE TRAINING

Organizing the way you conduct your multi-engine instruction will help your students to master the required knowledge and skill more efficiently. Think of the training as having four parts:

- Ground Instruction
- Basic Operations
- One Engine Inoperative Manoeuvres
- Abnormal or Emergency Situations

GROUND INSTRUCTION

Ground school is not a regulatory requirement in training for the multi-engine class rating, but it is a good idea. Whether you offer ground school to a group of students or on an individual basis, there are many points that must be covered before attempting in-flight instruction for specific exercises. The place to look for these points is under the "Essential Background Knowledge" listed for each exercise. Possible topics include aeroplane systems, theory of flight as it relates to multi-engine aircraft, aeroplane performance, weight and balance, and human factors.

The ground instruction could be organized in one long session, but it is better to present the material in several shorter units. This will allow the student to study and absorb new material at home and let you use review of previous work to improve retention.

Whether you choose to include a formal ground school component or not, you must ensure that all the points listed as "Essential Background Knowledge" are covered before related in-flight instruction is attempted. To do otherwise takes more time, reduces student achievement, and increases frustration for both you and your student.

You should also spend time with the student sitting in the aeroplane on the ground locating controls and practising checks and cockpit procedures. Finally, consider assessing knowledge by requiring the student to pass a written examination before going flying.

BASIC OPERATIONS

Aside from having two engines, there are a number of other differences between this aeroplane and any that the student has flown in the past. The multi-engine aeroplane probably features systems unfamiliar to the student, systems such as retractable landing gear, constant speed propellers, and hydraulic systems. Loading variations are probably greater than the student has experienced before. Attitude references will be different. All of this will take a bit of getting used to.

Spend the first flight or two giving your student the chance to operate this aeroplane with all systems functioning normally. Once reasonable proficiency is obtained, gradually introduce abnormal or emergency situations. Even if the student masters normal operations quite early, make sure that at least some parts of all future trips involve normal handling. It is easy to fall into the trap of concentrating only on the abnormal or emergency situations.

ONE ENGINE INOPERATIVE PROCEDURES

When should you introduce the first engine failure? Apart from a demonstration for familiarization purposes, you should be satisfied that the student can control the aeroplane in normal situations first but not leave it so late that training is rushed or needlessly extended. Usually, this means the second or third flight is the place to introduce the first engine failure.

The student will progress more quickly if you review and practise procedures on the ground or on a flight training device before simulating them in the air.

The introduction of engine failures should move from simple to complex. The first engine failure should be introduced in cruise flight. Once the more basic engine failure is mastered, proceed to engine failures in turns, in overshoots, and then to circuits and landings with one engine inoperative.

ABNORMAL AND EMERGENCY SITUATIONS

Training in abnormal and emergency situations should not be left to the end. Rather, introduce simple situations early, perhaps starting with abnormalities or emergencies commonly found in single-engine operations. As skill and confidence builds, introduce more complex situations. Be sure to review before each flight the abnormal or emergency situations to be covered. This will help learning progress more quickly.

PLANNING THE FLIGHT LESSONS

Maximize the effective use of a suitable flight training device or full-flight simulator to enhance the learning process. The device will allow one to realize the consequences of major pilot errors and the importance of following a prescribed procedure without creating a safety risk.

When you are planning a flight lesson, consider the lesson in the context of the lesson before and the lesson that will follow. Review some of the material from the previous lesson and build on that material. Include an introduction to exercises that will be presented in the next flight lesson. After the initial lesson, each trip should include some abnormal or emergency situations.

Once you have decided what will be covered in each flight lesson, identify those topics that will require ground instruction. Preparation for each flight lesson should include assignments related to weight and balance calculations, use of performance charts, or study of other parts of the Pilot's Operating Handbook. Assign advance study for your student if reference material is available. Consider assigning reading or other work to be done following each flight.

Careful planning of training will allow your student to become a proficient multi-engine pilot in a relatively short time. You will be able to take satisfaction in knowing that you have provided high quality instruction in a most professional manner.

PILOT TRAINING RECORD -- MULTI-ENGINE

Proper records are essential to keep track of the student's progress and to ensure continuity of training. The sample form given here has been designed to conform to the existing flight test report form so that it may be used with both the flight test guide and this instructor guide. If it is helpful, use it. If it is not, ignore it, and continue to use whatever record keeping you have used in the past.

Instruction, both on the ground and in the air, can be recorded in the nine columns provided for this purpose. If a student requires more training than this, use additional forms. The final column, entitled "Meets Test Standards", is a quick checklist of the training completed. Once you are satisfied that the student can perform at the flight test standard, check off the appropriate box in this column. A quick glance will show which exercises remain incomplete. When the column is completed, a pre-test evaluation flight should be conducted (see pp. 39, 40).

The back of the Pilot Training Record provides space for instructor's comments and student's observations. Use this part of the form to note student performance during ground or air instruction, to describe what areas worked well and where improvement is needed, to record any assignments given to the student, and generally note details that might add to the effectiveness and efficiency of the training.

PILOT TRAINING RECORD - MULTI-ENGINE

Given Names		Surname						File No														
								5802-														
Address		Tel: H										W										
												Instructor										
Date																						
Exercise		Ground	Air	Ground	Air	Ground	FTD/SIM	Air	Ground	FTD/SIM	Air	Ground	FTD/SIM	Air	Ground	FTD/SIM	Air	Ground	FTD/SIM	Air	Meets Flight Test Standards	
1.	Aeroplane Familiarisation and Preparation for flight																					
	A. Documents and Airworthiness																					
	B. Performance and Limitations																					
	C. Principles of Flight – One Engine Inoperative																					
	D. Weight and Balance, Loading																					
	E. Pre-Flight Inspection																					
	F. Engine Starting;/Run-Up, Use of Check Lists																					
2	Ancillary Controls/Operation of Aircraft Systems																					
3	Taxiing																					
4	Takeoff, Circuit and Landing																					
	Takeoff																					
	Circuit																					
	C. Approach and Landing																					
5	Cruising Flight																					
6	A. Engine Failure - Cruise Flight Aeroplane Control																					
	B. Cockpit Checks																					
	C. Single-Engine Manoeuvring																					

	Exercise	Ground	Air	Ground	Air	Ground	FTD/SIM	Air	Ground	FTD/SIM	Air	Ground	FTD/SIM	Air	Ground	FTD/SIM	Air	Ground	FTD/SIM	Air	MEETS FLIGHT TEST STANDARDS			
7	Manoeuvring at Reduced Airspeed																							
8	A. Stall (Clean Configuration)																							
	B. Approach to Stall (Landing Configuration)																							
9	Steep Turn																							
10	Engine Failure During Takeoff or Overshoot																							
	A. Engine Failure – Takeoff or Overshoot - Aeroplane Control																							
	B. Cockpit Checks																							
11	A. Intentional Engine Shutdown																							
	B. Arrival, Approach and Landing – One Engine Inoperative																							
12	Emergency Procedures/Malfunctions																							
	Landing Gear Malfunction																							
	Flap Failure																							
	Partial Power Loss																							
	Cross-feed Procedure																							
	Turbocharger Failure																							
	Electrical System Malfunction																							
	Propeller Feathering (Simulated)																							
	Boost Pump Failure																							
	Engine Fire																							
	Cabin Fire																							
	Emergency Engine Shutdown																							
	Heater Overheat																							

GROUND AND AIR EXERCISES

This section should be used in cross-reference with the Flight Test Guide. Exercise numbers correspond to those in the Guide. Generally, preparatory ground instruction and, subsequent pre-flight briefing should be given before in-flight training.

Each exercise has been divided into five sections:

Objectives

Details what new knowledge or skills the student is expected to acquire.

Motivation

This material explains why the student needs to learn particular skills. The instructor must ensure that the student knows why the lesson is important, and where it fits into the overall curriculum of studies. In most cases, the motivation used in this instructor guide is specific to multi-engine aeroplanes.

Essential Background Knowledge

This is the minimum knowledge required for the student to benefit fully from the air instruction. One of your obligations as an instructor is to make sure that students complete all the pertinent ground instruction before beginning air instruction.

Advice to Instructors

Provides information that may help you in presenting or teaching a particular lesson.

Transport Canada no longer recommends actual inflight engine shutdown, feathering, engine restart and unfeathering procedures. It has been determined that the training value of conducting this procedure in-flight is not worth the increased safety risk and engine/airframe abuse/damage that is often incurred. It is highly recommended that engine failure procedures be trained to proficiency on a suitable Flight Training Device or Flight Simulator, where a procedure may be fully completed and the consequences of errors safely demonstrated, prior to simulating failures in the aeroplane.

Instruction and Student Practice

This includes the steps to follow in presenting the lesson. It also suggests exercises that will help the student to develop the skills needed to meet the objectives.

EX. 1 - AEROPLANE FAMILIARIZATION AND PREPARATION FOR FLIGHT

Objectives

To teach the student to:

- conduct a thorough pre-flight inspection
- determine that the aeroplane is ready for flight
- be familiar with the primary systems and controls
- properly use the performance data available
- compute weight and balance data for various load conditions
- start the engines and conduct the run-up using the aeroplane checklist

Motivation

This exercise covers areas of knowledge essential to the safe operation of the aeroplane. It may have been some time since students last dealt with portions of the subject material. In the meantime, information may have been updated, requiring the instructor to inform the student of current material.

Multi-engine flying exposes pilots to complex systems, controls and procedures that students must understand if they are to operate the aeroplane effectively.

Advice to Instructors

Proceed at a comfortable pace for the student in the early stages. It takes time to become familiar with the aeroplane.

Even though the student may hold a licence, do not assume they already know the information or will research the information without your assistance.

Assign from the POH study material related to this exercise. Completion of an open-book written examination on this information is recommended before the student proceeds to the aeroplane for the first flight.

Spend sufficient time with the student in the cockpit becoming familiar with the location and operation of various items. Caution must be exercised not to inadvertently select such items as landing gear "UP" during this familiarization.

Prior to each flight, have the student check the weather and compute the weight and balance, accelerate stop distance, take-off distance, and landing distance. Also, computation of take-off performance and one engine inoperative climb performance will make the student aware of how drastically aeroplane performance is reduced in an engine-out situation.

Assign additional practice using realistic scenarios.

GROUND INSTRUCTION

Documents and Airworthiness

Review:

- documents that must be carried on board the aeroplane
- validity of all documents
- requirements for Certificate of Airworthiness validity

Performance and Limitations

Explain use of performance charts including:

- limitations
- take-off and climb performance
- accelerate/stop distance
- one engine inoperative performance
- cruise performance
- descent and landing performance
- any other performance charts applicable to type

Explain essential performance speeds:

- Minimum Control Speed (V_{MC})
- Intentional One Engine Inoperative Speed (V_{SSE})
- Manoeuvring Speed (V_A)
- Maximum Landing Gear Extended Speed (V_{LE})
- Maximum Flap Extended Speed (V_{FE})
- One Engine Inoperative Best Rate-of-Climb (V_{YSE})
- Stalling Speed (V_{SO})
- any other speeds applicable to type

Explain one engine inoperative performance limitations:

- rate of climb
- service ceiling
- climb gradient
- cruise speed
- cruise range

Weight and Balance

Review specific terms including arm, moment, datum, centre of gravity, take-off weight, landing weight and zero fuel weight.

Explain:

- weight and balance limitations
- how to calculate weight and balance under various load conditions.
- how to correct various overload and out of balance conditions.
- various graphs and envelopes that are available to calculate weight and balance.
- effects of various centre of gravity positions on flight characteristics.
- use of a weight and balance calculator if available.
- any specific items for the training aeroplane used.

Pre-flight Inspection

Explain using the POH and the aeroplane:

- basic aeroplane familiarization.
- pre-flight inspection.
- ELT location, operating procedures and limitations.
- how to determine the fuel and oil quantities.
- appropriate action to be taken on finding an unsatisfactory item.

Engine Start, Run-up and Use of Checklists

NOTE - If the operator does not have an adequate checklist, one could be developed to include at least the items recommended in the AFM/POH. For efficiency, the sequence of items on a checklist should be consistent with a natural flow of items across the cockpit and instrument panel.

Review the correct use of written checklists.

Explain the importance of a thorough pre-flight passenger safety briefing, which should include:

- emergency exits
- ELT
- fire extinguisher
- smoking limitations
- use of seat belts
- items specific to the aeroplane type being used
- action to take in the event of an emergency
- other items for use in an emergency

Familiarize the student with:

- parking brake usage
- door operation
- pre-start checks
- start and warm-up techniques
- run-up and pretake-off checks
- cross-feed checks
- procedures for flooded starts and hot starts
- use of the ground power unit

Explain the appropriate action to be taken on discovering an unsatisfactory condition.

EX. 2 - ANCILLARY CONTROLS/OPERATION OF AIRCRAFT SYSTEMS

Objectives

To teach the requirements for, and the proper use, of carburettor heat, alternate air, mixture controls, cowl flaps, heating, defrosting, ventilation and any other ancillary controls applicable to the aeroplane type.

Motivation

Many ancillary controls may be new to the student; therefore, detailed training is required. Proper use of certain controls is necessary for safe and optimum use of the aeroplane. Misuse could lead to an actual in-flight emergency.

Essential Background Knowledge

Review and explain for the aeroplane being used:

- carburetted engines:
 - carburettor icing
 - intake icing
 - causes, symptoms, effects on performance
- fuel injected engines
 - intake icing
 - alternate air usage
 - causes symptoms and effects on performance
 - turbocharger precautions and fault symptoms
- mixture control:
 - during takeoff, climb, cruise, descents
 - use of fuel flow and exhaust gas temperature gauges
- cooling considerations:
 - use of cowl flaps
 - before and during one engine inoperative operation
- cabin heating and ventilation, including heater and windscreen defogging equipment.
- primary flight controls
- aileron, rudder and elevator trim
- landing gear and retraction system
- flap system
- brakes

- electrical, including alternator or generator
- hydraulics
- fuel systems
 - carburetted engines
 - fuel injected engines
 - cross-feed
 - engine priming system
- turbocharger
- propeller and constant speed governor
- de-icing/anti-icing
- pressurization
- crew and passenger oxygen
- any other systems applicable to type

Advice to Instructors

Prior to flying, spend sufficient time in the cockpit with the student to become familiar with the location and operation of the various ancillary controls.

Students learn best by doing. Let them operate the ancillary controls as much as possible. Lack of student proficiency may be the result of an instructor's tendency to operate these controls rather than allowing the student to do so. Traditionally, the practical operation of the cabin heater is poorly taught, as the heater controls are often located on the lower right-hand panel, in easy reach by the instructor. As a result, the candidate neglects heater operation as an integral part of pilot duties during flight tests, even in winter.

This may be the first time the student has encountered some of these items. Before flight, ensure that the student understands when, why and how they are used.

Instruction and Student Practice

During pre-flight briefings, question the student on the operation of the applicable' ancillary controls during various phases of the intended flight. Use the aeroplane checklist as a guide.

When satisfied that the student understands when, why, and how to operate the applicable controls, use close supervision to ensure that the tasks are completed correctly.

Ask questions to ensure that the student is not performing a function by "rote" or simply because it appears on the checklist.

EX. 3 - TAXIING

Objectives

To teach how to fly a multi-engine aeroplane safely, avoiding interference with other traffic, under varying conditions.

Motivation

All flights involve taxiing. Manoeuvring multi-engine aeroplane can be demanding due to the larger size, engine placement and heavier weight. Therefore, safe taxiing habits must be developed.

Essential Background Knowledge

Review:

- safe taxiing practices including
 - speed control
 - differential power
 - brake usage
- the use of the centreline to taxi
- use of the flight controls under strong wind conditions while taxiing
- conducting flight instrument checks during taxi
- local taxi rules, procedures and ATC instructions

Explain taxiing with one engine inoperative.

ADVICE TO INSTRUCTORS

Most light twins tend to taxi faster than single-engine aeroplanes. Consequently, the student may tend to ride the brakes.

Avoid overuse of differential power during taxiing. This quite often leads to see-saw taxiing at high speeds. Differential power should be used in crosswind conditions and for turning in confined areas.

Some aeroplanes do not have brake controls on the instructor's side. If such is the case with your training aeroplane, the student should be so informed.

Due to the height of the engines and propellers, propeller clearance may be limited. The student must exercise caution when taxiing on uneven surfaces or close to the edge of ramp areas.

Avoid doing run-up, pretake-off, and post-landing checks while the aeroplane is in motion. Otherwise, the distractions associated with such checks could lead to a taxiing accident or inadvertent selection of incorrect items such as the landing gear **“UP”** rather than flaps **“UP”**.

Instruction and Student Practice

Have the student place the flight controls properly for the existing wind conditions.

Start the aeroplane rolling and conduct a brake test. If the aeroplane is equipped with brake controls on the instructor's side, test them, too.

Allow the student to taxi the aeroplane with the object of noting similarities and differences in comparison with single engine aeroplanes.

Conduct the instrument checks in a clear area.

Demonstrate how to control the speed by first reducing the power and then applying the brakes.

When manoeuvring in the run-up area, demonstrate the use of differential power.

EX. 4 - TAKEOFF, CIRCUIT AND LANDING

Objectives

To teach how to take off, fly the circuit and land safely in a predetermined touchdown zone under existing traffic, runway and weather conditions.

Motivation

As well as having more complex systems, multi-engine aeroplanes tend to operate at higher airspeeds and heavier weights. These factors impose greater demands upon a pilot's ability to control the aeroplane and adapt quickly to changing conditions.

Essential Background Knowledge

Review existing runway conditions and requirements:

- density altitude
- crosswind limitations
- the accelerate/stop distance

Review considerations for takeoff:

- aeroplane configuration
- take-off safety briefing
- rejected takeoff
- recommended take-off speed
- engine failure below V_{MC}
- one engine inoperative climb performance
- take-off and climb profiles
- power reduction for cruise climb

Review traffic pattern:

- procedures
- speeds.

Review landing:

- approach profiles
- approach speeds
- aeroplane configuration
- overshoot procedures from various configurations

Advice to Instructors

During pre-flight planning, the student should compute the weight and balance, the one engine inoperative rate of climb and the one engine inoperative service ceiling for the existing conditions. Density altitude should be considered at this time as well. Often the density altitude of an airport is above the one engine inoperative service ceiling of the aeroplane, making a one engine inoperative climb impossible.

Accelerate/stop distances should be computed if graphs are available for the aeroplane. If no graphs are available, a general rule can be used. Normally these distances are approximately double the take-off distance.

Prior to the takeoff, the pilot should have a plan of action to be used in the event of an actual engine failure or other emergency during the takeoff and initial climb. On dual flights the student and instructor must be very clear on the actions to be taken by either pilot in the event of an actual emergency.

For students being trained for positions that involve crew concepts, the use of a crew-concept take-off briefing should be considered.

Time between take-off speed and reaching V_{YSE} should be kept as short as possible. This is a critical period for multi-engine aeroplanes. The takeoff should be rejected if an engine failure occurs during this phase of flight.

The majority of multi-engine aeroplanes will not accelerate to V_{YSE} on one engine after the takeoff. The ability to climb in this configuration, even at V_{YSE} , is drastically reduced. The 50% loss in power can result in an 80-100% loss in climb performance. For this reason, engine failures must not be simulated immediately following the takeoff. Engine failures should be demonstrated and practised only at an operationally safe altitude.

Full-stop landings are preferable to touch-and-go operations. The limited time available during a touch-and-go landing is not sufficient to complete all the actions necessary to prepare for a safe takeoff and may lead to the inadvertent selection of such items as gear "UP". Several accidents have occurred when students have been rushed during touch-and-go operations.

Due to the higher weights, airspeeds and engine power, multi-engine aeroplanes can be more difficult to control during the take-off and landing phases than single-engine aeroplanes. Therefore, ensure that the aeroplane is trimmed at all times.

When the student becomes proficient at normal operations, introduce crosswind takeoffs and landings. Performance takeoffs and landings are not required on the flight test, but students should be exposed to them at some point in the training.

Instruction and Student Practice

At the beginning of the take-off roll, ensure that the student monitors:

- engines for even response, smoothness, absence of abnormal conditions
- gauges for abnormal readings.

Consult the POH for the recommended take-off speed. In the event that the POH does not specify a speed, the takeoff should be achieved at or above V_{MC} .

After the takeoff, accelerate the aeroplane to the best rate of climb speed (V_Y) as quickly as possible, and climb at V_Y until a safe manoeuvring altitude is reached.

Landing gear should not be retracted until a positive rate of climb is attained and a gear-down landing is no longer possible on the runway. In order to prevent damage to the tires, wheel assemblies and the landing gear compartment, brakes should be applied before retraction of the landing gear.

After the landing gear is retracted the aeroplane should be accelerated to the cruise-climb speed and power can then be reduced to the cruise-climb setting.

Conduct the remaining post take-off checks when it is safe to do so.

With the higher airspeeds and more complex systems of a multi-engine aeroplane, close supervision is required to ensure the student is conforming to circuit procedures.

Conduct the pre-landing checks early on the downwind leg. The desired touchdown zone should be identified at this time to allow for proper approach planning.

Flaps may be extended on base leg or on final approach to control airspeed and descent rate to touchdown. However, flaps should be fully extended only when the possibility of an overshoot no longer exists.

Stabilize the aeroplane early on final approach. Approach speed on final should not be less than V_{YSE} until the landing is assured.

Landing within the pre-determined touchdown zone and on the centreline is critical in multi-engine aeroplanes. Overshoot if the approach is not proceeding as planned.

Balked approaches should be demonstrated and practised from various positions and configurations on the approach.

Do not retract the flaps or carry out post-landing checks until the aeroplane is clear of the runway and stopped.

EX. 5 - CRUISING FLIGHT

Objectives

To teach the student to:

- achieve specific cruise-power settings using the throttle, propeller and mixture controls for various conditions, as recommended in the Pilot Operating Handbook
- apply any additional measures recommended by the manufacturer with respect to aeroplane configuration or other considerations.

Motivation

The majority of flight time is spent in cruise flight. In order to obtain optimum performance, the pilot must know how to configure the aeroplane properly.

Essential Background Knowledge

Explain:

- cruise performance charts in the POH
- manifold pressure/RPM relationship and the correct use of related controls
- power and airspeed relationship, using the formula: “1 inch MP = approximately 5 Kts”

Advice to Instructors

Before the initial flight, ensure that the student is familiar with the relevant procedures, either through demonstration in the aeroplane, a simulator or through discussion.

The student must be able to fly and trim the aeroplane for level flight or difficulties may be experienced on future flights. A good exercise for straight and level flight is to have the student reduce manifold pressure 1 inch at a time and note the speed change and re-trim while maintaining level flight.

When teaching propeller synchronization, exaggerate the unsynchronized condition to allow the student to recognize it. Have the student practice synchronizing the propellers solely by sound.

Emphasize that after levelling off, the aeroplane must be allowed to accelerate to cruise speed prior to setting cruise power.

Emphasize the importance of monitoring all engine instruments.

Discuss cold weather operations, especially if the student is training during warmer months. Consideration should be given to propeller cycling, monitoring engine gauges and cowl flap operation. For those training during cooler periods of the year, warm weather operations must be discussed. Consideration should be given to performance at higher density altitudes.

Explain the operation of the autopilot, if the aeroplane is equipped with one. During flight, allow the student to operate the autopilot.

As this is one of the first air exercises taught, emphasize the need for a good lookout. Students and instructors must maintain a good lookout during this and subsequent air exercises.

Instruction and Student Practice

Monitor the student closely before and during the level-off. Because multi-engine aeroplanes have a higher rate-of-climb, the level-off procedure will have to be started earlier. Firm control inputs will be required at this time, as the aeroplane will accelerate to cruise speed quickly. Trimming the aeroplane during the level-off may be required.

Have the student set cruise power in accordance with the POH. These settings may be determined prior to flight or upon reaching cruise altitude.

Synchronize the propellers.

Have the student practice increasing and decreasing airspeed by making appropriate power changes. Concentrate on altitude and heading control and trim adjustment. Good airmanship must prevail to prevent shock cooling or other engine damage when reducing power settings. This is especially important with turbocharged engines and with any engine during cold weather.

Emphasize the importance of trimming the aeroplane. The use of aileron and rudder trim, in addition to elevator trim, may be new to the student. Demonstrate the use of the electric trim if the aeroplane is so equipped.

Have the student use the checklist to complete the level-off items.

EX. 6 - ENGINE FAILURE (CRUISE FLIGHT) AND MANOEUVRING WITH ONE ENGINE INOPERATIVE

Objectives

To teach the student:

- to identify the failed engine
- the procedure to be followed when an engine failure occurs in cruise flight
- to complete all necessary checks in accordance with the “Engine Failure in Flight” checklist and the Pilot Operating Handbook (POH)
- to manoeuvre the aeroplane safely and effectively with one engine inoperative

Motivation

In the proper configuration, using approved procedures, multi-engine aeroplanes are controllable after the failure of an engine. Incorrect configurations may require more power than is available from the operating engine. Incorrect procedures may lead to loss of aeroplane control.

Essential Background Knowledge

Explain related theory:

- definition of critical engine
- factors affecting V_{MC}
- one engine inoperative stall/spin characteristics

Explain aeroplane handling:

- POH/AFM procedure
- control of yaw
- roll and pitch
- bank towards live engine
- operating speeds
- critical engine
- zero-thrust power settings

Explain operational considerations:

- service ceiling
- drift-down altitude
- fuel management
- range calculations
- affected systems

- hot/cold temperatures

Outline safety considerations:

- lookout
- altitude
- proximity to the airport
- density altitude

Engine Failure (Cruise Flight)

*In the absence of a procedure in the POH/AFM, these steps should be taken. Note that **BOLDFACE** denotes memory items. With the majority of emergencies, certain procedures must be performed immediately from memory. Students should be made aware of such items during simulation on an engine failure.*

CONTROL	yaw, roll, airspeed
POWER	mixture, propellers, throttles
DRAG	confirm landing gear up, flaps up
IDENTIFY	failed engine
VERIFY	failed engine by reducing throttle of suspected failed engine
CAUSE CHECK	if time and altitude permit, attempt to assess and correct problem using appropriate checklist. Then advance throttle to determine if engine is developing power.
FEATHER	propeller on the failed engine
SECURE	complete the “Engine Failure in Flight” checklist and monitor the operating engine and its related systems

Proceed to the nearest suitable airport, taking into consideration the facilities, surface wind, elevation, obstacles and the seriousness of the emergency.

Advice to Instructors

Prior to flight it must be made clear that should an actual emergency occur, the instructor will state "I have control" and assume control of the aeroplane. Actions for the student to follow will be delegated as required.

Density altitude must be considered when working in areas with high terrain during conditions of warmer than standard temperatures.

Simulated engine failures should be conducted within 15 miles of an airport, in the event that mismanagement or errors occur during student practice. Remember, “The hand is faster than the eye.” Altitude for this exercise must be in accordance with the POH/AFM or at least 3,000 feet

above ground level. Prolonged manoeuvring with an engine at idle or zero-thrust should be avoided, especially in colder weather.

Encourage the student to do the engine failure checks only a few items at a time (once the memory items are completed) and to monitor the aeroplane between these times. This will help to overcome the natural tendency to give most attention to checks and neglect lookout and control of the aeroplane.

Pilots should be aware that relying on engine gauge indications could be misleading in trying to identify the inoperative engine. Point out that manifold pressures can remain normal during some engine failures and give the pilot the false impression that everything is all right. On the other hand, gauges can be very useful in determining partial power losses or power surges when the "dead foot, dead engine" rule is not giving a true indication. All evidence of an engine failure must be considered when the condition is not obvious.

Should the suspected cause of an engine failure be fuel contamination, the pilot must avoid the use of cross-feed.

Have the student simulate feathering the propeller by moving the propeller control lever a short distance towards the "feather" position. The instructor must block the lever to prevent an actual feathering of the propeller with a "live" engine. Avoid substituting a verbal drill for this action. The "hands-on" drill will promote the proficiency needed to select the correct lever during an actual engine failure emergency. Then, simulate a feathered condition by adjusting manifold pressure and rpm to achieve zero thrust.

Engine gauges should also be monitored for indications of impending problems at all times, such as decreasing oil pressure or increasing temperatures. In such cases, the pilot may elect to shut down the affected engine, having the advantage of doing so in a deliberate and planned manner. Engine temperatures and pressures must be monitored to avoid excessive cooling or overheating while operating on one engine.

Caution students on turning toward the inoperative engine at airspeeds below V_{SSE} or V_{XSE} and if using higher angles of bank. There may not be enough control input to level the wings for straight and level flight unless power is reduced.

Discuss situations in which an in-flight emergency engine failure/shutdown would call for an unplanned landing at a nearby airport, rather than continuing to the destination airport, which might otherwise be more suitable. An example of such a situation would be an engine fire in flight.

Instruction and Student Practice

Demonstrate the cockpit drills and the use of the emergency checklist on the ground in the aeroplane, followed by student practice. Caution must be exercised to avoid inadvertent selection of items such as landing gear "UP", while on the ground.

Once airborne, allow the student to establish cruise flight and complete the required checklist items.

Actual engine shutdowns for training purposes are not recommended, as the training value is not worth the added safety risk and abuse of engines and airframe. Simulated engine failures should be conducted within 15 miles of a suitable landing site in case an inadvertent actual engine shutdown occurs, after which the engine cannot be restarted. Schools operating out of airports at

higher elevations must also be cautious during warmer temperatures. Single-engine service ceiling and performance can be drastically affected under these conditions.

Simulate the engine failure by reducing the throttle to idle, while calling out "simulated". Complete the engine failure drill in accordance with the POH or the procedures outlined on the previous page.

When these checks have been completed, and you are ready to simulate feathering the propeller, adjust the manifold pressure and rpm to simulate by setting zero thrust. Consult the POH for zero thrust power settings prior to flight. Complete the engine securing items by referring to the appropriate emergency checklist.

Ensure that all procedures are carried out completely and correctly. Concentrate on the accuracy of the checks rather than the speed at which they are performed.

Emphasize that control of the aeroplane is the prime concern. Ensure that the aeroplane is banked 3-5 degrees towards the operating engine. Also, lookout must not be allowed to suffer, even though you and the student will be busy inside the aeroplane.

Briefly demonstrate the aeroplane's ability to manoeuvre in level flight, climbs, descents and turns of up to 30 degrees of bank.

Using the in-flight engine restart and propeller unfeathering checklists, simulate a re-start of the "inoperative" engine and resume normal cruise flight. Return control of the aeroplane to the student, allowing the student to practise the procedure in its entirety. When simulating the engine failure, obscure the selected control from the students view.

V_{MC} DEMONSTRATION

You do not have to conduct a V_{MC} demonstration during training for this rating, yet many instructors do. This can be valuable, but extreme caution must be exercised during the demonstration. Some POHs recommend a procedure for the demonstration. In the absence of a published procedure, instructors may demonstrate this using the following guidelines:

- **Passengers are not to be carried**
- Ensure that you have adequate altitude for recovery from an unusual attitude, should one develop.
- Both engines must be developing power, one at idle, the other at maximum power.
- Allow the aeroplane to decelerate slowly while maintaining directional control.
- For an extra safety measure, **use only half-rudder input**. This will allow the symptoms of V_{MC} to be experienced at a speed higher than the actual V_{MC}.
- Recover as soon as directional control cannot be maintained.
- Reduce the power on the operating engine, or reduce the pitch attitude, or both.
- **Failure to recover at the first indication of V_{MC} can lead to a spin.**

Caution:

The published V_{MC} is determined at a standard sea-level density altitude and will decrease with a gain in altitude, unless you have turbocharged piston engines. At a given *indicated* airspeed, the flight controls will have the same effectiveness, regardless of altitude. Since the operative engine is producing less power at the higher “safe” altitude, there is less asymmetric thrust, torque and yawing force for the rudder to overcome.

A less experienced instructor, who in the interest of safety climbs to a higher altitude for a V_{MC} demonstration, may find that he/she has entered a situation where V_{MC} has decreased to below the stall speed and ends up demonstrating a full-power single-engine stall and spin.

EX. 7 - MANOEUVRING AT REDUCED AIRSPEED

Objectives

To teach how to maintain safe flight control in all configurations while manoeuvring at speeds in the approach speed range.

Motivation

During take-off, approach and landing, the student will have to manoeuvre the aeroplane in an approach speed range. The ability to control the aeroplane safely throughout this speed range is critical. Approach airspeeds may be necessary for circuit spacing, during a circling approach, while overshooting, or may be encountered if the pilot is distracted.

Essential Background Knowledge

Review:

- speed to be used
- handling characteristics
- trim
- power management

Explain effects of gear and flap.

Advice to Instructors

Teach the student how to monitor the instruments while maintaining a good lookout. With the reduction in airspeed, engine cooling is reduced. Engine gauges should be monitored to avoid overheating.

Have the student retract flap in stages. The aeroplane may be difficult to control in pitch and may develop a high sink rate if flaps are moved from fully down to fully up in one action.

The candidate will be tested at the full-flap final approach speed.

Instruction and Student Practice

Have the student stabilize the aeroplane at $1.3 V_{SO}$ or $V_{MC} + 10$ knots, whichever is greater, with landing gear and flap retracted. Manoeuvre the aeroplane through climbs, descents and turns.

Return to straight and level flight while maintaining the full flap final approach speed. Select landing gear "DOWN", noting the difference in pitch attitude and power required to maintain altitude and airspeed. Manoeuvre the aeroplane through climbs, descents and turns.

Again return to straight and level flight while maintaining the selected airspeed. Now select the flap "DOWN" in stages. Again note the difference pitch attitude and power required to maintain altitude and airspeed. Manoeuvre the aeroplane through climbs, descents and turns.

Maintaining level flight, retract the landing gear and flaps and note the effect on aircraft handling. Increase the power and resume normal cruise flight.

With each configuration or power change the student should re-trim the aeroplane. As the student gains proficiency with this exercise, landing gear and flap extension and retraction should be practised during climbs, descents and turns.

EX. 8 - STALL

Objectives

To teach:

- recognition of the symptoms of an approaching stall
- recognition of power-off stalls in both the landing and cruise configurations
- positive and smooth recovery, while maintaining directional control, with a minimum loss of altitude

Motivation

The handling characteristics of the multi-engine aeroplane during the stall and on the subsequent recovery can be considerably different from those of single engine aeroplanes. Additional items such as landing gear and propeller add to the pilot's workload. Pilots must be able to recognize the approach to the stall and the stall itself, and then initiate correct recovery procedures.

Essential Background Knowledge

Review basic stall theory:

- aerodynamics
- adverse flight characteristics
- effect of power
- effect of Weight and balance
- entry, recognition and recovery

Explain:

- effects of landing gear and flap
- asymmetric power
- V_{MC} considerations

Advice to Instructors

All stalls must be entered from power-off straight and level flight with slow deceleration, in accordance with the POH/AFM. Power-on stalls are to be avoided. Using power on the entry can lead to an inadvertent spin entry, from which recovery may be difficult and result in substantial loss of altitude.

Trimming the aeroplane during the stall entry can lead to control difficulties on recovery, especially with full power application. The trim should be set for an airspeed that is not slower than V_{YSE} .

The aeroplane is to be fully stalled in the clean configuration for this exercise.

Some POHs may not list a stall recovery procedure. In such a case, stall recoveries should be in accordance with the Flight Training Manual. Following the initial stall recovery, drag can be

eliminated and the aeroplane returned to the cruise or climb configuration in the same way as described in the overshoot procedure for the aeroplane.

The sequence for landing gear and flap retraction may vary among aeroplane types; consult the POH/AFM for the correct recovery procedures.

Inadvertent spin entry is possible during practice of this exercise. If a wing drops at the point of the stall, or if one engine responds faster than the other while the speed is below V_{MC} , the aeroplane will yaw and roll and may become uncontrollable. In these situations, verify power is at idle for both engines and do not apply power again until the airspeed is above V_{MC} . Review the spin recovery procedure for the aeroplane type.

Instruction and Student Practice

Ensure that all appropriate safety checks have been completed prior to initiating this exercise.

Conduct this exercise at an operationally safe altitude that will allow for the recovery to be completed at or above the height specified by the manufacturer, or no less than 3,000 feet above ground, whichever is greater.

Demonstrate and allow the student to practice stalls in various configurations:

- landing gear retracted - flaps retracted
- landing gear extended - flaps retracted
- landing gear extended - flaps extended

Emphasize during stall training:

- prevention
- recognition
- effective recovery with a minimum loss of altitude
- maintaining directional control

AVOID SLAMMING THE THROTTLES, advance throttles smoothly to ensure that both engines respond evenly.

EX. 9 - STEEP TURN

Objectives

To teach how to complete a steep turn in a heavier aeroplane:

Motivation

Controlling a heavier aeroplane and maintaining altitude and airspeed during a steep turn can be more difficult and require considerably heavier control forces. Additionally, a student must be prepared to control the aeroplane should an engine failure occur during a turn.

Essential Background Knowledge

Explain:

- Required pitch attitude
- Required additional power
- Rolling tendencies and ambiguities, depending on which engine fails during a turn

Advice to Instructors

This exercise emphasizes handling an aeroplane during a steep turn. It is important that the student be able to perform an accurate steep turn before expecting proficiency in handling the one engine inoperative condition, should it occur during a turn.

This exercise should be practised at various speeds throughout the normal cruise speed range of the aeroplane.

Simulate engine failures by reducing the power to idle while calling out "simulated". When the student is practising, obscure the throttles from view until they correctly establish which engine has failed.

Instruction and Student Practice

Ensure that the appropriate safety checks are completed prior to conducting this exercise.

Demonstrate a 45-degree bank steep turn and have your student practise to get the feel of the control forces required. After the student achieves a degree of proficiency with steep turns, simulate a failure of the engine on the high side of the turn. Point out that the aeroplane will have a tendency to roll level. Roll the aeroplane level and conduct the engine failure drill in accordance with *Exercise #6, Engine Failure (Cruise Flight)*. Restore the "failed" engine power and resume cruise flight. Allow for student practice.

Enter another steep turn and then fail the engine on the low side of the turn. Point out that the aeroplane may tend to roll into the turn. Considerable control input will be required to roll the aeroplane level. Roll the aeroplane level and conduct the engine failure drill in accordance with *Exercise #6, Engine Failure (Cruise Flight)*. Restore the "failed" engine power and resume cruise flight. Clarify student concerns. Return control of the aeroplane to the student. Have the student practise the exercise.

Encourage the student to do the engine failure checks only a few items at a time (once the memory items are completed) and to monitor the aeroplane performance between these items.

This will help overcome the natural tendency to give most attention to checks and neglect lookout and control of the aeroplane. Practise as required, using various airspeeds on subsequent flights.

EX 10 - ENGINE FAILURE DURING TAKEOFF OR OVERSHOOT

Objectives

To teach the student to:

- maintain safe flight control following an engine failure during a takeoff or overshoot
- perform the correct emergency procedures
- attain the appropriate airspeeds and, if the aeroplane is capable, continue to climb

Motivation

The takeoff and overshoot are two of the most critical phases of flight. Failure of an engine at these times requires prompt, correct responses by the pilot to maintain safe control of the aeroplane.

Essential Background Knowledge

Review Essential Background Knowledge from *Exercise #6, Engine Failure (Cruise Flight)*, as required.

- Because this scenario, in real life, would happen close to the ground, there is a greater urgency and less room for error than for “Engine Failure in Flight”.
- A prompt and correct sequence of actions is required to prevent misidentification of the failed engine.
- Impress upon the student that the sequence of actions must be in accordance with the “Engine Failure on Takeoff/Lift-off” checklist.

Review one-engine inoperative performance charts.

Explain that the loss of an engine can result in a loss of 80% or more of the aeroplane's climb performance.

Explain the further decrease in performance caused by

- flaps
- landing gear
- windmilling propeller
- cowl flaps
- less than 3 to 5 degrees bank

Explain the recommended procedure from the POH/AFM to follow in the event of an engine failure. In the absence of a procedure in the POH/AFM, see the procedure on the next page.

Advice to Instructors

Compare the power-to-weight ratio of a single-engine aeroplane the student has flown to the power-to-weight ratio for the multi-engine aeroplane to be used in training. The ratio when one engine is inoperative will illustrate interesting differences.

Practice of this exercise should be done only at an operationally safe altitude and in accordance with the POH/AFM. Consideration should be given to density altitude when practising in warm temperatures or at high altitudes. Prior to simulating an engine failure during an overshoot students must be competent doing overshoots with both engines operating. It is not recommended to simulate engine failures below 500 feet AGL. Practise this exercise on actual approaches to landing only when the student is competent at handling the emergency at altitude.

The initial demonstration and subsequent student practice should be at a pace that allows for completion of all items successfully. Once habit patterns have been developed, the pace can be increased.

Emphasize that following an engine failure during an overshoot one should normally complete a circuit and land. Determining the cause of the engine failure is best dealt with on the ground. Cause checks should be done only if the pilot must proceed to an alternate airport.

The student must complete the "memory items" immediately following the engine failure while maintaining control of the aeroplane. Ensure that the student maintains airspeed and directional control. After attaining a safe altitude, a review of the correct emergency checklist should be undertaken and followed up with the "Single-Engine Approach and Landing" checklist or the "Clean-up/Shutdown" checklist, depending on the closeness to the nearest appropriate airport.

Instruction and Student Practice

Engine Failure During an Overshoot

*In the absence of a procedure in the POH, these steps should be taken. Note that **BOLDFACE** denotes memory items.*

CONTROL	yaw, roll, airspeed
POWER	mixtures rich, propellers FULL increase, throttles FULL power
DRAG	check landing gear up, flaps up
IDENTIFY	failed engine
VERIFY	failed engine by reducing throttle of suspected failed engine
FEATHER	the propeller on the failed engine
SECURE	complete checklist when time and altitude permit
LAND	if an airport is not suitable, then proceed to the nearest suitable airport

Cause and clean-up checks would be completed if proceeding to another airport.

In an area away from the airport, and at an operationally safe altitude have the student complete the pre-landing checklist and establish the aircraft in a descent, at the full flap final approach airspeed, in the landing configuration.

Assume control of the aeroplane. Commence an overshoot at a pre-determined altitude. Retract the landing gear and flaps in accordance with the POH. While maintaining the recommended climb speed, note the indicated rate of climb, then simulate an engine failure by reducing the power on one engine to idle. Complete the memory items from the emergency checklist. Just prior to simulating propeller feathering, point out the decrease in rate of climb. Then simulate feathering by setting zero thrust. Again point out the rate of climb, which should have increased slightly.

Using the engine restart in-flight checklist, restore the engine and allow the student to practise as demonstrated.

Next, demonstrate by failing the engine prior to retracting the landing gear and flap. Allow for student practice.

EX. 11A – INTENTIONAL ENGINE SHUTDOWN (SIMULATED)

Objectives

To teach the student to:

- respond appropriately to various scenarios that would require an emergency or precautionary engine shutdown
- respond with good pilot decision-making in light of the situation and distance to a suitable airport
- carry out the appropriate emergency procedure to simulate an engine shutdown.

Motivation

Should an engine malfunction occur during a flight, the pilot must respond appropriately to either prevent a catastrophic failure or to take precautionary actions to prevent a cascading of failures that may result in a fire.

EX. 11B - ONE ENGINE INOPERATIVE ARRIVAL, APPROACH AND LANDING

Objectives

To teach the student to:

- fly a circuit and approach with one engine inoperative
- land in a predetermined touchdown zone

Motivation

Should an engine fail, a pilot must be able to fly an arrival procedure and plan a precise approach to a successful landing. Failure to do so could result in an overshoot on one engine. Under certain loading, weather, terrain and aeroplane conditions, an overshoot with one engine inoperative may be difficult or impossible.

Essential Background Knowledge

Review:

- one engine inoperative procedures
- aeroplane performance
- circuit and approach procedures

Explain:

- use and effect of power, flaps and landing gear on the approach
- one engine inoperative overshoot
- declaring an emergency

Advice to Instructors

Ensure that the student is proficient in normal landings and one engine inoperative procedures before introducing this exercise.

One engine inoperative procedures should be simulated using zero-thrust power settings so that, should you have to initiate an overshoot, both engines will be available.

DO NOT practise ACTUAL one engine inoperative circuits, approaches and landings. Do not simulate the failure of an engine on the approach at less than 500 feet AGL, or at an airspeed less than the one engine inoperative best rate-of-climb airspeed (V_{YSE}).

Emphasize planning and anticipation, considering the following:

- effect of wind on the circuit
- emergency landing gear extension
- the point at which a one engine overshoot is not possible

If an engine failure occurs while an aeroplane is in the circuit, emphasize that the pilot should not attempt to restart the engine in the traffic pattern. Feather the propeller and prepare for a one-engine-inoperative landing.

Landing gear should not be extended until you are in a position to commence the final descent for landing. Full flaps should not be extended until landing is assured.

The one-engine-inoperative final approach should be as close as possible to a normal approach. A high-speed/low-power approach (diving) should be avoided. It could result in a long touchdown or porpoising. An approach with low airspeed, high drag and high power (dragging in) must also be avoided. Such an approach may place the aeroplane in a marginal control situation from which you may not be able to recover.

The initial demonstration of the one-engine-inoperative landing is best done on return from the training area. This allows you to configure the aeroplane before entering the circuit, gives you the time to conduct a more effective demonstration and also better simulates a real one-engine situation.

When an engine actually fails during the final descent segment of a normal landing, the standard engine failure procedure will be modified somewhat. If you are able to maintain the descent profile to the runway, gear and/or flaps may be left down. Once the failed engine has been **verified**, the propeller should be **feathered** - a cause check should not normally be completed. If it is necessary to retract the landing gear, caution your student of the possibility of forgetting to extend the landing gear again.

Instruction and Student Practice

Well clear of the traffic pattern, simulate one engine inoperative flight by setting zero thrust.

Advise Air Traffic Control, or traffic in the area, that you are practising a simulated one-engine-inoperative landing.

Join the circuit pattern. Once established on the downwind leg, the instructor should assume control of the aeroplane.

Fly the approach in accordance with the procedures outlined in the POH. Maintain the recommended airspeed until the landing is assured. If the POH does not recommend an airspeed, V_{YSE} is the minimum speed that should be maintained on the approach. Point out to the student that the approach path is the same or only slightly higher than a normal approach. After touchdown, it is far better to stop on the runway or taxi back to the threshold to complete preparations for takeoff.

Allow for student practice on the return from future training flights.

EX. 12 – EMERGENCY PROCEDURES/MALFUNCTIONS

Objectives

To teach:

- recognition of an emergency condition or system malfunction
- how to complete all procedures in accordance with the POH

Motivation

When an abnormal or unsafe condition is detected, a pilot must correctly assess the situation, then carry out the proper procedure to resolve the problem. Alternative action must also be considered if the pilot is not able to fully resolve a system malfunction. The alternative may be to divert to an airport nearby, while coping with limited aeroplane systems.

Essential Background Knowledge

Review decision making concepts and handling emergencies.

Explain, for the aeroplane being used, the procedures for:

- engine fire on the ground
- engine failure during take-off
- engine fire in-flight
- propeller feathering
- engine shut-down
- restart and propeller unfeathering
- one engine inoperative overshoot
- landing gear emergency extension
- gear-up landing
- flaps:
 - emergency extension
 - split flap condition
- emergency exits
- fuel cross-feed during single-engine operations
- electrical system malfunction
- electrical smoke or fire
- unlatched door in-flight
- maximum glide with both engines inoperative
- inadvertent spin entry and recovery

- propeller overspeed
- runaway electric elevator trim
- cabin fire
- pressurization loss (as applicable to the aeroplane type)
- other systems failures applicable to the aeroplane type.

Advice to Instructors

Ensure that the student is familiar with normal procedures and is handling the aeroplane well, before introducing emergencies and system failures.

It is important that the student be familiar with the POH format, including the location of all emergency checklists, systems and emergency procedures. Instructors must ensure that the student learns all memory items. The aeroplane should be equipped with a handy Emergency Procedures checklist or Quick Reference Handbook (QRH) that is readily available, in addition to the Normal Procedures checklist.

Emergency procedures can be introduced early and progressively during the training and not left to the later stages of training. Situations involving landing gear, flap, electrical or fuel problems can be given during the initial training stages.

For “Time Critical Emergencies”, the student will need to know the sequence of actions verbatim. Time permitting, after completing the check sequence from memory, using the checklist to confirm everything that needed to be done was done is recommended, but the initial actions should be from memory. If the emergency is critical (fire, engine failure), one really shouldn't be pulling out a checklist until the problem is dealt with. Long checklists take time to do, and the more useless items on there; the more likely one will miss an important item. Additionally, it takes away from things like looking outside, scanning instruments (IFR), flying the airplane... etc; remember – Aviate, Navigate, Communicate. All of which are more important than checking some pointless item that hasn't, and shouldn't have moved the entire flight.

Engine failures on departure or during an overshoot should only be simulated at altitude. Simulated engine failures should not be initiated below 2000 feet AGL. It is good advice to avoid setting yourself up for a “cushion-sucking” surprise when a trainee with minimal experience makes a potentially catastrophic error. Remember, “The hand is quicker than the eye.”

Actual engine shutdowns for training purposes are no longer recommended, as the training value is not worth the increased safety risk and abuse of engines and airframe. Simulated engine failures should be conducted within 15 miles of a suitable landing site in case an inadvertent actual engine shut-down occurs after which the engine cannot be restarted. Schools operating out of airports at higher elevations must also be cautious during warmer temperatures. Single-engine service ceiling and performance can be drastically affected under these conditions.

Simulate rejected takeoffs from slower speeds by using scenarios such as a vehicle on the runway or low oil pressure. Always consider runway length, width and surface condition prior to doing this exercise. Avoid teaching rejected takeoffs by reducing the power to idle on one engine. This can lead to serious directional control problems.

Ensure that all emergency and system failure procedures applicable to the aeroplane used for the training have been covered by completion of the training. The examiner will test any three of those procedures during the flight test for the rating.

Instruction and Student Practice

All emergency and systems-failure procedures applicable to the aeroplane type are to be taught in accordance with the POH/AFM.

Have the student read the POH/AFM and other texts on multi-engine flight and view videos if available. Discuss emergencies with the student, using scenarios to help visualize what can happen. With the student in the aeroplane, go through the procedures, calling each item out loud and touching or moving the various controls.

Question the student to ensure that the critical memory items are learned. The student must know where to locate all other emergency checklist items.

Teach emergency procedures by presenting scenarios. This will assist students in analyzing problems and will better prepare them for actual situations. Always promote the development of sound decision-making skills.

Be careful not to overload the student with emergencies. Keep the scenarios reasonable and realistic. Avoid multiple emergencies, the student will become frustrated and little knowledge or skill will be gained. In the later stages of training, multiple related emergencies that cascade from the initial failure might be introduced.

PRE-FLIGHT-TEST EVALUATION

Before recommending your students for the flight test, you should complete a pre-flight-test evaluation. This should take the form of a simulated flight test, conducted by the instructor who did most of the training.

Why

There are three reasons for conducting the pre-flight-test evaluation:

- Familiarize the student with the format of the flight test.
- Enhance student confidence for the real flight test.
- Satisfy the instructor that the student is ready for the flight test.

When

Keep in mind that this flight is not the only evaluation you do of your student's performance. Every flight should involve evaluation of your student's performance in some way. When your student demonstrates the ability to perform to flight test standards on a particular exercise, you should make note of the fact on the Pilot Training Record in the column titled "Meets Test Standards". Keeping a running record of exercise-by-exercise performance will help you decide when the time is right to schedule the pre-flight-test evaluation. Schedule the flight only when your student has given you reason to believe that all exercises can be done successfully. Choosing the right time will give you an accurate picture of how your student will perform on the flight test. Also, your student will gain confidence by meeting all test standards during a "sample" flight test.

Avoid doing the test too early or too late. Attempting the pre-flight-test evaluation too soon risks turning the flight into a discouraging experience for the student because of poor performance. It may also require that you conduct a second pre-flight-test evaluation later, when the student is really ready. Leaving the flight too late simply adds training time and cost for the student and may lower his/her confidence level. Comparing your student's performance on all training flights with the standards specified in the flight test guide will tell you when the student is performing according to the standards. That is the time to schedule the pre-flight-test evaluation.

How

There is no secret about how the actual flight test is conducted. Talk to other instructors, examiners, or a Transport Canada inspector. Review the Flight Test Guide - Multi-Engine Class Rating. Your flight training unit should have copies of this guide. If none is available, call the Flight Training Standards Section of your nearest Transport Canada Regional Office or visit the Transport Canada website at <http://www.tc.gc.ca/eng/civilaviation/standards/general-flttrain-planes-menu-486.htm>

The "*Description*" section will describe how the examiner should test the exercise during the actual flight test. The "*Performance Criteria*" section will tell you how well the student must perform to receive a "pass" assessment.

Plan the pre-flight-test evaluation to parallel as closely as possible what the student can expect during the actual flight test. Think of some oral questions to assess performance on the five parts

of exercise 1. You may also be able to assess some parts of other exercises using oral questions. You should also plan the order in which the in-flight exercises will be tested. There is no hard and fast rule about the order, except that you should try to arrange the exercises so that a minimum amount of time is required without rushing the candidate.

The “ground flight test items” must be evaluated before the airborne portion. Most examiners begin the airborne portion of the flight test with a normal circuit. Next, depart the circuit and climb to an altitude and location suitable for the other exercises. Normally, the first exercise assessed is cruising flight, followed by an engine failure in cruise flight and some manoeuvring with one engine inoperative. Other exercises requiring altitude are then completed, including the “intentional engine shutdown” (simulated) exercise after which the flight returns to the airport for a simulated one engine inoperative arrival, approach and landing. System failures and emergency procedures are usually tested at various points during the flight or on the ground with or without engines shut down, as appropriate and safe, depending on the particular emergency being evaluated.

Resist the temptation to teach your student during the pre-flight-test evaluation. Remember, the purpose is to give your student an accurate preview of the actual flight test. Examiners do not teach during the test, nor should you during this simulated flight test.

During the pre-flight-test evaluation, give specific instructions to the student. If you expect the student to maintain altitude, give an instruction like "maintain 5,000 feet". If the grading criterion for an exercise includes maintaining airspeed, heading and altitude make sure you specify the airspeed, heading and altitude that you expect the student to maintain. In this way, there won't be any confusion and your student is more likely to do what you are expecting.

RECOMMENDING YOUR STUDENT

Once the pre-flight-test evaluation has been successfully completed, ensure that your student has all of the required documentation to be admitted to the flight test. Review the requirements to be admitted to a flight test. They are listed in the flight test guide. Check your student's licence and medical certification, including any temporary endorsements written on the back, to make sure that nothing has expired. Make sure the application form is correctly completed, including signatures by both you and the student. Be sure to include the letter of recommendation. A sample letter of recommendation is included at the end of the flight test guide. A FTU can formulate an equivalent letter on stationery with their company letterhead

NOTE: The certification that the candidate has received training for and has conducted actual inflight engine shutdown, propeller feathering, engine restart and unfeathering procedures is no longer required for admission to the flight test. This practice is no longer condoned by Transport Canada and is not recommended. Proficiency can best be achieved in a suitably equipped simulator or flight training device.

After the time and effort put into their training, your students deserve to get off to a good start on their flight test. Arriving without all the required documentation means that the test will be delayed at best (resulting in increased stress for the student) or cancelled all together. In either case, inadequate documentation reflects unprofessionally on you as an instructor. Having everything in order gives your student a more confident feeling for the test and reflects on your professionalism as an instructor.