

RESTRICTED

FILE: A

TECHNICAL ORDER No. 02-10AB-1

HANDBOOK OF
OPERATING INSTRUCTIONS
.
R-985 Series
AIRCRAFT ENGINES



NOTE: This Technical Order replaces T. O. No. 02-10AB-1 dated December 15, 1942. These instructions are to be used for flight purposes only when the Pilot's Handbook of Operating Instructions is not available. Consult Index, T. O. No. 00-1.

NOTICE: This document contains information affecting the National Defense of the United States within the meaning of the Espionage Act, 50 U. S. C., 31 and 32, as amended. Its transmission or the revelation of its contents in any manner to an unauthorized person is prohibited by law.

PUBLISHED BY AUTHORITY OF THE COMMANDING GENERAL,
ARMY AIR FORCES, BY THE HEADQUARTERS,
AIR SERVICE COMMAND, PATTERSON FIELD, FAIRFIELD, OHIO

TABLE OF CONTENTS

<u>Section</u>	<u>Page</u>
I Introduction	1
II General Operating Instructions	1-4
1. Procedure Preliminary to Starting	1
2. Starting	1-2
3. Warm-up	2
4. Take-off	2
5. Flight	2-3
6. Landing	3
7. Stopping the Engine	3
8. Control of Carburetor Air Temperature	3
9. Cowl Flaps	3
10. Mixture Controls	3
11. Fuel and Oil	3
12. Detonation	3-4
III Specific Operating Instructions	4-8



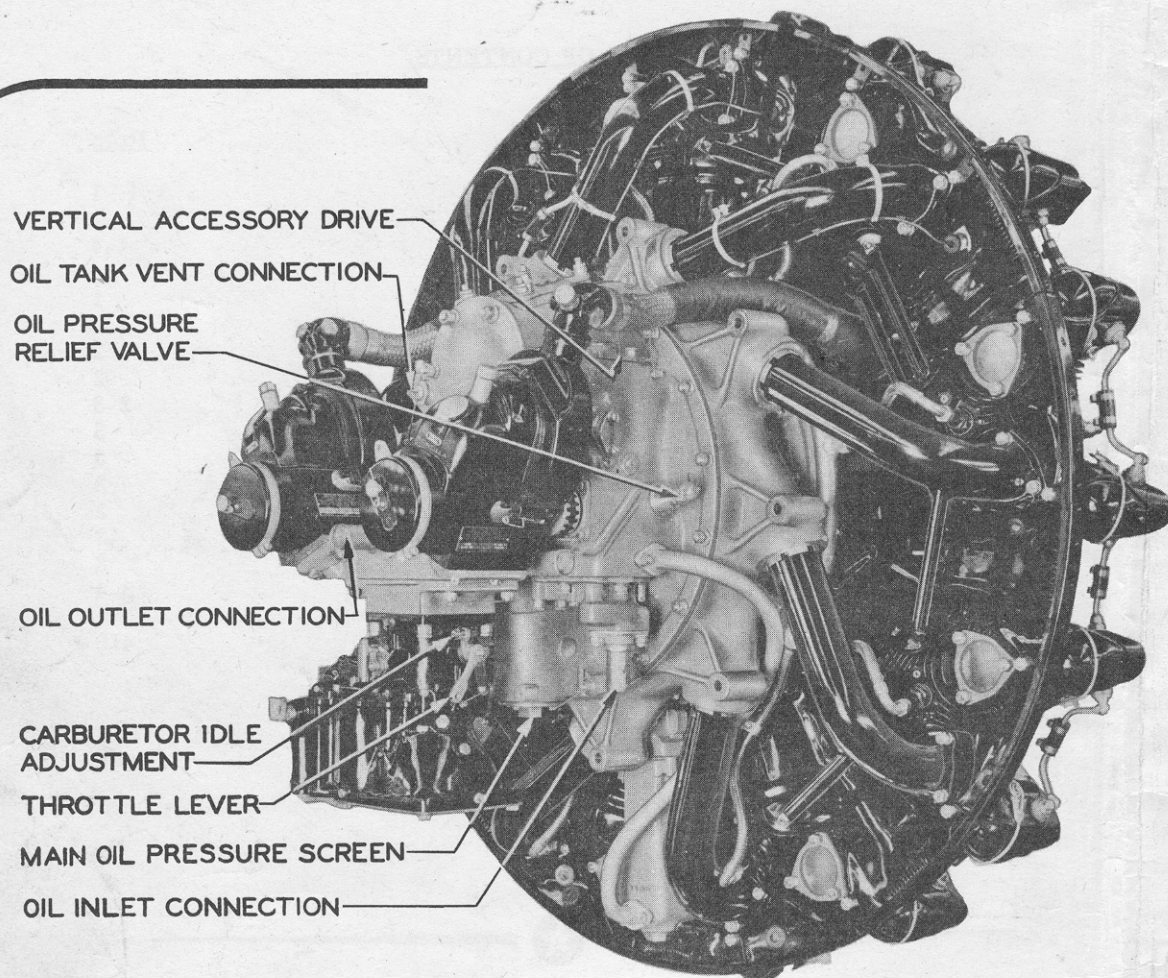


Figure 1
Three-Quarter Right Rear View
of R-985 Engine



SECTION IINTRODUCTION

1. This Technical Order constitutes the Operating Instructions for the Models R-985-A, -B, -9, -11, -13, -17, -19, -21, -23, -25, -27, -AN1, and -AN3 Engines manufactured by Pratt & Whitney Aircraft, East Hartford, Conn.

2. These instructions will be used for flight purposes

only when the Pilot's Handbook of Operation Instructions is not available. Refer to the Index, T. O. No. 00-1.

3. The following Technical Orders contain related instructions and are listed only for convenient reference where further information is required:

T. O. No.

02-1-5	Operation of Carburetor Air Heaters and Induction System De-icers.
02-1-7	Detonation in Aircraft Engines.
02-1-23	Flight Operation of Aircraft Engines.
02-1-29	Ground Operation Instructions for Aircraft Engines.
02-10AB-2	Service Instructions - R-985-A, -B, -9, -11, -13, -17, -19, -21, -23, -25, -27, -AN1, and -AN3.
03-10B-1	Operation and Service Instructions - Aircraft Carburetors (Bendix Stromberg).
03-10G-1	Operation of Carburetor Mixture Controls.
03-20-6*	Operation of Propeller Controls During Landing.
06-5-1	Fuels - Use and Disposition.
06-10-1	Aircraft Engine Lubricating Oils - Grades and Use.

SECTION IIGENERAL OPERATING INSTRUCTIONS1. Procedure Preliminary to Starting.

a. When an engine has stood idle or when excessive priming is used, oil and fuel will collect in the lower cylinders and intake pipes. If the engine is cranked over with liquid in the combustion chamber, the link rod will bend and eventually fail. Consequently, it is very important that the engine be pulled through slowly by hand. If there is any evidence of excessive compression, during hand cranking, do not attempt to pull the engine past that point, but remove the front spark plugs from the three lower cylinders and then continue to crank the engine over by hand to remove all liquid. Dry the spark plugs and replace.

b. Move throttle lever almost to "CLOSED" position (about one-tenth open, equivalent to 600-800 rpm). However, as much as one-fourth throttle opening and a corresponding increase in the amount of prime may be found necessary, particularly when engine is cold.

c. Open engine cowl flaps.

d. Set propeller control in low rpm (high pitch) position.

e. Set mixture control in "FULL RICH" position.

f. Set carburetor heater control at "COLD."

g. Be sure the fuel valve is turned to a tank containing fuel.

CAUTION: When turning fuel selector be careful to feel that the valve seats itself in the new position.

h. In twin engine installations employing a cross-feed fuel shut-off cock be sure the valve is in the "OFF" position.

i. With the hand wobble pump bring the fuel pressure to 3 or 4 pounds.

2. Starting.

a. Turn ignition to "BOTH" position.

b. Prime engine with three or four strokes of the hand primer.

CAUTION: Avoid excessive priming. If the engine is overprimed, proceed as directed in paragraph 1.a.

c. Energize starter, either electrically or with

hand crank or portable energizer. Disengage energy source from starter before meshing starter to engine.

d. If the engine does not start after two or three attempts, turn the ignition switch "OFF" and refer to section VI of T. O. No. 02-10AB-2 for possible causes.

e. If oil pressure is not indicated within 30 seconds, shut down engine immediately and make an investigation.

3. Warm-up.

a. General. - Engines will be warmed up and ground tested according to the following instructions. Any faulty operation or malfunctioning noted during ground tests will be investigated and the necessary adjustments made prior to take-off.

b. Oil Pressure and Temperature Check.

(1) Engines will be warmed up on the ground until proper lubrication and engine operation for take-off and flight are assured.

(2) After approximately 1 minute of operation, or when minimum oil pressure is indicated, shift propeller to take-off setting.

(3) During the warm-up period, the engine speed should not exceed one-half of the maximum permissible ground rpm until after the engine maintains, without fluctuations, at least two-thirds of the maximum oil pressure specified for full power. Also, the oil temperature gage must show a definite increase in oil temperature, indicating proper circulation of the oil. (The maximum permissible ground rpm and manifold pressure are those specified for "Maximum Cruising" in section III.) When these conditions are obtained, and the mixture and propeller controls are set for take-off, the engine speed may be increased to check for proper functioning of the engine and engine instruments at higher rpm. The maximum permissible ground rpm will not be maintained for periods in excess of 20 to 30 seconds.

NOTE: Due to insufficient cooling on the ground when operating at high rpm, it is desirable to nose the airplane into the wind during warm-up. Engines will be stopped rather than idled for prolonged periods after warm-up has been accomplished.

c. Ignition System Check.

(1) Note the loss of revolutions or manifold pressure when switched to one magneto at a time. To avoid detonation, the manifold pressure when operating on only one magneto must not exceed maximum cruising manifold pressure. The propeller controls must be set for take-off speed and the throttle adjusted to give cruising engine speed or less during the ignition check. It is important to switch back to

"BOTH" and leave switch in that position until the engine has picked up the loss in rpm resulting from operating on one magneto before testing on the other magneto. The normal loss in rpm when operating on one magneto should not exceed 100 rpm. This check should be made in as short a time as possible, and should not exceed 30 seconds.

(2) At the start of the day's flying, check the "OFF" position of the ignition switch on all engines using carburetors which incorporate an "IDLE CUT-OFF." This assures proper connection of the ground wires. The check should be made at the end of the engine warm-up period with the propeller in full low pitch and the engine turning over approximately 700 rpm. The switch should be turned to the "OFF" position momentarily to note whether the engine stops firing, and immediately returned to the "BOTH ON" position. Two or three seconds is ample time for the switch to remain in the "OFF" position.

d. Fuel Supply Check. - Functioning of all the fuel tanks will be tested by switching the fuel valve to each tank long enough to insure that fuel has an opportunity to flow to the engine.

e. Manifold Pressure Gage Drain. - When warming up the engine, the shut-off cock for the manifold pressure gage will be opened for a few seconds to clear the line of liquids and vapors. This will be done at idling speed only.

f. Controllable Propellers. - Check the operation of the controllable propeller. To prevent overheating of the engine while operating in low rpm (high pitch) position during ground operation, the manifold pressure must not exceed the specified maximum cruising manifold pressure.

4. Take-off.

a. Do not start take-off with cylinder head temperature above 205° C (401° F).

b. Set propeller control in high rpm (low pitch) position.

c. Normally the carburetor heater should be in the "COLD" position but, if the weather indicates danger of ice formation, the air heater should be partially opened.

d. Set mixture control in "FULL RICH" position below 3500 feet. Lean out somewhat to obtain smooth engine operation at altitudes above 3500 feet.

e. Check "Specific Operating Instructions" for manifold pressure required for take-off.

5. Flight.

a. General. - The rpm, the cylinder temperatures, the oil temperatures, and the oil pressure give the

most satisfactory indication of the engine's performance. If any of these appear irregular, the engine should be throttled and, if the cause cannot be eliminated, a landing should be made to investigate and correct the trouble.

b. Propeller. - Set the propeller control in high rpm (low pitch) position for climb and in low rpm (high pitch) for high speed and cruising.

c. To Increase Engine Power.

(1) Adjust mixture control to obtain the fuel/air ratio specified for power desired. (See "Specific Operating Instructions.")

(2) Move propeller controls to obtain desired rpm.

(3) Adjust throttle control to obtain desired manifold pressure.

(4) Readjust mixture control, if necessary.

d. To Decrease Engine Power.

(1) Adjust throttle to obtain desired manifold pressure.

(2) Move propeller controls to obtain desired rpm.

(3) Readjust throttle control if necessary.

(4) Adjust mixture control to obtain the desired fuel/air ratio.

6. Landing.

a. Preparatory to landing, controls will be set in the following manner:

(1) Set mixture control in "FULL RICH" position.

(2) Set propeller in maximum cruising rpm position.

b. After landing and during taxiing, the propeller controls will be kept in high rpm (low pitch) position.

7. Stopping the Engine.

a. Set mixture control at "FULL RICH."

b. Move propeller control to low rpm (high pitch) position.

c. Allow engine to run at normal idling speed with nose cowl fully open until the engine has cooled appreciably below cruising temperatures.

d. Idle the engine at 800 to 1000 rpm and then set the mixture control to the "FULL LEAN" position.

This actuates the idling cut-off valve, causing the engine to cut out abruptly.

8. Control of Carburetor Air Temperature.

The float-type carburetors used on these engines are very susceptible to ice formation. Adjust the carburetor heater to maintain mixture temperatures between 2° and 5° C (35° and 40° F). Refer to T. O. No. 02-1-5 for additional instructions on operation of carburetor air heaters.

9. Cowl Flaps.

Cowl flaps provide a means of controlling air flow around the engine and should be open for all engine runs on the ground (including warm-up runs), taxiing, and for climbing. During take-off, however, they should be closed to about 15 degrees in order to reduce drag. They should be closed or partly closed in level flight and in gliding, as indicated by cylinder head temperatures.

10. Mixture Controls.

The R-985 engines are equipped with models NA-R9, NA-R9A, and NA-R9B float-type carburetors. Idle cut-off is provided on these carburetors, but no automatic mixture control is provided. The mixture must thus be controlled manually as noted in the "Specific Operating Instructions." As the fuel mixture is leaned out, cylinder head temperatures will increase. Do not exceed temperatures specified in section III. For further information, see T. O. No. 03-10G-1.

11. Fuel and Oil.

a. The grade of fuel to be used in the operation of these engines is given in section III. Refer to T. O. No. 06-5-1 for general information on the use and disposition of fuels.

b. The grade of oil to be used in the operation of these engines should be determined by reference to T. O. No. 06-10-1.

12. Detonation.

a. Indications.

(1) Engine roughness does not necessarily indicate that detonation is present, but when unusual roughness is encountered it may be due to detonation.

(2) An increase in cylinder temperature due to detonation, if apparent, would first be noticed on the cylinder head thermocouples. Cylinder temperatures, however, cannot be relied on for a definite and complete indication of detonation.

(3) An erratic registering of the fuel/air ratio meter may indicate detonation and should be investigated. If, as the mixture is leaned out, the indicating

needle does not show a leaner mixture or backs up on the scale toward the rich side, detonation has probably been encountered.

(4) If exhaust stacks are visible, detonation may be indicated by intermittent puffs of dense black smoke, often accompanied with sparks or glowing carbon, in contrast to the indications of a rich mixture which is generally indicated by dull red flames with steady black smoke.

b. Causes.

(1) Use of fuel of too low octane rating. See that proper grade of fuel is used.

(2) A too low fuel/air ratio. Do not operate at mixtures that are too lean.

(3) Operation of engine above permissible limitations. Observe "Specific Instructions" in section III.

c. Stopping Detonation Immediately if Present.

(1) Reduce the manifold pressure.

(2) Enrich the mixture.

(3) Reduce the carburetor air preheating to the minimum temperatures at which icing of the carburetor may be prevented.

d. Refer to T. O. No. 02-1-7 for further information and instructions pertaining to detonation in aircraft engines.

SECTION III SPECIFIC OPERATING INSTRUCTIONS

ENGINE: R-985-A (-1)

DATE:

CONDITION	FUEL PRESSURE LB/IN. ²	OIL PRESSURE LB/IN. ²	OIL TEMP °C	COOLANT TEMP °C
DESIRED	3-4	75-90	50-70	
MAXIMUM		100		
MINIMUM		60		
IDLING		15		

MAX PERMISSIBLE ENGINE OVER SPEED: 2400 RPM

MAX ALLOWABLE OIL CONSUMPTION AT:

NORMAL RATED POWER _____ QT /HR
 MAXIMUM CRUISING 6.0 QT /HR
 MINIMUM SPECIFIC FUEL FLOW _____ QT /HR

FUEL GRADE 87 OCTANE

⊕ OPERATING CONDITION	HORSE POWER	R P M	MANIF PRESS. ALTITUDE (IN. HG)	PRESSURE ALTITUDE (IN FEET)	BLOWER CONTROL POSITION	USE LOW BLOWER BELOW	MIXTURE CONTROL POSITION	MINM F/A RATIO	FUEL FLOW GAL/HR	MAX CYL HD TEMP °C	REMARKS
TAKE-OFF	300	2000					"Full Rich" to "Smooth" Operation			260	5 Minute Limit
MILITARY RATED POWER											
⊙ NORMAL RATED POWER (100%)		2000					"Full Rich" to "Smooth" Operation		33.3	260	
MAX CRUISING (75%)		1750					"Best Power"		17.5	235	
DESIRED CRUISE (67%)		1650					"Best Power"		14.5	235	
DESIRED CRUISE (60%)		1550					"Best Power"		12.0	235	

NOTE: The data on this chart are the result of dynamometer tests and are adaptable for flight purposes in the absence of the Pilot's Handbook of Operating Instructions.

⊕ REFER TO T.O. NO. 00-10 FOR DEFINITION OF EACH OPERATING CONDITION

⊙ MAXIMUM PERMISSIBLE CONTINUOUS HORSE POWER

REVISED 12-1-41

SECTION III SPECIFIC OPERATING INSTRUCTIONS

ENGINE: R-985-B (-5) and -9

DATE:

CONDITION	FUEL PRESSURE LB/IN. ²	OIL PRESSURE LB/IN. ²	OIL TEMP °C	COOLANT TEMP °C	MAX PERMISSIBLE ENGINE OVER SPEED: 2520 RPM
DESIRED	3-4	75-90	50-70		MAX ALLOWABLE OIL CONSUMPTION AT: NORMAL RATED POWER _____ QT /HR MAXIMUM CRUISING <u>6.3</u> QT /HR MINIMUM SPECIFIC FUEL FLOW _____ QT /HR
MAXIMUM		100	95		
MINIMUM		60			
IDLING		15			
					FUEL GRADE <u>87</u> OCTANE

⊕ OPERATING CONDITION	HORSE POWER	R P M	MANIF PRESS. (IN. HG)	PRESSURE ALTITUDE (IN FEET)	BLOWER CONTROL POSITION	USE LOW BLOWER BELOW	MIXTURE CONTROL POSITION	MINM F/A RATIO	FUEL FLOW GAL/HR	MAX CYL HD TEMP °C	REMARKS
TAKE-OFF	350	2100					"Full Rich" to "Smooth" Operation			260	5 Minute Limit
MILITARY RATED POWER											
⊙ NORMAL RATED POWER (100%)		2100					"Full Rich" to "Smooth" Operation		35.5	260	
MAX CRUISING (75%)		1840					"Best Power"		19.5	235	
DESIRED CRUISE (67%)		1750					"Best Power"		16.0	235	
DESIRED CRUISE (60%)		1650					"Best Power"		13.5	235	

NOTE: The data on this chart are the result of dynamometer tests and are adaptable for flight purposes in the absence of the Pilot's Handbook of Operating Instructions.

⊕ REFER TO T.O. NO. 00-10 FOR DEFINITION OF EACH OPERATING CONDITION ⊙ MAXIMUM PERMISSIBLE CONTINUOUS HORSE POWER REVISED 12-1-41

SECTION III SPECIFIC OPERATING INSTRUCTIONS

ENGINE: R-985-11

DATE:

CONDITION	FUEL PRESSURE LB/IN. ²	OIL PRESSURE LB/IN. ²	OIL TEMP °C	COOLANT TEMP °C	MAX PERMISSIBLE ENGINE OVER SPEED: 2540 RPM
DESIRED	3-4	75-90	50-70		MAX ALLOWABLE OIL CONSUMPTION AT: NORMAL RATED POWER _____ QT /HR MAXIMUM CRUISING <u>7.2</u> QT /HR MINIMUM SPECIFIC FUEL FLOW _____ QT /HR
MAXIMUM		100	95		
MINIMUM		60			
IDLING		15			
					FUEL GRADE <u>87</u> OCTANE

⊕ OPERATING CONDITION	HORSE POWER	R P M	MANIF PRESS. (IN. HG)	PRESSURE ALTITUDE (IN FEET)	BLOWER CONTROL POSITION	USE LOW BLOWER BELOW	MIXTURE CONTROL POSITION	MINM F/A RATIO	FUEL FLOW GAL/HR	MAX CYL HD TEMP °C	REMARKS
TAKE-OFF	400	2200					"Full Rich" to "Smooth" Operation			260	5 Minute Limit
MILITARY RATED POWER											
⊙ NORMAL RATED POWER (100%)		2200					"Full Rich" to "Smooth" Operation		40	260	
MAX CRUISING (75%)		1925					"Best Power"		23.4	235	
DESIRED CRUISE (67%)		1850					"Best Power"		20	235	
DESIRED CRUISE (60%)		1700					"Best Power"		16	235	

NOTE: The data on this chart are the result of dynamometer tests and are adaptable for flight purposes in the absence of the Pilot's Handbook of Operating Instructions.

⊕ REFER TO T.O. NO. 00-10 FOR DEFINITION OF EACH OPERATING CONDITION ⊙ MAXIMUM PERMISSIBLE CONTINUOUS HORSE POWER REVISED 12-1-41

SECTION III SPECIFIC OPERATING INSTRUCTIONS

ENGINE: R-985-13

DATE:

CONDITION	FUEL PRESSURE LB./IN. ²	OIL PRESSURE LB./IN. ²	OIL TEMP °C	COOLANT TEMP °C
DESIRED	3-4	70-100	50-70	
MAXIMUM		100	95	
MINIMUM		60		
IDLING		15		

MAX PERMISSIBLE ENGINE OVER SPEED: 2640 RPM

MAX ALLOWABLE OIL CONSUMPTION AT:

NORMAL RATED POWER _____ QT /HR

MAXIMUM CRUISING 5.6 QT /HR

MINIMUM SPECIFIC FUEL FLOW _____ QT /HR

FUEL GRADE 87 OCTANE

⊕ OPERATING CONDITION	HORSE POWER	RPM	MANIF PRESS. (IN. HG)	PRESSURE ALTITUDE (IN FEET)	BLOWER CONTROL POSITION	USE LOW BLOWER BELOW	MIXTURE CONTROL POSITION	MINM F/A RATIO	FUEL FLOW GAL/HR	MAX CYL HD TEMP °C	REMARKS
TAKE-OFF	450	2300	37.0				"Full Rich"			260	5 Minute Limit
MILITARY RATED POWER											
⊕ NORMAL RATED POWER (100%)	400	2200	35.5				"Full Rich" to "Smooth" Operation	.090	40	260	
MAX CRUISING (75%)		1925	28.5				"Smooth" Operation	.079	26.5	235	
DESIRED CRUISE (67%)		1925	26.5				"Best Power"	.073	22.0	235	
DESIRED CRUISE (60%)		1850	24.5				"Best Power"	.071	19.0	235	

NOTE: The data on this chart are the result of dynamometer tests and are adaptable for flight purposes in the absence of the Pilot's Handbook of Operating Instructions.

⊕ REFER TO T.O. NO. 00-10 FOR DEFINITION OF EACH OPERATING CONDITION

⊕ MAXIMUM PERMISSIBLE CONTINUOUS HORSE POWER

REVISED 12-1-41

SECTION III SPECIFIC OPERATING INSTRUCTIONS

ENGINE: R-985-17

DATE:

CONDITION	FUEL PRESSURE LB./IN. ²	OIL PRESSURE LB./IN. ²	OIL TEMP °C	COOLANT TEMP °C
DESIRED	3-4	65-90	50-70	
MAXIMUM		90		
MINIMUM		55		
IDLING		15		

MAX PERMISSIBLE ENGINE OVER SPEED: 2640 RPM

MAX ALLOWABLE OIL CONSUMPTION AT:

NORMAL RATED POWER _____ QT /HR

MAXIMUM CRUISING 5.6 QT /HR

MINIMUM SPECIFIC FUEL FLOW _____ QT /HR

FUEL GRADE 87 OCTANE

⊕ OPERATING CONDITION	HORSE POWER	RPM	MANIF PRESS. (IN. HG)	PRESSURE ALTITUDE (IN FEET)	BLOWER CONTROL POSITION	USE LOW BLOWER BELOW	MIXTURE CONTROL POSITION	MINM F/A RATIO	FUEL FLOW GAL/HR	MAX CYL HD TEMP °C	REMARKS
TAKE-OFF	450	2300	36.5				"Full Rich"			260	5 Minute Limit
MILITARY RATED POWER											
⊕ NORMAL RATED POWER (100%)	400	2200	32.8				"Full Rich" to "Smooth" Operation	.090	40	260	
MAX CRUISING (75%)		1925	28.5				"Smooth" Operation	.079	26.5	235	
DESIRED CRUISE (67%)		1925	26.5				"Best Power"	.073	21.5	235	
DESIRED CRUISE (60%)		1850	25.0				"Best Power"	.073	19.0	235	

NOTE: The data on this chart are the result of dynamometer tests and are adaptable for flight purposes in the absence of the Pilot's Handbook of Operating Instructions.

⊕ REFER TO T.O. NO. 00-10 FOR DEFINITION OF EACH OPERATING CONDITION

⊕ MAXIMUM PERMISSIBLE CONTINUOUS HORSE POWER

REVISED 12-1-41

SECTION III SPECIFIC OPERATING INSTRUCTIONS

ENGINE: R-985-19

DATE:

CONDITION	FUEL PRESSURE LB/IN. ²	OIL PRESSURE LB/IN. ²	OIL TEMP °C	COOLANT TEMP °C
DESIRED	3-4	65-80	50-70	
MAXIMUM		90	95	
MINIMUM		55		
IDLING		15		

MAX PERMISSIBLE ENGINE OVER SPEED: 2640 RPM

MAX ALLOWABLE OIL CONSUMPTION AT:

NORMAL RATED POWER _____ QT /HR

MAXIMUM CRUISING 5.6 QT /HR

MINIMUM SPECIFIC FUEL FLOW _____ QT /HR

FUEL GRADE 87 OCTANE

⊕ OPERATING CONDITION	HORSE POWER	RPM	MANIF PRESS. (IN. HG)	PRESSURE ALTITUDE (IN FEET)	BLOWER CONTROL POSITION	USE LOW BLOWER BELOW	MIXTURE CONTROL POSITION	MINM F/A RATIO	FUEL FLOW GAL/HR	MAX CYL HD TEMP °C	REMARKS
TAKE-OFF	450	2300	36.5				"Full Rich"			260	5 Minute Limit
MILITARY RATED POWER											
⊙ NORMAL RATED POWER (100%)	400	2200	32.8				"Full Rich"	.090	40	260	
MAX CRUISING (75%)		1925	28.8				"Best Power" or "Smooth" Operation	.079	24	235	
DESIRED CRUISE (67%)		1925	26.4				"Best Power" or "Smooth" Operation	.073	22	235	
DESIRED CRUISE (60%)		1860	25.0				"Best Power"	.073	20	235	

NOTE: The data on this chart are the result of dynamometer tests and are adaptable for flight purposes in the absence of the Pilot's Handbook of Operating Instructions.

⊕ REFER TO T.O. NO. 00-10 FOR DEFINITION OF EACH OPERATING CONDITION

⊙ MAXIMUM PERMISSIBLE CONTINUOUS HORSE POWER

REVISED 12-1-41

SECTION III SPECIFIC OPERATING INSTRUCTIONS

ENGINE: R-985-21

DATE:

CONDITION	FUEL PRESSURE LB/IN. ²	OIL PRESSURE LB/IN. ²	OIL TEMP °C	COOLANT TEMP °C
DESIRED	3-4	65-80	50-70	
MAXIMUM		90		
MINIMUM		55		
IDLING		15		

MAX PERMISSIBLE ENGINE OVER SPEED: 2640 RPM

MAX ALLOWABLE OIL CONSUMPTION AT:

NORMAL RATED POWER _____ QT /HR

MAXIMUM CRUISING 5.9 QT /HR

MINIMUM SPECIFIC FUEL FLOW _____ QT /HR

FUEL GRADE 87 OCTANE

⊕ OPERATING CONDITION	HORSE POWER	RPM	MANIF PRESS. (IN. HG)	PRESSURE ALTITUDE (IN FEET)	BLOWER CONTROL POSITION	USE LOW BLOWER BELOW	MIXTURE CONTROL POSITION	MINM F/A RATIO	FUEL FLOW GAL/HR	MAX CYL HD TEMP °C	REMARKS
TAKE-OFF	440	2300	34.6				"Full Rich"			260	5 Minute Limit
MILITARY RATED POWER											
⊙ NORMAL RATED POWER (100%)	420	2200	34.1				"Full Rich"	.094		260	
MAX CRUISING (75%)		1925	30.6				"Full Rich" to "Best Power"	.080	26	235	
DESIRED CRUISE (67%)		1925	28.1				"Best Power"	.076	22	235	
DESIRED CRUISE (60%)		1850	27.2				"Best Power"	.073	20	235	

NOTE: The data on this chart are the result of dynamometer tests and are adaptable for flight purposes in the absence of the Pilot's Handbook of Operating Instructions.

⊕ REFER TO T.O. NO. 00-10 FOR DEFINITION OF EACH OPERATING CONDITION

⊙ MAXIMUM PERMISSIBLE CONTINUOUS HORSE POWER

REVISED 12-1-41

SECTION III SPECIFIC OPERATING INSTRUCTIONS																																			
ENGINE: R-985-23					DATE:																														
<table border="1"> <tr> <th>CONDITION</th> <th>FUEL PRESSURE LB/IN.²</th> <th>OIL PRESSURE LB/IN.²</th> <th>OIL TEMP °C</th> <th>COOLANT TEMP °C</th> </tr> <tr> <td>DESIRED</td> <td>3-4</td> <td>65-90</td> <td>50-70</td> <td></td> </tr> <tr> <td>MAXIMUM</td> <td></td> <td>90</td> <td></td> <td></td> </tr> <tr> <td>MINIMUM</td> <td></td> <td>55</td> <td></td> <td></td> </tr> <tr> <td>IDLING</td> <td></td> <td>15</td> <td></td> <td></td> </tr> </table>					CONDITION	FUEL PRESSURE LB/IN. ²	OIL PRESSURE LB/IN. ²	OIL TEMP °C	COOLANT TEMP °C	DESIRED	3-4	65-90	50-70		MAXIMUM		90			MINIMUM		55			IDLING		15			MAX PERMISSIBLE ENGINE OVER SPEED: 2640 RPM MAX ALLOWABLE OIL CONSUMPTION AT: NORMAL RATED POWER _____ QT /HR MAXIMUM CRUISING 4.6 QT /HR MINIMUM SPECIFIC FUEL FLOW _____ QT /HR FUEL GRADE 87 OCTANE					
CONDITION	FUEL PRESSURE LB/IN. ²	OIL PRESSURE LB/IN. ²	OIL TEMP °C	COOLANT TEMP °C																															
DESIRED	3-4	65-90	50-70																																
MAXIMUM		90																																	
MINIMUM		55																																	
IDLING		15																																	
⊕ OPERATING CONDITION	HORSE POWER	R P M	MANIF PRESS. (IN. HG)	PRESSURE ALTITUDE (IN FEET)	BLOWER CONTROL POSITION	USE LOW BLOWER BELOW	MIXTURE CONTROL POSITION	MINM F/A RATIO	FUEL FLOW GAL/HR	MAX CYL HD TEMP °C	REMARKS																								
TAKE-OFF	450	2300	36.5				"Full Rich"			260	5 Minute Limit																								
MILITARY RATED POWER	450	2300	35.5				"Full Rich"	.097		260	5 Minute Limit																								
⊙ NORMAL RATED POWER (100%)	400	2200	33.0				"Full Rich" to "Smooth" Operation	.090		260																									
MAX CRUISING (75%)		1925	28.5				"Smooth" Operation	.082	29	235																									
DESIRED CRUISE (67%)		1925	26.5				"Best Power"	.075	22	235																									
DESIRED CRUISE (60%)		1850	25.5				"Best Power"	.072	19	235																									
NOTE: The data on this chart are the result of dynamometer tests and are adaptable for flight purposes in the absence of the Pilot's Handbook of Operating Instructions.																																			
⊕ REFER TO T.O. NO. 00-10 FOR DEFINITION OF EACH OPERATING CONDITION ⊙ MAXIMUM PERMISSIBLE CONTINUOUS HORSE POWER REVISED 12-1-41																																			

SECTION III SPECIFIC OPERATING INSTRUCTIONS																																			
ENGINE: R-985-25, -27, -AN1 and -AN-3					DATE:																														
<table border="1"> <tr> <th>CONDITION</th> <th>FUEL PRESSURE LB/IN.²</th> <th>OIL PRESSURE LB/IN.²</th> <th>OIL TEMP °C</th> <th>COOLANT TEMP °C</th> </tr> <tr> <td>DESIRED</td> <td>3-4</td> <td>75-90</td> <td>50-70</td> <td></td> </tr> <tr> <td>MAXIMUM</td> <td></td> <td>100</td> <td>95</td> <td></td> </tr> <tr> <td>MINIMUM</td> <td></td> <td>60</td> <td></td> <td></td> </tr> <tr> <td>IDLING</td> <td></td> <td>15</td> <td></td> <td></td> </tr> </table>					CONDITION	FUEL PRESSURE LB/IN. ²	OIL PRESSURE LB/IN. ²	OIL TEMP °C	COOLANT TEMP °C	DESIRED	3-4	75-90	50-70		MAXIMUM		100	95		MINIMUM		60			IDLING		15			MAX PERMISSIBLE ENGINE OVER SPEED: 2760 RPM MAX ALLOWABLE OIL CONSUMPTION AT: NORMAL RATED POWER _____ QT /HR MAXIMUM CRUISING 4.6 QT /HR MINIMUM SPECIFIC FUEL FLOW _____ QT /HR FUEL GRADE 87 OCTANE					
CONDITION	FUEL PRESSURE LB/IN. ²	OIL PRESSURE LB/IN. ²	OIL TEMP °C	COOLANT TEMP °C																															
DESIRED	3-4	75-90	50-70																																
MAXIMUM		100	95																																
MINIMUM		60																																	
IDLING		15																																	
⊕ OPERATING CONDITION	HORSE POWER	R P M	MANIF PRESS. (IN. HG)	PRESSURE ALTITUDE (IN FEET)	BLOWER CONTROL POSITION	USE LOW BLOWER BELOW	MIXTURE CONTROL POSITION	MINM F/A RATIO	FUEL FLOW GAL/HR	MAX CYL HD TEMP °C	REMARKS																								
TAKE-OFF	450	2300	38.5				"Full Rich"	.092	50	260	5 Minute Limit																								
MILITARY RATED POWER																																			
⊙ NORMAL RATED POWER (100%)	450	2300	37.5	1000			"Full Rich"	.092	50	260																									
MAX CRUISING (75%)	350	2000	33.0	3500			"Full Rich" to "Smooth" Operation	.084	31	235																									
DESIRED CRUISE (67%)	330	2000	31.0	5000			"Best Power"	.075	27	235																									
DESIRED CRUISE (60%)	310	1940	29.5	6000			"Best Power"	.073	23	235																									
NOTE: The data on this chart are the result of dynamometer tests and are adaptable for flight purposes in the absence of the Pilot's Handbook of Operating Instructions.																																			
⊕ REFER TO T.O. NO. 00-10 FOR DEFINITION OF EACH OPERATING CONDITION ⊙ MAXIMUM PERMISSIBLE CONTINUOUS HORSE POWER REVISED 12-1-41																																			