ENSTROM HELICOPTER CORPORATION

ENSTROM 480 OPERATOR'S MANUAL

AND

FAA APPROVED ROTORCRAFT FLIGHT MANUAL

REPORT NO. 28-AC-022

DATED: JUNE 7, 1993

Revision 21, dated September 27, 2019, applies to the Enstrom 480 Operators and FAA Approved Rotorcraft Flight Manual, dated 7 June, 1993. Incorporate this revision by removing and inserting the pages listed below.

Remove pages	Insert pages
v through vi	v through vi
viii through xi	viii through xi
5-6-3 through 5-6-3.1	5-6-3 through 5-6-3.1
5-6-5	5-6-5
6-2	6-2
7-13	7-13
7-35	7-35
8-15	8-15
9-i	9-i
9-3 through 9-4	9-3 through 9-4

ENSTROM 480 OPERATOR'S MANUAL
LOG OF REVISIONS

REV. NO.	PAGES	DESCRIPTION	DATE	FAA APPROVAL
16	i,v thru xi,2-2, 2-4,2-5,8-i,8-3, 8-6 thru 8-16	Added information about inspecting/servicing the overrunning clutch (ORC) when the ORC cover is equipped with a sight plug	09/17/06	Joseph C. Miess
17	v, vi, ix, x, xi, 1-2, 5-6-3, 5-6-3.1	Added Speed Avoid Range to Dual Tachometers	03/06/07	Joseph C. Miess
18	v, ix-xi, 1-8, 1-12, 8-2, 8-13 through 8-16	Clarified temperature limits for use of anti-icing fuel additives. Removed biocidal additive requirement. Updated fuels, lubricants, specifications.	09/20/10	Joseph C. Miess
19	v, vi, viii through xi, 1-8, 1-12, 1-17, 2-i through 2-2, 2-4 through 2-7.2, 2-11, 2-12, 2-18, 3-i, 3-ii, 3-8, 3-9, 3-12, 3-16, 3-18, 3-19, 6-i, 6-2, 6-10, 6-11, 7-16, 7-22 through 7-22.1, 7-28, 7-30, 7-35, 8-i, 8-2, 8-3, 8-5 through 8-8, 8-13 through 8-16, 9-i, 9-3.	General text clarifications and revisions throughout Chapters 2, 3, 7, 8 and 9. Para. 2-9.1, 2-11, 2-17: revised (fuel management, dipstick removed); Para. 2-11, 7-44, Figure 8-1, Para. 8-9, Figure 8-2, Table 8-1: revised (vented clutch oil reservoir). Para. 2-37: revised; Para. 2-49: new (deceleration check). Para. 3-40: revised (lamiflex bearing failure). Para. 6-8: revised (battery weight and balance). Figure 6-1: revised; Para. 6-9: new (operation without doors).	08/17/15	Ronald D. McElroy
20	v, ix, 1-2, 3-ii, 3-19	Updated Dual Tachometer Speed Avoid Range (p. 1-2), Added Cyclic Trim Failure Emergency Procedure (p. 3-19).	05/19/16	Ronald D. McElroy
21	v, vi, viii, ix, x, xi 5-6-3, 5-6-3.1, 5-6-5, 6-2, 7-13, 7-35, 8-15, 9-i, 9-3, 9-4	Updated Dual Tachometer Speed Avoid Range (p. 5-6-3, 5-6-3.1); Updated Max. Allowable Torque Chart (p. 5-6-5); Corrected typo (p. 6-2); Clarified caution light illumination parameters (p. 7-13, 7-35) Updated recommended oil list (p. 8-15); Updated Vortex Ring State (Settling With Power) (p. 9-3, 9-4).	10/09/19	RYAN BRUCE NELSON Digitally signed by RYAN BRUCE NELSON Date: 2019.11.14 15:05:44 -06'00' Ryan Nelson

Approved by the Manager, Southwest Flight Test Section, AIR-713
Federal Aviation Administration, Ft. Worth, TX

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REV. NO.	DATE	EASA APPROVAL	FAA APPROVAL ON BEHALF OF EASA
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2	Sep 28/03	Article 3, Commission Regulation (EU) 748/2012	N/A
3	Sep 28/03	Article 3, Commission Regulation (EU) 748/2012	N/A
4	Sep 28/03	Article 3, Commission Regulation (EU) 748/2012	N/A
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14	May 29/05	2005-4678	N/A
15	Sep 9/05	Decision 2004/04/CF	N/A
16	Sep 17/06	Decision 2004/04/CF	N/A
17	Aug 2/07	EASA.IM.R.C.01427	N/A
18	Jan 27/14	EASA 10045751	N/A
19	May 1/17	FAA/EASA T.I.P. *	M. Javed
20	May 1/17	FAA/EASA T.I.P. *	M. Javed
21	Nov 14/19	FAA/EASA T.I.P. **	R. Nelson

* Section 3.2 T.I.P. Revision 5

** Section 3.5.12 T.I.P. Revision 6

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SUPPLEMENT NO.	DATE	EASA APPROVAL	FAA APPROVAL ON BEHALF OF EASA
1	Sep 28/03	Article 3, Commission Regulation (EU) 748/2012	N/A
2	Sep 28/03	Article 3, Commission Regulation (EU) 748/2012	N/A
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4	Sep 28/03	Article 3, Commission Regulation (EU) 748/2012	N/A
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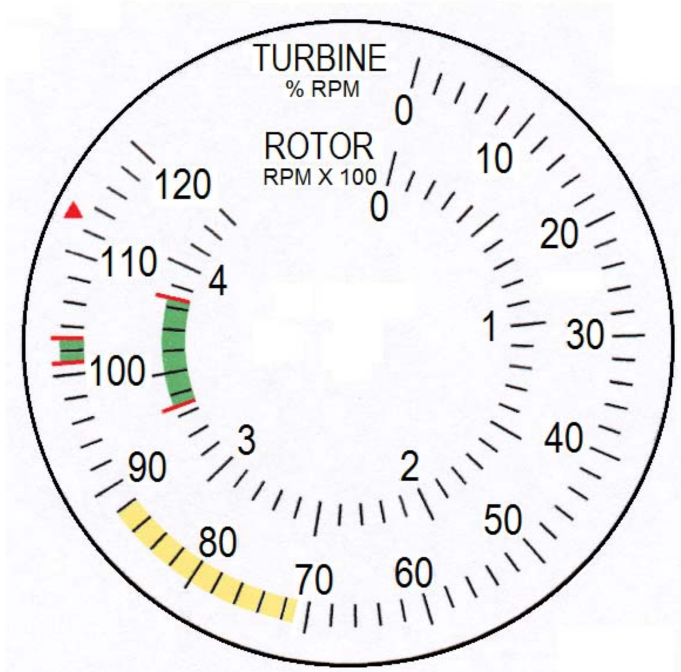
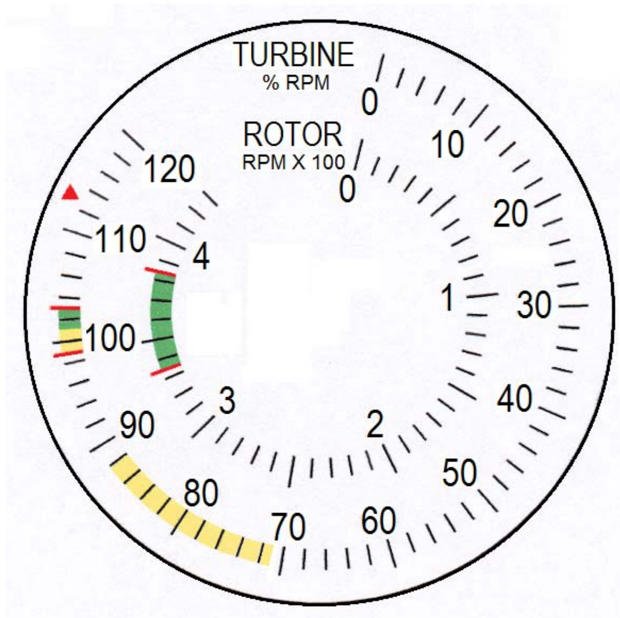


DUAL ROTOR AND POWER TURBINE TACHOMETER

ROTOR		
385 RPM	Red Radial	Maximum Power OFF
334-385 RPM	Green Arc	Continuous Operation (Including Autorotation)
334 RPM	Red Radial	Minimum Power OFF

POWER TURBINE (N_2)		
113% RPM	Red Arrowhead	15 Second Maximum Transient N_2 Varies Linearly from 113% in Autorotation per Figure 1-2.
103% RPM	Red Radial	Maximum N_2 Continuous
101-103% RPM	Green Arc	Normal Operating Range
101% RPM	Red Radial	Minimum N_2 Continuous
71-88 % RPM	Yellow Arc	Speed avoid range. Move through range as expediently as possible.

FIGURE 5-6-1. INSTRUMENT MARKINGS (Sheet 1 of 3)



DUAL ROTOR AND POWER TURBINE TACHOMETER

ROTOR		
385 RPM	Red Radial	Maximum Power OFF
334-385 RPM	Green Arc	Continuous Operation (Including Autorotation)
334 RPM	Red Radial	Minimum Power OFF

POWER TURBINE (N_2)		
113% RPM	Red Arrowhead	15 Second Maximum Transient N_2 Varies Linearly from 113% in Autorotation per Figure 5-6-2.
103% RPM	Red Radial	Maximum N_2 Continuous
101-103% RPM	Green Arc	Limited Operations in certain Loading Conditions with Emergency Pop-out Floats Installed. See supplement for emergency floats (supplement #8).
101% RPM	Red Radial	Minimum N_2 Continuous
71-88 % RPM	Yellow Arc	Speed avoid range. Move through range as expediently as possible.

FIGURE 5-6-1. INSTRUMENT MARKINGS (Sheet 2 of 3)

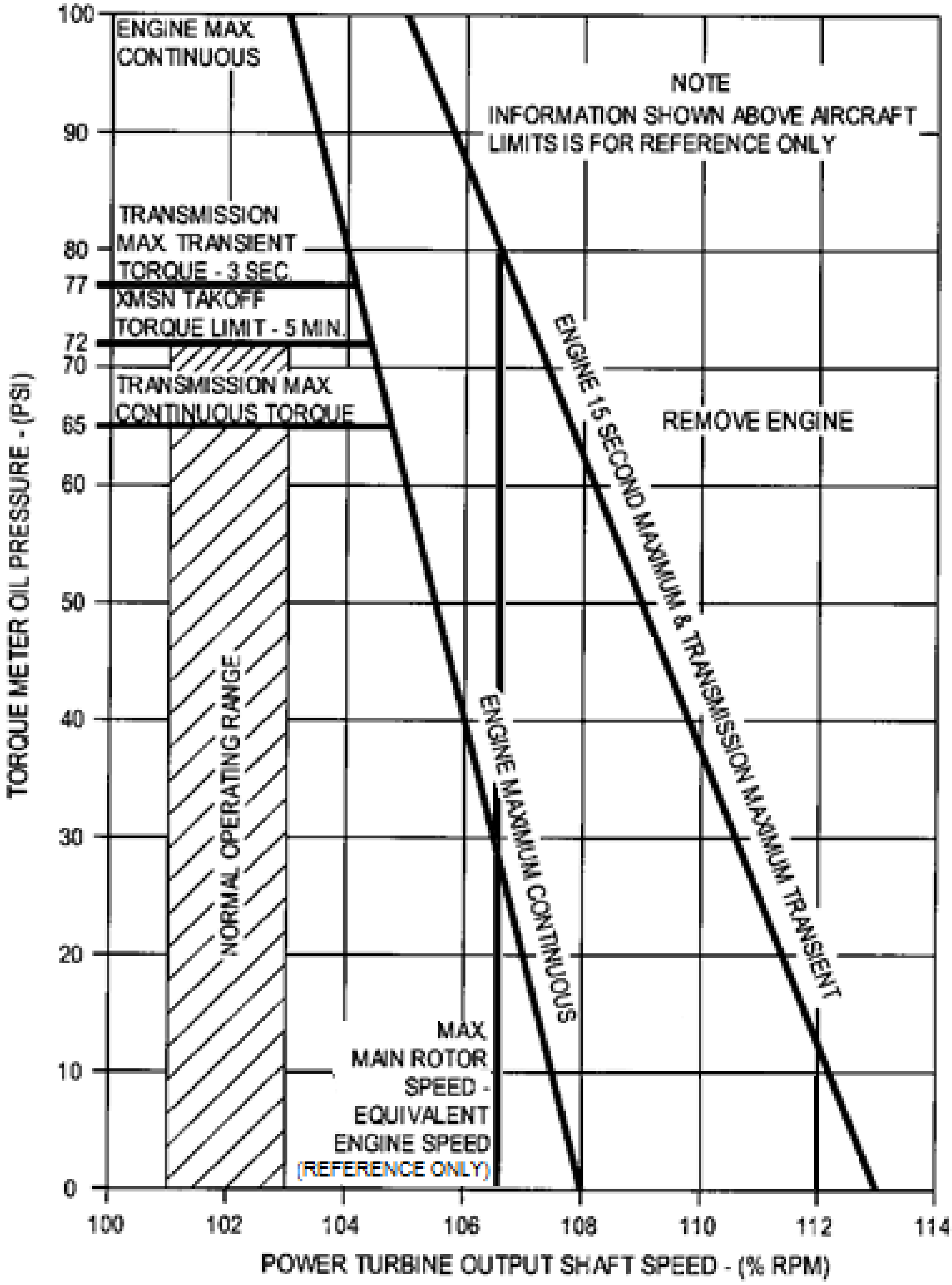


FIGURE 5-6-2. MAXIMUM ALLOWABLE TORQUE AND N2

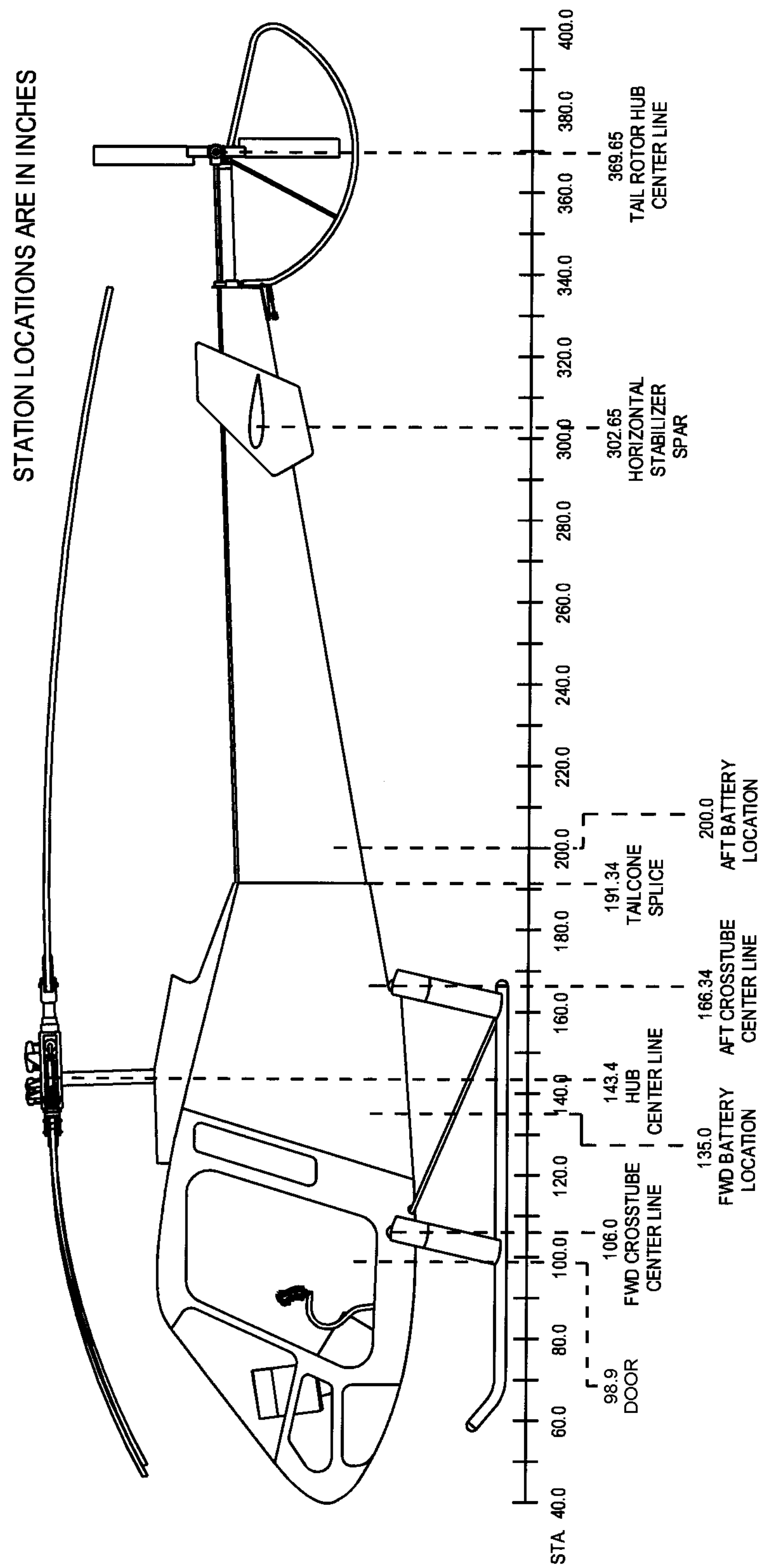


Figure 6-1. Helicopter Station Diagram

Indicator and is driven by a remote sensing thermocouple located at the engine oil tank outlet. The dual indicating instrument is powered by the aircraft 28-volt electrical system through the **ENG T/P** circuit breaker.

h. Caution Lights.

(1) The **ENG INLET** caution light is discussed in the air induction system section, paragraph 7-19.

(2) The **FUEL FILTER** caution light is discussed in paragraph 7-22.

(3) The **ENG CHIP** caution light is discussed in paragraph 7-27.

(4) The **ENG OIL TEMP** caution light will illuminate when the engine oil temperature reaches 107°C ascending and will extinguish at 100° descending. A set of contact closures in the dual engine oil temperature/pressure indicator send a signal to the segmented caution panel logic circuit at each of the above set points to turn the caution light either on or off accordingly.

(5) The **ENG OIL PRESS** caution light will illuminate if the N1 is above 78.5% and the oil pressure is at or below 88 psig. The light will extinguish as the pressure rises above 90 psig with the N1 above 78.5%. For helicopters equipped with P/N ECD4078 caution panel, the **ENG OIL PRESS** caution light will also illuminate anytime engine oil pressure is below 50 psi or above 130 psi.

TABLE 7-1. CAUTION PANEL SEGMENTS

SEGMENT	COLOR	DESCRIPTION OF FAULT
ENG CHIP	**AMBER**	Engine scavenge oil has ferrous metal fragments
MAIN XMSN CHIP	**AMBER**	Main transmission chip detector has detected ferrous metal fragments
TAIL CHIP	**AMBER**	Tail rotor gearbox chip detector has detected ferrous metal fragments
ENG OIL TEMP	**AMBER**	Engine oil temperature is above 107°C
MAIN XMSN HOT	**AMBER**	Main transmission oil temperature is above 107°C
DRIVE BRG HOT	**AMBER**	Either the forward or aft lower pulley bearings are above 120°C
ENG OIL PRESS	**AMBER**	Engine N_1 RPM is above 78.5% and engine oil pressure is below 90 psi; (P/N ECD4078 caution panel only: or anytime engine oil pressure is below 50 psi or above 130 psi)
BATT HOT*	**RED**	Battery temperature exceeds 71°C
ENG INLET AIR	**AMBER**	Engine inlet swirl tube particle separator partially blocked
BATT TEMP*	**AMBER**	Battery temperature exceeds 63°C
DC GEN	**AMBER**	DC generator system failure
FUEL FILTER	**AMBER**	Fuel filter bypass is impending
FUEL LOW	**AMBER**	Fewer than 5 gallons/19 liters remaining
ENG ANTI-ICE	**GREEN**	Engine anti-ice is activated
SPARE	**AMBER**	Unused segment
A/F FILTER**	**AMBER**	Airframe fuel filter bypass is impending
MRGB PRESSH	**AMBER**	Pump inlet pressure is less than 4.4-5.9 psi/30.2-40.7 kPa of vacuum

NOTE: On early production aircraft, the engine anti-ice segment was labeled "ENG DEICE". All of the associated references in this RFM and on aircraft placards refer to engine anti-ice. They are one and the same.

* These segments are labeled "SPARE" and are unused if the aircraft is equipped with the optional lead-acid battery.

** The AA/F FILTER@ segment is part of the optional external (airframe mounted) fuel filter kit and will be installed in the ASPARE@ location.

H The AMRGB PRESS@ segment is part of the main rotor transmission filtration/cooling system and will be installed in the ABATT HOT@ location. If the aircraft is equipped with the main rotor transmission filtration/cooling system, the aircraft will be equipped with the optional lead acid battery.

TABLE 8-2. APPROVED COMMERCIAL OILS (CONTINUED)

MIL-PRF-2105/API GL-5

MANUFACTURER	MANUFACTURER'S DESIGNATION
Exxon Mobil Corp.	Mobil 1 Synthetic Gear Lubricant LS 75W-90 Mobil Delvac 1[1] Synthetic Gear Oil 75W-90 Mobilube HD LS 80W-90 Mobilube HD Plus 80W-90
Shell Oil Company	Shell Spirax® S Gear Lubricant 75W-90 Shell Spirax® HD 80W-90
Esso	Esso Gear Oil GX 75W-90 Esso Gear Oil GX Extra 75W-90
BP Lubricants USA, Inc.	Syntorq GL-5 75W Castrol Syntrax Limited Slip 75W-90 (Syntec Gear Oil)

TABLE 8-3. APPROVED PRIMARY, EMERGENCY, AND COLD WEATHER FUELS

TYPE	SPECIFICATION	LIMITATIONS
Primary	ASTM D1655 Jet A or A1 ASTM D6615 Jet B MIL-DTL-5624 JP-4 & JP-5 MIL-DTL-83133 JP-8 GOST 10227 Grade TS-1 or RT (Russia) STAS 5639-88, Grade TH (Romania) GB 6537, Grade No. 3 (Peoples Republic of China) GSTU 320.00149943.007-97 Grade -RT(PT) (Ukraine) GSTU 320.00149943.007-99 Grade -TS-1(TC-1) (Ukraine)	With anti-ice additive **(See Note below)**
Emergency	ASTM D910 AVGAS (without TCP)	All Grades, Maximum 6 hours operation per overhaul period. With anti-ice additive
Cold Weather	MIL-DTL-5624 JP-4 ASTM D6615 Jet B ASTM D910 AVGAS-Jet fuel mixture **(See Note below)**	With anti-ice additive

[1] Mobil Delvac 1 75W-90 supersedes Mobil Delvac 75W-90 and Mobil SHC 75W-90.

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9-8. Operating Characteristics

The flight characteristics of this helicopter, in general, are similar to other single rotor helicopters. This helicopter is capable of hovering in winds from any azimuth up to 35 knots.

9-9. Retreating Blade Stall

Blade stall occurs at higher forward speeds when a portion of the retreating blade stalls because of the reduced relative velocity of airflow over the blade at high blade angles. When the airspeed of the tip of the retreating blade falls below a predetermined value, or when a relative blade angle exceeds a predetermined value, blade stall will be experienced. If blade pitch is increased (as with increased collective or forward cyclic control), or if the forward speed is increased, the stalled portion of the rotor disc increases, and the stall progresses from the tip toward the root of the retreating blade. During maneuvers that increase the g-load, such as sharp turns or high-speed flares from diving descents, where rapid application of collective or cyclic pitch control is involved, severe blade stall may be encountered. Severe blade stall may also be encountered in turbulent air by gust-induced load factors or corrective control applications by the pilot. In the stall condition, each main rotor blade will stall as it passes through the stall region, creating a three per rev vibration. When significant blade stall is encountered a mild roughness will be noted along with some cyclic control feedback that will cause the cyclic to have a tendency to displace aft of the trimmed position. The vibration due to the blade stall will increase as blade stall progresses, as will the requirement for forward force to maintain the cyclic in the initial trimmed position. Both of these cues should provide adequate warning that blade stall is being encountered. Severe turbulence or abrupt control movement at this point will increase the severity of the stall but will not cause any loss of control to occur. In this helicopter, there is not as pronounced a tendency for the fuselage to pitch up and roll left in response to the rotor stalling as may be experienced in other helicopters, but if the rotor is held in a stalled condition and the blade stall is aggravated, the helicopter will eventually exhibit this pitch and roll tendency. Even though blade stall may be encountered, the helicopter is fully controllable even in severe blade stall because of the blade design and the high rotor control power inherent in this rotor design. Blade stall may be eliminated by any or all of the following actions:

a. Gradually decrease the severity of the maneuver.

b. Gradually decrease collective pitch.

c. Gradually decrease airspeed.

d. Increase the rotor speed to maximum power on RPM by beeping the engine to 103% N_2.

9-10. Vortex Ring State (Settling With Power)

CAUTION

Flight conditions causing Vortex Ring State should be avoided at low altitudes because of the loss of altitude necessary for recovery.

Vortex Ring State may occur when a helicopter is flown at low airspeeds using a relatively high power setting and at relatively low rates of descent. Under this condition, the helicopter is descending through the air displaced by its own rotor system. The downwash then recirculates through the helicopter rotor system and results in reduced rotor efficiency. This condition can be recognized by increased roughness accompanied by a rapid build-up in rate of descent. Increasing collective pitch alone only tends to aggravate the situation. The Vuichard technique is very effective at recovering from settling with power. This technique uses the tail rotor thrust and the cyclic to move the advancing blade into clear air, at which point the vortex ring will dissipate. Recovery can be completed with much less altitude loss than with traditional techniques.

The Vuichard technique can be performed as follows:

a. Simultaneously, apply sufficient right cyclic to cause a 10° to 20° bank, apply left pedal to maintain heading, and increase collective.

During approach for landings at high gross weights, conditions associated with Vortex Ring State should be avoided.

9-11. Loss of Tail Rotor Effectiveness

Loss of tail rotor effectiveness (LTE) is a phenomenon which can occur in any single main rotor/anti-torque tail rotor helicopter. Although the 480B has a very effective tail rotor and does not exhibit any tendencies for LTE, the pilot should be aware that the potential for LTE, however small, does exist. As such, pilots should be aware of the causes and recovery techniques.

There are a number of factors which reduce the effectiveness of the tail rotor or increase the thrust required from the tail rotor. These factors include high power settings, low airspeeds, left crosswinds or tailwinds, and right, yawing turns. Under exactly the right conditions, these factors can combine to make the tail rotor virtually ineffective. This LTE can be recognized by an uncommanded right yaw which can not be stopped using the tail rotor pedal alone. Recovery from LTE can be accomplished by increasing forward speed, lowering the collective if altitude permits, and applying left pedal. The longer corrective actions are delayed, the more difficult it will be to recover from LTE.

9-12. Ground Resonance

Ground resonance is an aerodynamic phenomenon associated with fully articulated rotor systems. It develops when the rotor blades move out of phase with each other and cause the rotor disc to become unbalanced. The chance of encountering ground resonance in the 480B is very remote; however, the potential does exist if the main rotor dampers or oleo struts are severely degraded or damaged.

If severe vibrations are encountered on the ground when bringing the main rotor rpm up to operating speed, immediately turn the throttle to the flight idle position. If severe vibrations are encountered when the main rotor rpm is at operating speed, immediately hover the aircraft and allow the vibrations to dampen. Attempt to land the aircraft. If severe vibrations are encountered again, immediately hover the aircraft, allow the vibrations to dampen, and perform a hovering autorotation.