TRANSITION TO TWINS

Your First Multi-Engine Rating

DAVID ROBSON

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A Focus Series Book
Aviation Supplies & Academics, Inc.
Newcastle, Washington

Transition to Twins: Your First Multi-Engine Rating
by David P. Robson

First published 1998 in Australia as *The Multi-Engine Piston* by the Aviation Theory Centre Pty Ltd.

First ASA Edition 2000.

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Published 2000 by Aviation Supplies & Academics, Inc.
eBook edition published 2021

ISBN 978-1-64425-113-3
ASA-TWINS-PD

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Preface

This book was written and first published to satisfy the needs of Australian and British pilots who were about to undergo their first endorsement (rating) on a multi-engine piston aircraft. It follows the sequence and meets the requirements of the licensing authorities and training organizations in those countries.

By popular demand, it has now been published in the U.S. and has been adapted for the U.S. operating environment. The principles do not change. However, the procedures and techniques advocated by the FAA may differ slightly. You should discuss these aspects with your flight instructor.

We recognized the need for more diverse study material that provides practical advice to newcomers to flying—whether on a professional or recreational basis. There is a wealth of knowledge that has been learned from the *school of hard knocks* that is not being widely disseminated. It relies on word of mouth. Some pilots have been lucky enough to rub shoulders with an old hand who had the wealth of experience and the desire to pass on the wisdom of years of learning. In our own way, we are trying to broaden the distribution of such wisdom. In doing so, we are very conscious that not all advice is black-and-white and that there are widely differing views on many topics. Aviation is still an art rather than a science. For this reason we are also vulnerable to criticism for synthesizing and interpreting many differing viewpoints.

We hope that the information contained in this manual is taken in the spirit in which it is given—as advice with which we take every care but for which the responsibility ultimately lies with the reader. We hope it will promote discussion and thought. Use it wisely.

David Robson

Author

David Robson is a career aviator having been nurtured on balsa wood, dope (the legal kind) and tissue paper. He made his first solo flight in a De Havilland Chipmunk shortly after his seventeenth birthday. He made his first parachute jump at the age of sixteen. His first job was as a junior draftsman (they weren't persons in those days) at the Commonwealth Aircraft Corporation in Melbourne, Australia. At the same time, he continued flying lessons with the Royal Victorian Aero Club. He joined the Royal Australian Air Force (RAAF) in 1965 and served for twenty-one years as a fighter pilot and test pilot. He flew over 1,000 hours on Mirages and 500 on Sabres (F-86 with a Rolls-Royce engine). He completed the Empire Test Pilot's course at Boscombe Down in England in 1972, flying everything from gliders, to the magnificent Hunter, Canberra and Lightning. He completed a tour in Vietnam with the United States Air Force, as a Forward Air Controller, flying the O 2A—*Oscar Deuce*. He was a member of the seven-aircraft formation aerobatic team, the *Deltas*, which flew his favorite aircraft, the Mirage fighter. This team was specially formed to celebrate the fiftieth anniversary of the RAAF.

After retiring from the Air Force, he became a civilian instructor and lecturer. During 1986–88 he was the editor of the *Aviation Safety Digest* which won the Flight Safety Foundation's international award. He spent over ten years at the Australian Aviation College as the Chief Instructor, Director of Pilot Training and Manager, Business Development. The college had 35 airplanes and trained over 1,000 cadet pilots for the world's leading airlines. In 1998, he was awarded the Australian Aviation Safety Foundation's Certificate of Air Safety. He loves airplanes, aerobatics and instructing—and he still dreams of, one day, flying a Spitfire.

Introduction

The title of this book encompasses a wide variety of aircraft. A multi-engine aircraft comes in many guises and many sizes. The main purpose of this book is to provide information and advice to pilots undergoing their first Multi-Engine Rating. It is less likely that this would be conducted in a three or four engine aircraft and engine failure in these or in a centerline thrust twin is less critical in terms of control or performance than a light twin. Our focus then is a conventional twin with wing-mounted engines and tractor propellers.

Why fly a twin-engine aircraft? There are basically two reasons to seek a multi-engine rating on your pilot's licence:

- you want the added performance and safety margins that are potentially offered by a multi-engine aircraft; or
- you are progressing up the rungs of the pilots' career ladder and the next stage of qualification and employment is the multi.

A twin-engine aircraft is the next stage of performance and complexity although many complex singles can offer equivalence. The real advantages of the twin are complete duplication, and therefore redundancy, of all systems—including the *spare* engine and propeller—in addition to the added performance over a similar technology single.

But it comes at a potential price—the consequences of an engine failure are less clear-cut and may be more difficult to handle than the single. This is not a major problem if the pilot is properly trained and maintains currency in practicing for these circumstances.

Why have two engines—or are two better than one?

Two heads are better than one—but does this apply to engines? Statistically, you have a greater probability of a failure with a more complex aircraft but in practical terms, the consequences of that failure won't be as serious—if the pilot is properly trained and current. This is a significant proviso and is probably the major reason that licensing authorities don't demand that all aircraft have two or more engines. Modern engines are very reliable and the chances of surviving a forced landing are reasonable. The chances of an non-current pilot coping with an engine failure on takeoff in a twin are not so good. Similarly, many accidents occur on the final approach with one engine feathered—a situation that should be relatively under control. If you are properly trained and current, the procedures are not difficult. That's why you are here.

So, two are better than one, provided that the pilot is properly prepared and above all, never places the aircraft in a situation where the second engine cannot be used to get out of trouble. Otherwise there is no point having the second engine. This requires a depth of preflight planning that is well above that required for a single.

There are two aspects relating to engine failure:

- control; and
- performance.

The design category for light twins does not guarantee positive climb performance in all circumstances following engine failure. The *Queen of the Skies* is likely to become a *Drag Queen*.

Nevertheless, controllability comes first and this book highlights all of the factors that affect control following engine failure. It is significant that although twins suffer less accidents than singles, the twin accident is more serious.

The knowledge contained in this book is particularly important as it forms the basis for understanding the principles of multi-engine flying that apply to all subsequent types that you may fly. Having said that, there may be specific items not covered in this book or explained for a generic twin-engined aircraft, that are not applicable to your aircraft. Treat the contents of this book as advice and please follow the directives and instructions of your instructor and Flight Manual.

This manual will give you an understanding of the principles and practice of operating a twin. It is structured in two parts:

- Part One—general principles and procedures.
- Part Two—a suggested program for the multi-engine rating.

Please study this material and discuss it actively with your instructor until you are comfortable in the knowledge that you understand all aspects.

Flying a twin demands a professional attitude. You can fly a small single in a casual way and get away with it. Not so the twin. If you are not going to be able to keep abreast of the regulations and procedures and remain current on the aircraft, I would have second thoughts about converting to a twin.

There is much talk about human factors these days and they are not only applicable to the operation of heavy jets with two crew. The personal qualities of the pilot are just as important in the light, single pilot twin. Your instructor will have introduced the concept of *airmanship. Care in the air* is what it is all about and it will keep you and your passengers, alive. It includes also the quality of your decision-making. More about this later.

Welcome to the world of multi-engines, the next step on the ladder of professional pilotage.

Happy landings or, more importantly, happy takeoffs.

Chapter 1

Introducing the Twin and its Systems

Introduction

Where Are You Coming From?

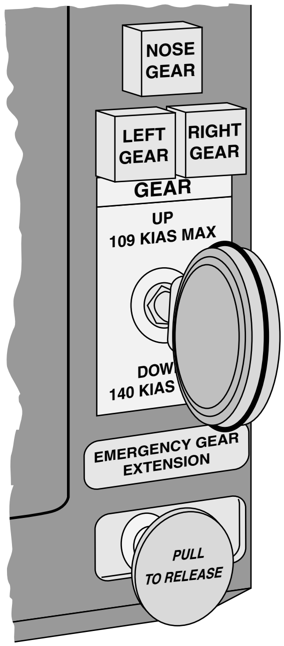
The step up to a twin involves a significant change in complexity from the small single-engine aircraft in which you trained. Probably the best way to approach the twin is to firstly become familiar with the *complex* single, which has many systems in common with a typical twin. Then we will separately tackle the multi-engine aspects. Let's start with a brief look at the features of a typical complex single. The most noticeable features will be:

- retractable landing gear;
- electrically operated flaps;
- perhaps electrically operated elevator trim;
- rudder trim in addition to elevator trim;
- constant-speed propeller; and
- turbocharger on the engine.

It could also have the following:

- IFR instrumentation, including an autopilot and, perhaps, weather radar;
- separate entrance for the passengers;
- air conditioning and, perhaps, pressurization;
- oxygen system; or
- several baggage compartments and a more complex loading system.

The principle of operation of these systems is well and truly described in the ASA-PM-2 and -3, *Ground School* and *Instrument Flying* manuals, so let's concentrate on the practical implications and functioning of these systems.



■ **Landing gear selector and lights**

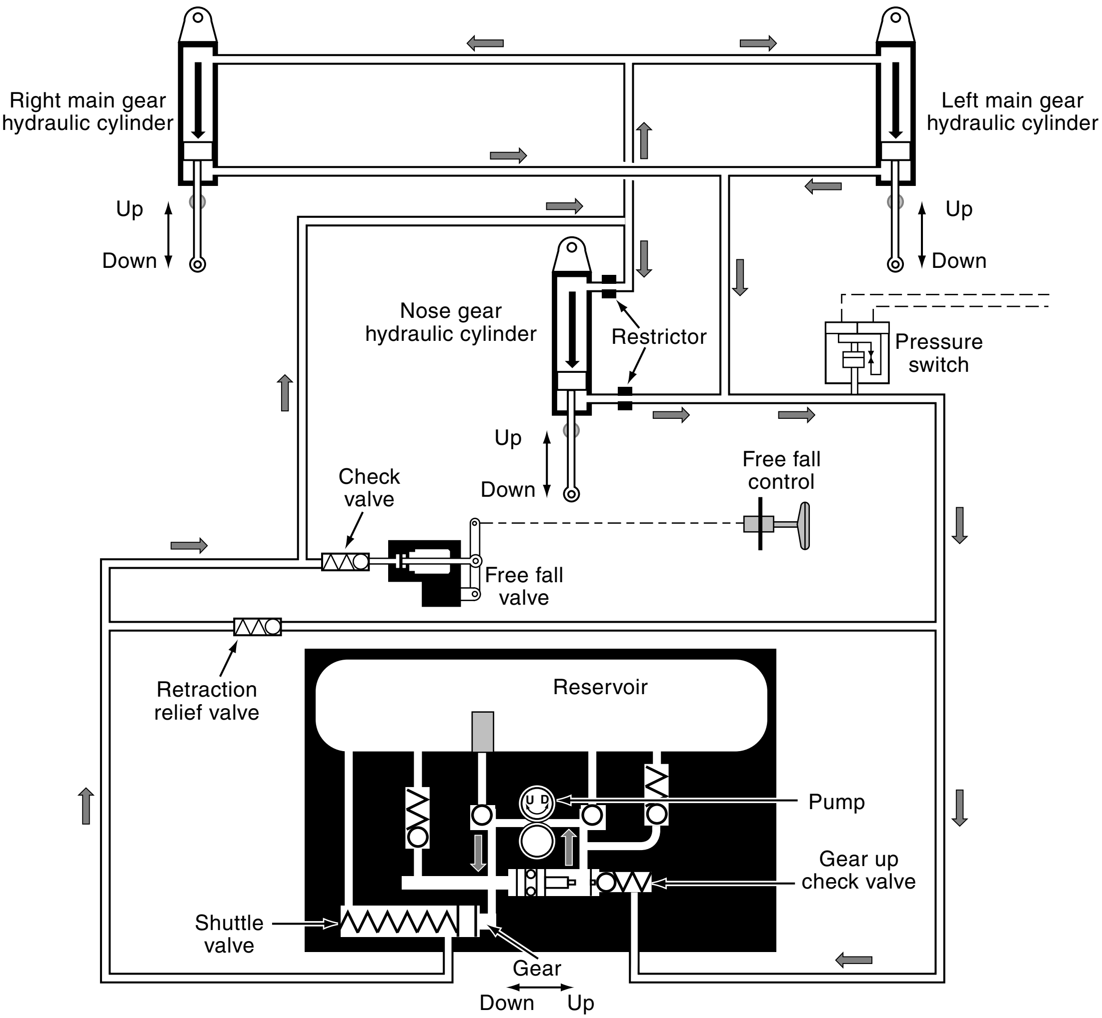
Complex Systems

Retractable Landing Gear

The landing gear will be electrically selected. The normal extension and retraction will either be direct by an electric motor or indirect by an electrically driven hydraulic pump. There is little difference between them as far as the pilot is concerned. The hydraulic gear tends to be faster operating.

There will be limiting speeds for operation of the gear (V_{LO}) and for flight with it extended (V_{LE}).There may even be one maximum speed for selecting the gear down and another maximum speed after takeoff by which the landing gear must be up. The Pilot's Operating Handbook will explain the particular limits for your aircraft.

The lights show green when the gear is down and locked, red when the gear is in transit, and go out when the wheels are up and locked. The gear will have a micro-switch on one leg, known as the *squat switch*, to prevent up selection when there is weight on the wheels. There will be a warning horn that operates when the throttles are retarded at low airspeed and the gear is up. It may also depend on flap position.



■ **Typical hydraulic retractable landing gear system**

There will be an emergency extension facility—either:

- a pressure dump and gravity drop of the gear (free fall);
- a manual handle to pump the gear down hydraulically; or
- a crank handle which will manually wind the gear down.

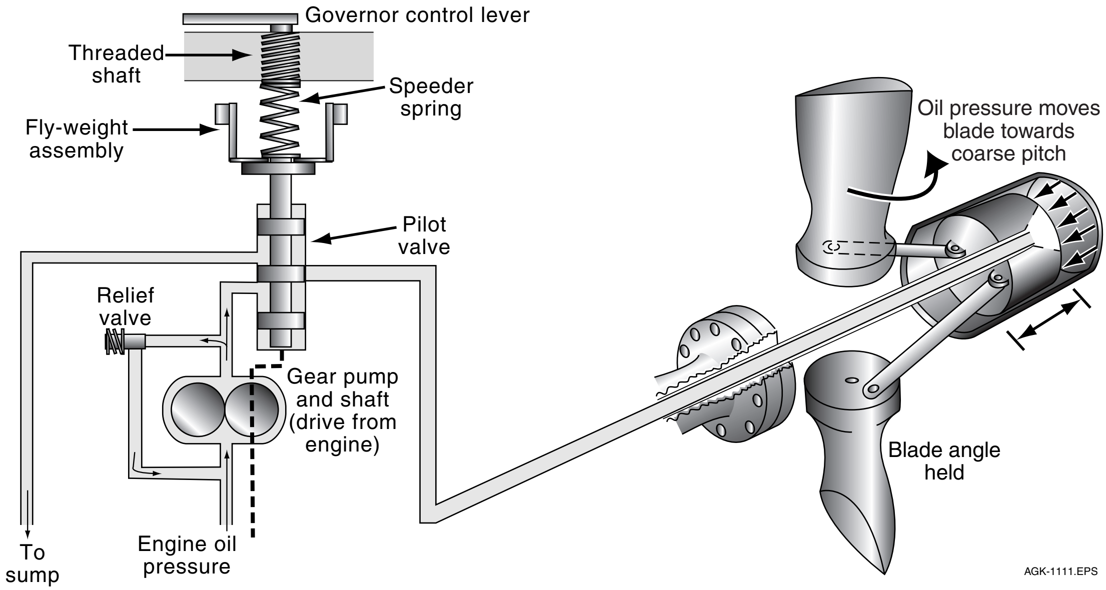
The manual crank may take 50–60 turns and may be difficult to operate while flying. Practice occasionally in VFR conditions.

With manual extension there may be no lights to indicate the landing gear is down and locked—but generally you can feel them extend and lock. (There may be a mirror on the side of the engine nacelle of the twin to visually check the extension of the nosewheel.)

Constant-Speed Propeller

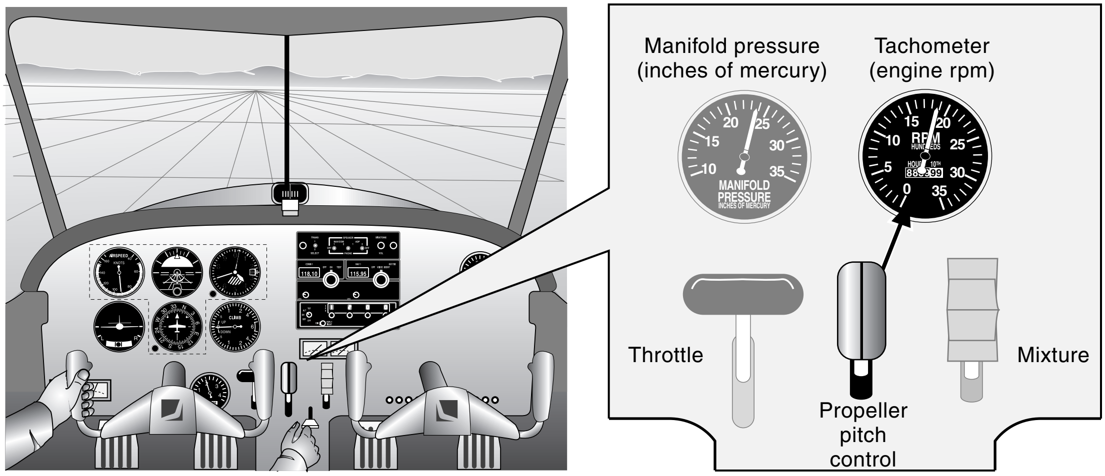
The constant-speed propeller offers a much higher level of efficiency and, with it, some complication in its operation. Oil pressure is used to drive the blade angle, and a governor mechanism then controls the angle to maintain the selected RPM. Loss of oil pressure causes the blades to go to the full fine position. In addition to the RPM indicator, the pilot has a manifold pressure gauge (MP) with units of inches of mercury. Power is set by a combination of MP and RPM. The throttles control MP and the propeller levers, RPM. Typical settings are 25 in./2,500 RPM for climb and 23 in./2,300 RPM for cruise.

To avoid stress on the engine, MP should be less than RPM ÷ 100.



■ **Constant speed propeller unit**

The levers have to be selected in a certain order (prop up before throttle and throttle back before RPM reduction—*revs up and throttle back*) to avoid the risk of detonation.



■ **Propeller rpm selector from cockpit**

Electric Flaps

Flaps could be manually or electrically operated by a simple switch with detents for *up*, *takeoff* and *land* positions. There is a sensor on the flaps to stop the electric motor when the flaps reach the selected setting (*select and forget*). There is a position indicator to show the actual position of the flaps. They are mechanically connected to prevent asymmetric positions. It is very valuable to be able to reach and select the various flap positions without having to look inside for the switch or to read the position indicator—except for confirmation. A little time spent in the cockpit rehearsing all checks is worthwhile. (Chuck Yeager learned his checks until he could do them blindfolded.)

Electric Trim

For the electric trim system, the usual cable-operated elevator trim has an electric motor to position both the trim tab and the trim wheel. (It is quite remarkable to watch the trim wheel in a Boeing aircraft spinning under the influence of the electric trim!) The trim switch will be on the control yoke to be operated by the thumb and it works in a conventional sense—forward for nose down trim and vice versa. The switch is spring-loaded to the central *off* position. The regulations require that the trim can be manually overridden or disconnected but be careful. In some aircraft, the out-of-trim forces can be so high as to interfere with safe operation of the aircraft—especially on takeoff when you need one hand to operate other controls.