

- I. PURPOSE: The Operating Instructions covered by this specification are for the purpose of supplying basic engine characteristics, operating recommendations and limitations for the aircraft engines for which the instructions are written insofar as they can be determined without regard to the type or model of aircraft in which the engine is installed. They should contain all the engine operating information necessary to the airplane manufacturer when preparing a final instruction for the operation of a specific model airplane.
- II. SCOPE: This specification covers the requirements for the preparation of Operating Instructions in published form or in manuscript form suitable for publication as designated herein.
- III. GENERAL REQUIREMENTS:
- A. The Operating Instruction will be complete with all necessary instructions for the satisfactory operation of the engine as a unit and will only attempt to cover instructions for flight operation of a particular aircraft when feasible since such instructions would be dependent upon airframe, propeller and accessory characteristics that may not be available to the engine manufacturer.
 - B. Symbols: The use of symbols and abbreviations is to be avoided as much as is practicable.
 - C. Units of Measurement for length, weight, temperature, etc., which are used throughout the instruction, shall conform to SAE standards.
 - D. Material and Process Specifications: Reference to material and process specifications shall be made by SAE specification number, if any, unless the customer desires that his own specification numbers be included. In case there is no specification number of any type applicable to certain materials, it shall be permissible to refer to that material by its trade name. The materials referred to above involve lubricants, fuels, etc.
 - E. Binding: Printed Operating Instructions shall be furnished in binders of suitable size for 8-1/2 x 11 inch sheets. The use of looseleaf binders is recommended.
 - F. Phraseology: Technical phraseology requiring specialized knowledge shall be avoided except in cases where no other phraseology will clearly convey the intended meaning. Instructions covering standard operations and description of engine parts and instruments need not be entered into in any greater detail than is necessary for personnel having a general training in the operation of aircraft engines to understand.
 - G. Revisions: Revisions shall be effected either by the publication of later editions or through the use of revised pages. In later editions, or if revised pages are issued, a statement will be included in the front of the instruction indicating the major revisions over the previous edition.

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IV. DETAIL REQUIREMENTS:

A. Format

- A-1. Size: Operating Instructions shall be published on 8-1/2 x 11 inch pages, with margins adjusted to accommodate the type of binder to be used. The text limits shall be 7 x 9 inches exclusive of headings. It is recommended that the text be set in two columns in preference to a single column. Fold-over pages are undesirable except in the case of performance curves.
- A-2. Type Size: The type appearing in the published Operating Instruction shall not be smaller than approximately eight point.
- A-3. Major Divisions of Instruction: The Operating Instructions shall be divided into four major sections as follows, and each section shall be started on a right-hand page:

	Title Page
	Table of Contents
Section I	- Introduction
Section II	- General Operating Instructions
Section III	- Method of Reading Performance Curves
Section IV	- Engine Characteristics and Specific Operating Data

- B. Paragraphs: Where applicable the sections shall be subdivided into major paragraphs, and each major paragraph into primary, secondary, and tertiary subparagraphs.

- B-1. Paragraph Identification: Major paragraphs and primary subparagraphs shall be identified for ready reference. This will be done either by a system of letters and numerals or by the use of headings with appropriate variations in type faces and type sizes. When letters or numerals are used, these paragraphs shall be identified by a heading following the paragraph number. In cases where slight deviations from the basic instruction are necessary, such deviation shall be prefaced by the word "Note" printed with an appropriate variation in type face. The information given in the note shall be indented in block form.

- C. Page Numbering: The first page of Section I shall be numbered "1" (Arabic numerals), and the numbers carried straight through to the last page of the instruction. For pages preceding Section I, lower case Roman numerals shall be used. In order to prevent the necessity of re-setting type, added pages if required in last minute alterations of an instruction in the process of reproduction may be numbered 1A, 1B, 2A, 2B, etc.
- D. Page Headings: Section identification shall appear in the running head of each right-hand page after the first page of each section. The running head may be omitted on full page or fold-over illustrations.

- E. Engine Serial Numbers: Reference to engines shall be made by model designation if possible. Where the model number does not furnish sufficient identification further identification by serial number or physical characteristics is permissible. It is recommended that in order to make Sections I and II of the manual interchangeable among several engine models specific reference to engine models be restricted to the Title Page and Section IV.
- F. Nomenclature: Throughout the text of the instruction the principal noun in the nomenclature of a particular part shall be the same as that specified in the Spare Parts Catalog. The descriptive nomenclature of the principal noun may vary, however, according to the particular use and location to which reference is made.
- G. Engine Equipment: Instructions for the operation of items of engine equipment such as carburetors, magnetos, pumps, etc. which are required for normal engine operation shall be included in the Operating Instruction in as great detail as necessary for the satisfactory operation of the engine. These instructions may also include general instructions for items of airplane equipment which may have a definite effect on engine operation such as cowl flaps, carburetor heaters, oil cooler shutters, etc.
- H. Illustrations: Illustrations shall be included in the Operating Instruction only whenever an illustration will serve to clarify or simplify any information of the text.
- H-1. The hands of an operator may be included in an illustration where necessary to illustrate an operation. The inclusion of more of an operator's body than his hands is permitted only as necessary to properly illustrate the procedure.
- H-2. Each illustration shall show directly beneath it the figure number (Arabic numerals) and the name or title of that particular illustration. The figure numbers shall be applied to the illustrations in the order in which the illustrations are shown in the instruction.
- H-3. Illustrations shall be inserted as closely as possible to the applicable text.
- H-4. Reference to the illustrations shall be made by figure number throughout the text immediately following descriptive text material.
- I. Title Page: The Title Page shall be to the manufacturer's standard, except where it is necessary to abide by a customer's standard. The Title Page shall include the following information, if available:
1. Title of publication
 2. Name of manufacturer and address
 3. Engine designation
 4. Date of issue
- J. Table of Contents: The Table of Contents shall immediately follow the Title Page and shall contain a list of each of the Operating Instruction section titles with a break-down into their major paragraph titles and primary subparagraph titles, showing the page numbers on which the detailed data is found.

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K. Introduction: This section shall be titled "Section I" (Roman numeral), "Introduction".

K-1. Special Notes, Terms, and Abbreviations: The Introduction shall contain definitions of standard terms used in the text. The following are given as examples:

Front	- Propeller end
Rear	- Anti-propeller end
Right Side	- As viewed facing rear of engine
Left Side	- As viewed facing rear of engine
Horizontal	- Position as in normal level flight
Inverted	- Upside down (position as in inverted flight)
Nose Down	- Propeller end pointing downward
Nose Up	- Propeller end pointing upward
Crankshaft, Propeller Shaft or Propeller Rotation	- Clockwise or anti-clockwise as viewed facing rear of engine
Accessory Rotation	- Clockwise or anti-clockwise as viewed facing accessory mounting pad of the engine

K-2. The Introduction shall include such introductory matter as is deemed pertinent or desirable and which may aid in the proper use of the Operating Instruction. Reference shall be made to other available publications covering the same engine.

K-3. There shall be no ambiguous terms or abbreviations used in the text of the instruction that are not fully explained in the Introduction.

K-4. The Introduction shall also furnish all the information necessary to clarify the purpose of the instruction and how it should be used.

L. General Operating Instructions: This section shall be numbered "Section II" (Roman numerals), "General Operating Instructions" and shall be made up of the necessary text (as differentiated from tabular matter) for operating the engines under consideration. Following is a list of typical subjects to be covered:

1. Procedure Preliminary to starting
2. Starting (with starter and by hand)
3. Warm up
4. Ground test
5. Taxiing
6. Take-off
7. Emergency take-off
8. Climb
9. Cruise
10. Glides
11. Landing
12. Stopping engine

Particular stress should be made of such items as:

Use of operation of mixture controls	
" " " " carburetor air heaters	
" " " " propeller controls	
" " " " oil dilution valves	
" " " " special engine controls, etc.	

Operating values shall not generally be given in this section but reference should be made to Section IV. This procedure is recommended to expedite revisions required by changes in operation limits and to allow this section to be interchangeable for different model engines.

- M. Method of Reading Performance Curves: This section shall be titled "Section III" (Roman numerals), "Method of Reading Performance Curves", and shall explain in detail the methods employed by the engine manufacturer when preparing a table of engine operating data from an altitude performance curve. Both constant manifold pressure and rpm operation and constant horsepower and rpm operation shall be explained where applicable.
- N. Engine Characteristics and Specific Operating Data: This section shall be titled "Section IV" (Roman numerals), "Engine Characteristics and Specific Operating Data". The information contained in this section will be applicable only to those engines for which this section is prepared and may be furnished separately from the basic instruction contained in Sections I through IV. It shall be subdivided into four major parts as follows:
1. Table of Engine Characteristics
 2. Table of Specific Operating Data
 3. Engine Performance Curve
 4. Fuel Consumption Curve
- N-1. Table of Engine Characteristics shall contain the basic characteristics for the particular engines covered in Section IV of the Operating Instructions. The following outline is typical of what is desired.

TABLE OF ENGINE CHARACTERISTICS

Model
Type
Number of Cylinders
Bore
Stroke
Supercharger Types and Ratios
Guaranteed ratings if Desired
Direction of Rotation of Crankshaft
Direction of Rotation of Propeller if Geared
Propeller Reduction Gear Ratio
Magnetos Type
Carburetor or Fuel Injector Type
Grade of Fuel Required and Octane Rating
Fuel Pressures, Desired Maximum Minimum for Idling
Priming System Type
Grade of Oil Required- (Summer) (Winter)
Coolant Temperature Limits

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N-2. Table of Specific Operating Data shall contain the specific data for the particular engines covered in the Operating Instructions. A typical table of what is desired is shown on the following page. This table will give the operating recommendations and limits for the particular engine models at the various power conditions listed. Performance data will be taken from and shall agree with the engine calibration curve. The remainder of the data shall be obtained from the most reliable source available, or calculated, as the case may be. The definitions of the engine power ratings shown on the table are as follows:

1. Take-Off: Maximum recommended for take-off under the specified time limit.
2. War Emergency: An unguaranteed rating in excess of the maximum design power rating of the engine which may be used for short periods of emergency combat use without likelihood of immediate failure.
3. Military Rated Power: The rating established by the manufacturer and accepted by the Government to be used in an emergency for maximum performance of the engine under the specified time limit.
4. Normal Rated (Maximum Continuous): The maximum permissible RPM and power rating for continuous operation.
5. Cruising Powers: Arbitrarily chosen RPM and power ratings less than normal rated. It is recommended that the following ratings be given:
 - a. Cruising max: The RPM and power rating consistent with normal engine durability.
 - b. Cruising recommended: Combinations of RPM and power, at a lower power than maximum cruising, selected from a standpoint of improved durability and fuel economy.

N-3. Engine Performance Curve: Sea level and altitude performance curves will be prepared on the applicable graph sheet as illustrated in Aeronautical Standard AS 1 from data compiled as a result of calibration tests run on the engine for which the curve is drawn. The sea level section of the curve will indicate revolutions per minute lines plotted against brake horsepower and absolute manifold pressure in inches of mercury, and the altitude section will indicate revolutions per minute and absolute manifold pressure lines in inches of mercury plotted against brake horsepower and altitude. Sufficient notes and references to clarify and facilitate identification will be plainly fixed thereto. This curve will be the basis from which data included in the Table of Specific Operating Data will be taken.

N-4. Fuel Consumption Curve: Fuel consumption curves will be prepared on standard coordinate paper as a result of calibration tests run on the engine for which the curve is drawn. The specific fuel consumption in pounds per brake horsepower per hour will be plotted against RPM of several power ratings in the cruising range.