

Chapter 5

Rotorcraft Flight Manual

Introduction

Title 14 of the Code of Federal Regulations (14 CFR) part 91 requires pilot compliance with the operating limitations specified in approved rotorcraft flight manuals, markings, and placards. Originally, flight manuals were often characterized by a lack of essential information and followed whatever format and content the manufacturer deemed appropriate. This changed with the acceptance of the General Aviation Manufacturers Association (GAMA) specification for a Pilot's Operating Handbook, which established a standardized format for all general aviation airplane and rotorcraft flight manuals. The term "Pilot's Operating Handbook (POH)" is often used in place of "Rotorcraft Flight Manual (RFM)."



Bell 206L
ROTORCRAFT
FLIGHT MANUAL

ROBINSON R22
ROTORCRAFT
FLIGHT
MANUAL

However, if “Pilot’s Operating Handbook” is used as the main title instead of “Rotorcraft Flight Manual,” a statement must be included on the title page indicating that the document is the Federal Aviation Administration (FAA) approved Rotorcraft Flight Manual (RFM). [Figure 5-1]

Not including the preliminary pages, an FAA-approved RFM may contain as many as ten sections. These sections are: General Information; Operating Limitations; Emergency Procedures; Normal Procedures; Performance; Weight and Balance; Aircraft and Systems Description; Handling, Servicing, and Maintenance Supplements; and Safety and Operational Tips. Manufacturers have the option of including a tenth section on safety and operational tips and an alphabetical index at the end of the handbook.

Preliminary Pages

While RFMs may appear similar for the same make and model of aircraft, each flight manual is unique since it contains specific information about a particular aircraft, such as the equipment installed, and weight and balance information. Therefore, manufacturers are required to include the serial number and registration on the title page to identify the aircraft to which the flight manual belongs. If a flight manual does not indicate a specific aircraft registration and serial number, it is limited to general study purposes only.

Most manufacturers include a table of contents, which identifies the order of the entire manual by section number and title. In addition, some helicopters may include a log of changes or a revision page to track changes to the manual. Usually, each section also contains its own table of contents. Page numbers reflect the section being read, 1-1, 2-1, 3-1, and so on. If the flight manual is published in looseleaf form, each section is usually marked with a divider tab indicating the section number or title, or both. The emergency procedures section may have a red tab for quick identification and reference.

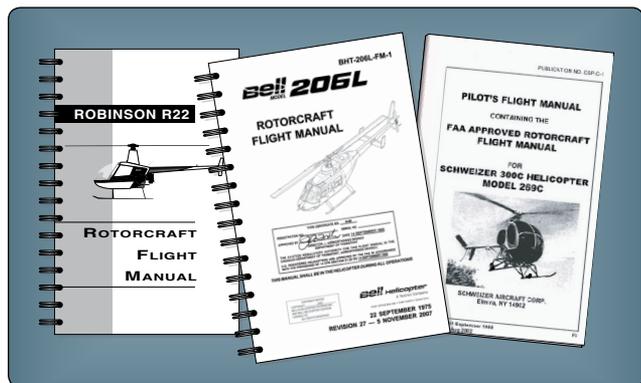


Figure 5-1. The RFM is a regulatory document in terms of the maneuvers, procedures, and operating limitations described therein.

General Information (Section 1)

The general information section provides the basic descriptive information on the rotorcraft and the powerplant. In some manuals there is a three-view drawing of the rotorcraft that provides the dimensions of various components, including the overall length and width, and the diameter of the rotor systems. This is a good place for pilots to quickly familiarize themselves with the aircraft. Pilots need to be aware of the dimensions of the helicopter since they often must decide the suitability of an operations area for themselves, as well as hanger space, landing pad, and ground handling needs.

Pilots can find definitions, abbreviations, explanations of symbology, and some of the terminology used in the manual at the end of this section. At the option of the manufacturer, metric and other conversion tables may also be included.

Operating Limitations (Section 2)

The operating limitations section contains only those limitations required by regulation or that are necessary for the safe operation of the rotorcraft, powerplant, systems, and equipment. It includes operating limitations, instrument markings, color coding, and basic placards. Some of the areas included are: airspeed, altitude, rotor, and powerplant limitations, including fuel and oil requirements; weight and loading distribution; and flight limitations.

Instrument Markings

Instrument markings may include, but are not limited to, green, red, and yellow ranges for the safe operation of the aircraft. The green marking indicates a range of continuous operation. The red range indicates the maximum or minimum operation allowed while the yellow range indicates a caution or transition area.

Airspeed Limitations

Airspeed limitations are shown on the airspeed indicator by color coding and on placards or graphs in the aircraft. A red line on the airspeed indicator shows the airspeed limit beyond which structural damage could occur. This is called the never exceed speed, or V_{NE} . The normal operating speed range is depicted by a green arc. A blue or a red cross-hatched line is sometimes added to show the maximum autorotation speed. [Figure 5-2]

Other airspeed limitations may be included in this section of the RFM. Examples include reduced V_{NE} when doors are removed, maximum airspeed for level flight with maximum continuous power (V_H), or restrictions when carrying an external load. Pilots need to understand and adhere to all airspeed limitations appropriate to the make, model, and configuration of the helicopter being flown.

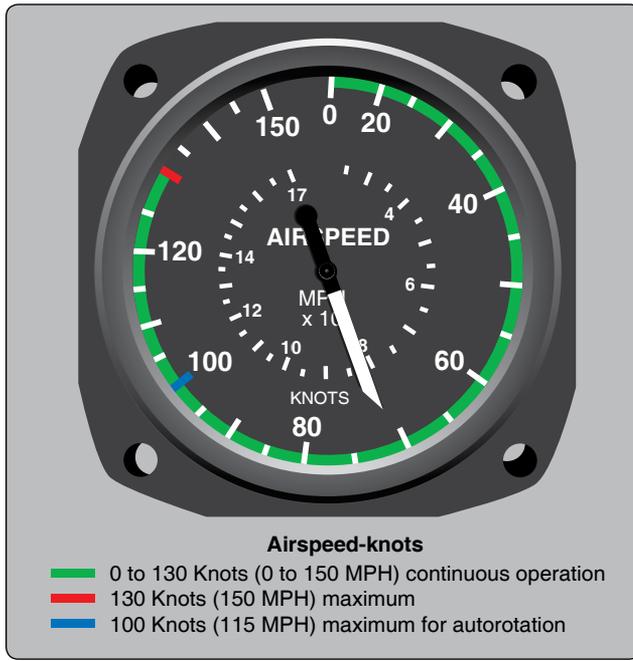


Figure 5-2. Typical airspeed indicator limitations and markings.

Altitude Limitations

If the rotorcraft has a maximum operating density altitude (see page 7-2), it is indicated in this section of the flight manual. Sometimes the maximum altitude varies based on different gross weights.

Rotor Limitations

Low rpm does not produce sufficient lift, and high rpm may cause structural damage, therefore rotor rpm limitations have minimum and maximum values. A green arc depicts the normal operating range with red lines showing the minimum and maximum limits. [Figure 5-3]

There are two different rotor rpm limitations: power-on and power-off. Power-on limitations apply anytime the engine is turning the rotor and is depicted by a fairly narrow green band. A yellow arc may be included to show a transition range, which means that operation within this range is limited due to the possibility of increased vibrations or harmonics. This range may be associated with tailboom dynamic modes. Power-off limitations apply anytime the engine is not turning the rotor, such as when in an autorotation. In this case, the green arc is wider than the power-on arc, indicating a larger operating range.

Powerplant Limitations

The powerplant limitations area describes operating limitations on the helicopter’s engine including such items as rpm range, power limitations, operating temperatures, and fuel and oil requirements. Most turbine engines and some reciprocating engines have a maximum power and a



Figure 5-3. Markings on a typical dual-needle tachometer in a reciprocating-engine helicopter. The outer band shows the limits of the superimposed needles when the engine is turning the rotor. The inner band indicates the power-off limits.

maximum continuous power rating. The “maximum power” rating is the maximum power the engine can generate and is usually limited by time. The maximum power range is depicted by a yellow arc on the engine power instruments, with a red line indicating the maximum power that must not be exceeded. “Maximum continuous power” is the maximum power the engine can generate continually and is depicted by a green arc. [Figure 5-4]

Manifold pressure is a measure of vacuum at the intake manifold. It is the difference between the air pressure (or vacuum) inside the intake manifold and the relative atmospheric pressure of the air around the engine. The red line on a manifold pressure gauge indicates the maximum amount of power. A yellow arc on the gauge warns of pressures approaching the limit of rated power.

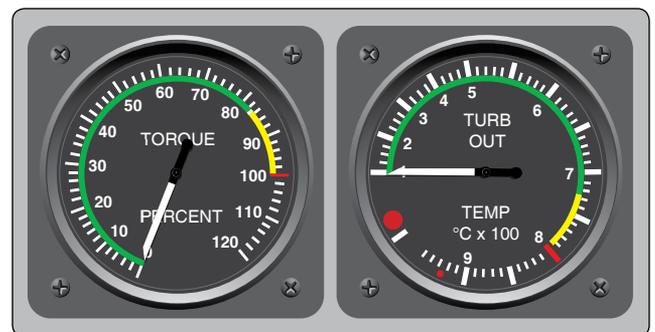


Figure 5-4. Torque and turbine outlet temperature (TOT) gauges are commonly used with turbine-powered aircraft.

[Figure 5-5] A placard near the gauge lists the maximum readings for specific conditions.

Weight and Loading Distribution

The weight and loading distribution section of the manufacturer's RFM contains the maximum certificated weights, as well as the center of gravity (CG) range. The location of the reference datum used in balance computations should also be included in this section. Weight and balance computations are not provided here, but rather in the weight and balance section of the RFM.

Flight Limitations

This area lists any maneuvers which are prohibited, such as acrobatic flight or flight into known icing conditions. If the rotorcraft can only be flown in visual flight rules (VFR) conditions, it is noted in this area. Also included are the minimum crew requirements, and the pilot seat location, if applicable, from which solo flights must be conducted.

Placards

All rotorcraft generally have one or more placards displayed that have a direct and important bearing on the safe operation of the rotorcraft. These placards are located in a conspicuous place within the cabin and normally appear in the limitations section. Since V_{NE} varies with altitude, this placard can be found in all helicopters. [Figure 5-6]

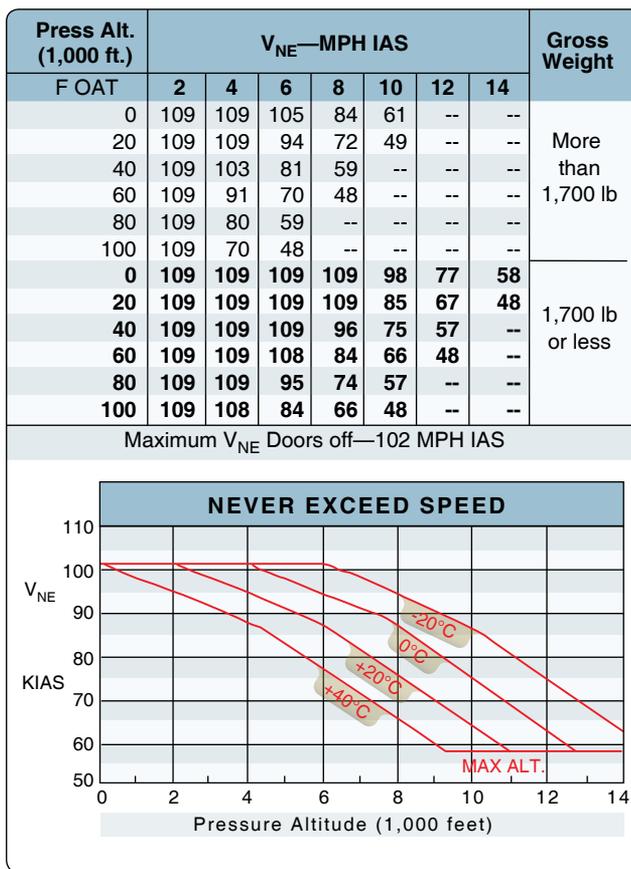


Figure 5-6. Various VNE placards.



Figure 5-5. The manifold pressure gauge is an engine instrument typically used in piston aircraft engines to measure the pressure inside the induction system of an engine. Manifold pressure is a measurement of vacuum and the measurement is taken at the intake manifold.

Emergency Procedures (Section 3)

Concise checklists describing the recommended procedures and airspeeds for coping with various types of emergencies or critical situations can be found in this section. Some of the emergencies covered include: engine failure in a hover and at altitude, tail rotor failures, fires, and systems failures. The procedures for restarting an engine and for ditching in the water might also be included.

Manufacturers may first show the emergencies checklists in an abbreviated form with the order of items reflecting the sequence of action. This is followed by amplified checklists providing additional information to clarify the procedure. To be prepared for an abnormal or emergency situation, learn the first steps of each checklist, if not all the steps. If time permits, refer to the checklist to make sure all items have been covered. For more information on emergencies, refer to Chapter 11, Helicopter Emergencies and Hazards.

Manufacturers are encouraged to include an optional area titled Abnormal Procedures, which describes recommended procedures for handling malfunctions that are not considered to be emergencies. This information would most likely be found in larger helicopters.

Normal Procedures (Section 4)

The normal procedures section is the section most frequently used. It usually begins with a listing of airspeeds that may enhance the safety of normal operations. It is a good idea to learn the airspeeds that are used for normal flight operations. The next part of the section includes several checklists, which cover the preflight inspection, before-starting procedure, how to start the engine, rotor engagement, ground checks, takeoff, approach, landing, and shutdown. Some manufacturers also include the procedures for practice autorotations. To avoid skipping an important step, always use a checklist when one is available. More information on maneuvers can be found in Chapter 9, Basic Flight Maneuvers, and Chapter 10, Advanced Flight Maneuvers.

Performance (Section 5)

The performance section contains all the information required by the regulations and any additional performance information the manufacturer determines may enhance a pilot's ability to operate the helicopter safely. Although the performance section is not in the limitation section and is therefore not a limitation, operation outside or beyond the flight-tested and documented performance section can be expensive, slightly hazardous, or outright dangerous to life and property. If the helicopter is certificated under 14 CFR part 29, then the performance section may very well be a restrictive limitation. In any event, a pilot should determine the performance available and plan to stay within those parameters.

These charts, graphs, and tables vary in style, but all contain the same basic information. Some examples of the performance information that can be found in most flight manuals include a calibrated versus indicated airspeed conversion graph, hovering ceiling versus gross weight charts, and a height-velocity diagram. [Figure 5-7] For information on how to use the charts, graphs, and tables, refer to Chapter 7, Helicopter Performance.

Weight and Balance (Section 6)

The weight and balance section should contain all the information required by the FAA that is necessary to calculate weight and balance. To help compute the proper data, most manufacturers include sample problems. Weight and balance is detailed in Chapter 6, Weight and Balance.

Aircraft and Systems Description (Section 7)

The aircraft and systems description section is an excellent place to study all the systems found on an aircraft. The manufacturers should describe the systems in a manner that is understandable to most pilots. For larger, more complex

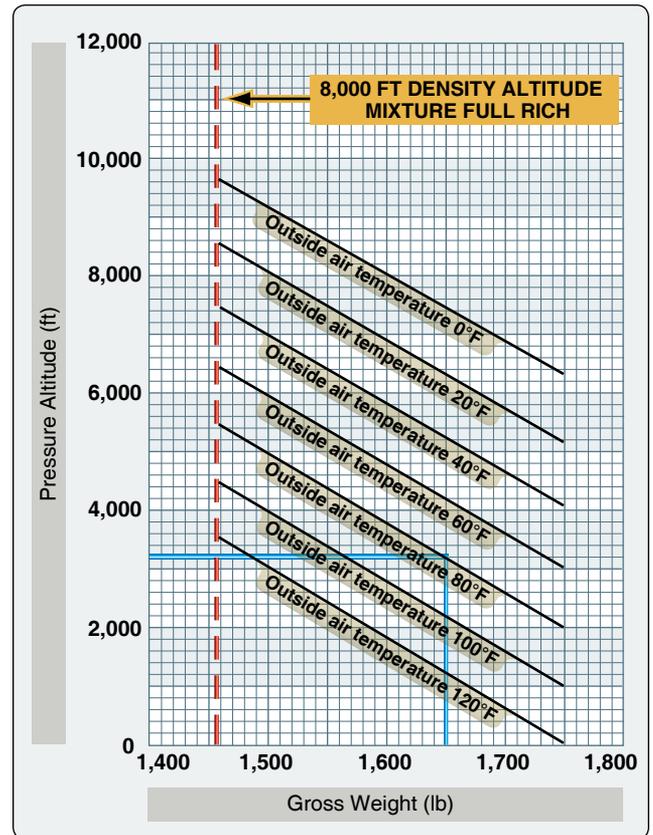


Figure 5-7. One of the performance charts in the performance section is the In Ground Effect Hover Ceiling versus Gross Weight chart. This chart can be used to determine how much weight can be carried and still operate at a specific pressure altitude or, if carrying a specific weight, determine that specific altitude limitation.

helicopters, the manufacturer may assume a higher degree of knowledge. For more information on helicopter systems, refer to Chapter 4, Helicopter Components, Sections, and Systems.

Handling, Servicing, and Maintenance (Section 8)

The handling, servicing, and maintenance section describes the maintenance and inspections recommended by the manufacturer, as well as those required by the regulations, and airworthiness directive (AD) compliance procedures. There are also suggestions on how the pilot/operator can ensure that the work is done properly.

This section also describes preventative maintenance that may be accomplished by certificated pilots, as well as the manufacturer's recommended ground handling procedures, including considerations for hangaring, tie down, and general storage procedures for the helicopter.

Supplements (Section 9)

The supplements section describes pertinent information necessary to operate optional equipment installed on the helicopter that would not be installed on a standard aircraft. Some of this information may be supplied by the aircraft manufacturer, or by the maker of the optional equipment. The information is then inserted into the flight manual at the time the equipment is installed.

Since civilian manuals are not updated to the extent of military manuals, the pilot must learn to read the supplements after determining what equipment is installed and amend their daily use checklists to integrate the supplemental instructions and procedures. This is why air carriers must furnish checklists to their crews. Those checklists furnished to the crews must incorporate all procedures from any and all equipment actually installed in the aircraft and the approved company procedures.

Safety and Operational Tips (Section 10)

The safety and operational tips section is optional and contains a review of information that could enhance the safety of the operation. Manufacturers may include best operating practices and other recommended procedures for the enhancement of safety and reducing accidents. Some examples of the information that might be covered include physiological factors, general weather information, fuel conservation procedures, external load warnings, low rotor rpm considerations, and recommendations that if not adhered to, could lead to an emergency.

Chapter Summary

This chapter familiarized the reader with the RFM. It detailed each section and explained how to follow and better understand the flight manual to enhance safety of flight.