TECHNICAL BULLETIN

ENGINE AND TRANSMISSION OILS, FUELS AND ADDITIVES FOR ARMY AIRCRAFT

This copy is a reprint which includes current pages from Changes 1 through 8.

This Technical Bulletin supersedes TB 55-9150-200-25, 27 October 1971, including all changes.

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NO. 8

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**ENGINE AND TRANSMISSION OILS,
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ENGINE AND TRANSMISSION
OILS, FUELS AND ADDITIVES FOR ARMY AIRCRAFT

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2-1 and 2-2	2-1 and 2-2
--------	2-2.1/2.2.2
2-7 and 2-8	2-7 and 2-8
2-8.1/2-8.2	2-8.1/2-8.2
2-9 and 2-10	2-9 and 2-10
3-3 and 3-4	3-3 and 3-4

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Technical Bulletin

**ENGINE AND TRANSMISSION OILS
FUELS AND ADDITIVES FOR ARMY AIRCRAFT**

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1-1/1-2	1-1/1-2
2-7 and 2-8	2-7 and 2-8
2-8.1/2-8.2	2-8.1/2-8.2
2-9 through 2-12	2-9 through 2-12
3-3 and 3-4	3-3 and 3-4

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2-7 through 2-10	2-7 through 2-10
3-3 and 3-4	3-3 and 3-4

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Chapter 2	2-5 thru 2-8	2-5 thru 2-8
	2-9 thru 2-12	2-9 thru 2-12
Chapter 3	3-11 and 3-12	3-11 and 3-12
	3-15 and 3-16	3-15 and 3-16

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No. 55-9150-200-24

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C. 30 July 1976

Engine and Transmission
Oils, Fuels and Additives For Army Aircraft

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistake or if you know of a way to improve the procedure, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publication and Blank Forms), or DA Form 2028-2 located in the back of this manual directly to: Commander, US Army Aviation and Troop Command, ATTN: AMSAT-l-MP, 4300 Goodfellow Blvd., St. Louis, MO 63120-1798. A reply will be furnished to you.

LIST OF TABLES

CHAPTER 1

GENERAL

1-1. Purpose.

This bulletin specifies fuels, oils, additives and hydraulic fluids that will be used in Army aircraft.

1-2. Scope.

This bulletin is applicable to all active US Army, US Army Reserve, and US Army National Guard activities operating and/or maintaining US Army aircraft.

1-3. Noncompliance Provision.

In all cases whenever compliance with provisions of this bulletin cannot be accomplished, the reasons will be forwarded to Commander, US Army Aviation and Troop Command, ATTN: AMSAT-1-MP, 4300 Goodfellow Blvd., St. Louis, MO 63120-1798.

1-4. Definitions.

For the purpose of this bulletin, the following definitions will apply:

a. Army standard fuel. These are the Army designated primary fuels adopted for world-wide use. These will be the only fuels which will be readily available in the Army supply system.

b. Alternate fuel. This is a fuel which can be used continuously when the Army standard fuel is not available, without reduction of power output. Power setting adjustments and increased maintenance may be required when an alternate, fuel is used.

c. Approved commercial fuels. Commercial fuels may be used when standard or alternate fuels are not available. Refer to applicable aircraft manuals for limitations.

d. Emergency fuel. This fuel may be used if the standard, alternate, and approved commercial fuels are not available. Refer to applicable aircraft and engine manuals for operating limitations.

e. Engine manufacturer's recommended fuel. This is the fuel recommended by the engine manufacturer as most suitable for use in a particular engine for maximum efficiency and longest engine life.

f. Draining. This is a procedure where oil fluid (fuel, oil, hydraulic fluid, etc.) in a reservoir or line is removed by gravity flow leaving residual amounts of old fluid on the walls of the component.

g. Flushing and purging. This is a cleaning procedure whereby the old fluid is first drained and then completely removed from lines or reservoir by action of a solvent. The dry line or reservoir is then refilled with new fluid, drained to remove solvent, and then refilled with service fluid. The oil-lubricated parts are then mechanically rotated, if possible, to assure proper lubrication.

1-5. Unlisted Commercial Products.

An effort has been made to list all known qualified manufacturers and their products. These products meet the requirements of the applicable Military Specifications. Equivalent products of unlisted manufacturers may be used providing they meet the requirements of the applicable Military Specifications as verified by ATCOM. Code numbers for the identification of fuels, lubricants and allied products used by the NATO Armed Forces are listed in TB 34-9-25.

1-6. Packaged Products.

See MIL-HDBK-200, Chapter 8 for storage, stock rotation and markings of packaged petroleum products.

CHAPTER 2

FUELS AND FUEL ADDITIVES

Section I. TURBINE ENGINE FUELS

2-1. General.

a. Turbine fuels are high-quality fuels covering the general heavy gasoline and kerosine boiling range. They do not contain dyes or tetraethyl lead.

b. One of the major differences between the wide-boiling and the kerosine types is the fuel volatility. JP-4 type fuels have a wider boiling range with their initial boiling point considerably below that of kerosine. As a group, these fuels have lower specific gravities than kerosine types. Wide-boiling range fuels have Reid Vapor Pressures of 2-3 pounds and flash points of below room temperature. The kerosine type fuels have Reid Vapor Pressures of less then 0.5 pound and flash points higher then 100°F (38°C). Wide-boiling range fuels generally have lower freezing points than kerosine type fuels.

c. Military specification MIL-T-5624 covers JP-4 and JP-5 fuels. Jet A, Jet Al and Jet B are commercial fuels which conform to the American Society for Testing Materials specification ASTM-D-1 655.

d. Jet B is a JP-4 type fuel; its freezing point is -56°F (-49° C) instead of -72° F (-58° C).

e. JP-5, Jet A, and Jet A-1 are kerosine-type fuels.

f. ASTM Jet A and A-1 differ primarily in fuel freezing point. Jet A is considered suitable down to fuel temperatures of -36°F (-38°C), while Jet A-1 has a minimum requirement of -54°F (48° C).

g. JP-4 is a fuel consisting of approximately 65% gasoline and 35% light petroleum distillate, with rigidly specified properties.

h. JP-5 is a specially refined kerosine having a minimum flash point of 140"F and a freezing point of -51°F (-46° C).

i. JP-8 is a specially refined kerosine having a minimum flash point of 110F and a freezing point of -54°F (-48°C).

j. JP-4 is the Army standard fuel for turbine engines.

2-2. Identification.

a. Turbine engine fuel specifications, characteristics, freezing points, flash points, ASTM grades and NATO code numbers are listed in table 2-2.

b. Table 2-3 lists the Army standard, alternate and emergency fuels for fixed and rotary wing turbine powered aircraft.

c. Jet fuels at commercial airports are usually identified by brand names or the American Society for Testing and Materials (ASTM) grades in lieu of NATO code numbers. Table 2-4 contains a list of current brand name products that may be encountered in the USA and at overseas commercial airfields.

2-3. Special Precautions.

a. See aircraft manuals for special precautions in using various turbine fuels.

b. The use of kerosine fuels (JP-5 type) in turbine engines dictates the need for observance of special precautions. Both ground starts and air restarts at low temperature may be more difficult due to negligible vapor pressure. Kerosine fuels having a freezing point of -40°F (-40°C) limit the altitude of a mission to 28,000 feet (8400m) under "standard day" conditions. Those having a freezing point of -67°F (-55°C) limit the altitude of a mission to 33,000 feet (9900m) under "standard day" conditions. The above altitude limits need not be complied with if an engine fuel heater is used.

c. Fuels must be kept free of water to prevent plugging of the fuel system by ice crystals at high altitudes. Elimination of water is also essential to prevent the growth of microbiological organisms. See MIL-HDBK-200, Chapter 9, for information on fuel quality and fuel contamination.

d. Turbine engine fuels, as well as AVGAS, form explosive mixtured readily. In order to Insure safety of personnel, aircraft handling and refueling operations will conform to TM 10-1101, TM 10-1105 and FM 10-68.

2-4. Additives.

a. In general, ASTM specifications for jet fuels permit the use of approved oxidation and corrosion inhibitors and metal deactivators. However, the quantities and types must be declared and agreed to by the consumer. Military specifications permit use of a metal deactivator in either JP-4 or JP-5 fuel and also permit an approved corrosion inhibitor in JP-4, provided it is blended into the fuel by the supplier. MIL-T-5624 presently contains the requirement that both grade JP-4 and JP-5 contain icing inhibitors. The specification requires that these inhibitors be added at the refinery to a minimum percent volume of 0.10 and 0.15% maximum.

WARNING

Inhibitor, Icing, fuel system MIL-I27686, undiluted ethylene glycol monomethyl other is both combustible and toxic. It is harmful If Inhaled or absorbed through the skin. It causes eye Irritation. Before handling undiluted ethylene glycol monomethyl other, consult appropriate safety and occupational health regulations.

b. Icing inhibitor conforming to MIL-1-27686 shall be added to commercial fuel not containing an icing inhibitor during refueling operations, regardless of ambient temperatures. The additive provides anti-icing protection and also functions as a biocide to kill microbial growths in aircraft fuel systems. Refueling operations shall be accomplished in accordance with accepted commercial procedures. (See specific aircraft manuals for any limitations.)

2-5. Interchangeability.

a. When changing from one type of authorized fuel to another, for example JP4 to JP-5, it is not necessary to drain the aircraft fuel system before adding the new fuel.

b. Fuels having the same NATO code numbers are interchangeable.

c. Fuel controls and fuel flow dividers, that are adjustable externally on some engines may require retrimming or readjustment for optimum performance when changing over to a fuel with a different specific gravity. The applicable aircraft operating and maintenance instruction manuals should be consulted for additional information and procedures. Occasionally, alternate fuels will be used in engines with fuel controls set for one specific fuel. Jet fuels conforming to ASTM D1655 specification may be used when MIL-T-5624 fuels are not available. This usually occurs during cross country flights where aircraft using NATO F-44 (JP-5) are refueled with NATO F-40 (JP-4) or commercial ASTM Type B fuels. Whenever this condition occurs, the engine operating characteristics may change in the lower exhaust gas temperatures (EGT). Slower acceleration, lower engine speed, easier starting, and shorter range may be experienced. The reverse is true when changing from F-40 (JP-4) fuel to F-44 (JP-5) or commercial ASTM Type A-1 fuels. Specific gravity adjustments in fuel controls and flow dividers shall be set for the type of fuel used. Most commercial turbine engines will operate satisfactorily on either kerosine or JP-4 type fuel. However, the difference in specific gravity may possibly require fuel control adjustments; if so, the recommendations of the manufacturers of the engine and airframe are to be followed. Also, if the fuel quantity gage is calibrated in pounds, changing to fuels of different specific gravity will cause the fuel gage to be in error.

2-6. Emergency Fuel.

a. Insure that the approval of the pilot is obtained prior to servicing an aircraft with an emergency fuel. The aircraft should be placarded in a conspicuous manner indicating the type emergency fuel used..

b. Gasoline fuel is used in some turbine engines under emergency conditions.

c. The use of straight unleaded gasoline may shorten the operating life of combustion parts; therefore, its use between scheduled internal inspections is limited. Refer to table 2-3 notes. When the allowable operating time has been reached, the use of unleaded gasoline must be discontinued pending result of internal inspection. Unleaded gasoline leaves combustor parts clean; therefore, no special cleaning is required between scheduled hot end inspections. Two parts of unleaded gasoline mixed with one part of kerosine produces a fuel which is preferred above that of straight unleaded gasoline. This mixture should be identified in the fueling record.

d. Leaded gasoline, either straight or mixed with unleaded fuel in any proportion, will deposit a layer of lead compounds on combustor parts. These attack the underlying metal and also act as an insulator which reduces combustion efficiency and causes the formation and deposition of carbon. Therefore, the operating time between

scheduled hot end internal inspections is limited. Refer to table 2-3 notes. Continued use of leaded aviation gasoline or jet fuel in excess of 1% of aviation gasoline, may cause failure of the vaporizing tubes and subsequent turbine blade damage resulting in a safety-of-flight hazard. The continued use of jet fuel contaminated with less than 1% of aviation gasoline is permissible in these aircraft. If the permissible accumulated operating time is exceeded, a special cleaning and inspection becomes mandatory. The cleaning and inspection may be delayed for 10 operating hours provided only recommended fuel is used during the delay. A fuel mixture which contains over 10% leaded gasoline shall be identified as all-leaded gasoline on DA Form 2408-13, Aircraft Inspection and Maintenance Record.

e. Gasoline containing TCP (Tricresyl Phosphate) in addition to TEL (Tetraethyl Lead) is more detrimental to combustor parts than gasoline containing TEL only. Deterioration of combustor parts occurs at least twice as fast when TCP is added to leaded gasoline. Operating time on gasoline with TCP is therefore limited to one-half the time allowed on leaded gasoline without TCP and shall be clearly indicated in the fueling records. Whenever fuel with TCP is used, special cleaning and inspection of combustor parts is mandatory.

f. For information concerning the cleaning of combustor parts after the use of emergency fuels, refer to the applicable maintenance manuals.

g. See footnote in table 2-3 for limitations and precautions with emergency fuel.

NOTE

Record emergency fuel flight time on DA Form 2408-13 block 17. When DA Form 2408-13 is removed from the log book, transfer the emergency fuel data to DA Form 2408-15 for the engine and record both that days flight time on emergency fuel and a total flight time on emergency fuel.

2-7. Detection of Leaks.

a. Introduction. Dyed fuel may be used for static leak detection of JP-4 fuel cells and complete fuel systems. Inflight tests to detect leaks, which cannot be detected by static or engine runup test may be used. However, the use of inflight tests requires special approval of the maintenance officer.

b. Preparation of Dye Solution. The quantities of liquid dye to be used and the mixing ratios are as specified in Table 2-1.

c. Mixing in Servicing Vehicle. The dye can be blended in a refueling vehicle that has been reserved for servicing dyed fuel. The required quantity of dye should be determined before starting. To insure proper mixing of dye in fuel, partially fill the trailer to about 10 percent and then add the appropriate amount of dye slowly to the contents of the trailer while the trailer is filled with . remaining fuel.

d. Static Leak Detection in Fuel Cells. Use a diagram of the leaking fuel cell which shows al' connections.

(1) Transfer the fuel into another cell or defuel as necessary. Pour the liquid dye into the leaking cell and fill to the 1/3 level with JP-4 fuel.

NOTE

One third level is determined from the known capacity of the cell; for example, 100 gads added to a 300 gallon cell.

Allow the dye solution to set in the cell for approximately 6 hours or until the dye solution comes through the drain. Should the dye appear, there is a leak within this level.

(2) Repeat the procedure at the 2/3 level and full level, as necessary. A full cell should be allowed to set for approximately 12 hours.

(3) When a leak is detected, connections should be checked, the cell defueled, and residual fuel removed with cloths and drained from the sump. Type MA-1 explosion proof blower may be used to remove fumes. Remove all connections, pull fuel cell down, and check for dye stains on exterior of the cell. These stains are easily detected, thus pinpointing the leak. Rarely is any maintenance necessary other than replacing seals and retorquing connections.

(4) Check for defective cells (blisters, layer separations, etc.) in accordance with the applicable fuel cell and/or aircraft maintenance manual.

(5) After closing the fuel cell, the dye solution may be transferred into the fuel cell once more to the three levels: 1/3, 2/3, and full, thereby ascertaining whether or not the cell still leaks.

(6) After completion of fuel cell leak detection operation, the aircraft may be flown with yellow dyed fuel. Red dyed fuel can be used provided it is diluted 10 parts to 1 part with undyed

fuel-in the fuel cell or cells. If dilution is not possible, the aircraft will be defueled of dyed fuel which will be stored in a bulk storage tank.

e. Static Leak Detection for Fuel System Including Lines and Engines. Leakage checks of airframe mounted lines and connectors, and of integral wing and auxiliary fuel tanks may be undertaken using any of the dyes authorized herein. However, when red dye is used the engine shall not be operated, and the aircraft shall be defueled of the dye fuel following testing. Residual yellow dyed fuel need not be removed.

f. Static Leak Detection in Airframe Lines and Fuel Cells. If only the airframe mounted fuel lines and connectors, or integral wing and auxiliary fuel cells are to be tested, allow the dyed fuel to stand in the aircraft 6 to 8 hours before performing leakage testing.

(1) Examine all accessible fuel cell interconnects, fuel cell access covers, drains, boost pump mounting points, and fuel line connections. Follow periodic instructions given in applicable aircraft maintenance technical manuals.

(2) If the aircraft has not had an engine run-up, operate fuel boost pumps keeping main fuel shutoff valve closed. Check for leaks in the lines upstream of the main fuel shutoff valve.

g. Leak Detection for Engine Run-Up. If engine run-up or test flight is programmed, the leakage test may-be conducted any time after the aircraft has been fueled. Only yellow dyed fuel may be used for engine run-up testing on the ground, after an engine change, or for test flights after a periodic or phased inspection. The dyed fuel is particularly useful in checking for leakage near the engine hot section area, where high temperatures prevent leaking fuel from leaving a wet spot. When the dyed fuel evaporates from a surface, the dye remains as a deposited residue.

(1) Perform engine run-up or test flight in accordance with applicable directives.

(2) Upon completion, carefully examine main fuel line shutoff valve connections and all other connectors downstream from it. Any dye deposit indicates leakage.

(3) When a leak has been repaired, remove the dye stain with the aircraft fuel or dry cleaning solvent conforming to P-D-680 and repeat the applicable test. Recheck repaired areas to verify leakage has been stopped.

h. Disposition of Dyed Fuel. JP-4 fuel dyed with yellow dye may be left in the fuel system, following leak detection operations, and used in normal operations.

(1) Yellow dyed fuel which must be removed from the fuel system may be placed in bulk storage and used without dilution or mixed with other dyed fuel which has been diluted.

(2) JP-4 fuel dyed with red dye liquid will be diluted in the aircraft 10 to 1 with undyed fuel and used in normal operations or removed from the aircraft and placed in bulk storage where it is diluted 10 to 1 with undyed fuel. This fuel may then be issued to base assigned aircraft for normal use.

(3) The bulk tank in which the dyed fuel is stored or mixed with standard fuel will be marked with signs 4'" x 12", black letters on white background, which will be prepared using wood or similar material. The signs will read: THIS TANK CONTAINS LEAK DETECTION DYED FUEL. These signs will be temporarily attached to the receiving and issuing valves. When all of the dyed fuel has been issued, the signs will be removed. This should be accomplished in order to avoid confusion with colored gasoline.

(4) Any excess liquid stain on aircraft, fuel cell, or storage equipment may be removed by wiping with a cloth. The dye will lose color over a short period of time; therefore, it is not necessary to take special measures to remove all stains.

i. Servicing Procedures to Transient Aircraft. Dyed fuel stored in bulk storage facilities will be serviced to locally assigned aircraft. It will not be serviced to transient aircraft. The presence of dyed fuel in transient aircraft could be falsely construed by air crews and maintenance personnel as contaminated fuel. If emergencies arise requiring servicing of dyed fuel to transient aircraft, the crew will be advised and note made on aircraft form that aircraft was serviced with dyed fuel.

Section II. RECIPROCATING ENGINE FUELS

2-8. General.

a. Aviation gasoline (AVGAS) is obtained by adding high-octane components, ethyl liquids and antioxidants to light fractions of petroleum or products of catylitic cracking.

b. The greatest difference among various grades of AVGAS is in anti-knock quality. However, properties in addition to knock are closely controlled by specifications so that the gasolines will perform properly.

c. Grade 100/130 aviation gasoline is the only grade available in the Army supply system. The other grades, if authorized for use, may be procured by local purchase.

d. When necessary, the different grades of aviation gasoline conforming to MIL-G-5572 or ASTM D-910-65T grades and also those designated by NATO code numbers as listed in table 2-5, may be used as specified in table 2-6 under alternate fuel.

2-9. Identification.

a. Gasolines may be colored for purposes of identification and gasolines containing TEL are required by law to be colored.

b. Grade 80/87 aviation gasoline is red, 100/130 is green, 115/145 is purple and commercial 100LL (low lead) AVGAS is blue.

(1) A change of color of an aviation gasoline usually indicates contamination with another product or a loss in fuel quality. A color change can also be caused by a chemical reaction that has weakened the lighter dye component. This color change in itself may not affect the quality of the fuel.

(2) A color change can also be caused by the preservative in a new hose. Grade 115/145 gasoline that has been trapped for a short period of time in new hose may appear green. Flushing a small amount of gasoline through the hose usually removes all traces of color change.

(3) During the period of transition from 115/145 to 100/130 grade as the Army Standard Fuel, there will be a color change resulting from mixing 115/145 purple with 100/130 green, or 100 LL blue in drums, tanks and transporters.

2-10. Operating Limits.

a. Engine operating limits shall not exceed those prescribed for the fuel grade in use. When operating on mixed grades of AVGAS the engine operating limits shall be those specified for the lowest grade of fuel in the tank.

b. When using a fuel (or mixture) other than the standard Army fuel 100/130 (or NATO equivalent), the applicable operator's and maintenance manuals should be referred to for special operational and maintenance procedures, so that power settings may be revised, commensurate with the grade of fuel in use. When going to a higher grade fuel, the published power settings or curves will be adhered to for all flight conditions.

c. When changing from one grade of fuel to another, for example, for 100/130 to 115/145, it is not necessary to drain the aircraft fuel system before adding the new fuel.

d. Motor gasoline should not be used in aircraft engines. Because of the special requirements of aircraft and their engines, aviation gasolines differ from motor gasolines in distillation characteristics, vapor pressure, and tetraethyl lead content. Furthermore, dissimilar lead compounds are used in the two types of fuels.

e. No emergency fuels are specified for reciprocating aircraft engines.

2-11. Additives.

a. Tetraethyl lead (TEL) is added to fuel to increase its octane or performance rating.

b. Tricresyl Phosphate (TCP) is added to prevent spark plug fouling. Only those specific piston engine aircraft showing excessive continuous spark plug lead fouling may be serviced with TCP additive fuels.

(1) TCP is stored and issued under NSN 6810-00-597-5775, supplied in 200 ml (cc) cans, and is a MIL-T-9188, type III product. Each 200 ml can of type III will treat one 55-gallon drum of aviation gasoline.

NOTE

Do not use Tricresyl Phosphate, Federal Specification TT-T-656. The concentration of phosphorus in TT-T-656 is not correct for use in A VGAS.

(2) TCP transforms lead deposits to phosphorus compounds, thus altering the electrical and temperature characteristics of the deposits which reduce spark plug fouling and preignition. TCP only helps relieve spark plug lead fouling in reciprocating engines using highly leaded fuels, especially in those engines operating on a lean mixture. It does not help when an engine is operating under rich fuel mixture conditions. TCP will not help in the resolution of problems involving engine power loss, excessive oil pumping, carburetor icing, valve-sticking, or the elimination of deposits. TCP is not a cure-all.

(3) The following procedures will be used to blend TCP with AVGAS. To treat a full 55 gallon drum of AVGAS, pour the entire contents of one 200 ml can of MIL-T-9188 type III TCP into the drum. The drum then will be rolled a minimum of 100 feet or agitated long enough to insure thorough mixing. Under no circumstances will TCP be introduced directly into aircraft fuel tanks because of the impossibility of proper blending.

WARNING

The majority of problems resulting from the use of TCP can be traced to incomplete mixing with fuel. Complete blending is necessary.

(4) The use of fine wire platinum spark plugs and TCP is helpful in lessening the problems caused by the use of leaded AVGAS.

WARNING

TCP is a toxic chemical. If TCP comes in contact with the skin, affected areas should be washed immediately with soap and water. Precautions should be observed to prevent inhalation of TCP vapors.

Section III. TABLES, FUELS AND FUEL SPECIFICATIONS

Table 2-1. Mixing Ratios

Static Fuel System Tests

Liquid Dye	NSN	Unit of Issue	MIL-SPEC	Mixing Ratio
Red	6820-00-926-8887	2 ounces	MIL-D-81298	Add 2 ounces
Red	6820-00-001-4192	1 gallon	MIL-D-81298	to each 100
Yellow	6820-00-412-2296	1 gallon	MIL-D-81298	gallons of fuel.

Run-Up and Inflight Fuel System Tests

Liquid Dye	NSN	Unit of Issue	MIL-SPEC	Mixing Ratio
Yellow	6820-00-412-2296	1 gallon	MIL-D-81298	Add 1.6 ounces to each 100 gallons of fuel.

Table 2-2. Turbine Engine Fuel Specifications.

NATO Code Number	ASTM Grade	Flash Point, Min	Freezing Point, Max	Characteristics	Specifications
F-40	JP-4	Below 0°F (-18°C)	-76°F (-60°C)	About 65% AVGAS and 35% kerosine	MIL-T-5624
F-44	JP-5	140°F (60° C)	-51°F (-46°C)	High flash point, Kerosine type, low freeze point	MIL-T-5624
F-34	JP8	110°F (43°C)	-54°F (48°C)	High flash point, kerosine type, low freeze point	MIL-T-83133
None	Jet A	110°F (43°C)	-40°F (-40°C)	Kerosine type aviation fuel	ASTM D 1655-70
F-34	Jet A-1	110°F (43°C)	-58°F (-50°C) freeze point	Kerosine type, low	ASTM D 1655-70
F-4	Jet B	--	-60°F (-51°C)	Wide cut gasoline type (2-3 lb Reid vapor pressure)	ASTM D 1655-70
F-42	None	140°F (60°C)	-40°F (-40°C)	High flash point aviation kerosine type fuel	None

Table 2-3. Turbine Engine Fuels

NOTE:
If there is a conflict between specific aircraft manuals and this table, the aircraft manual takes precedence.

Fixed Wing Aircraft

Aircraft	Engine	Army standard fuel	Alternate fuel	Emergency fuel
(MOHAWK)				
OV-1B	T53L-7/A	MIL-T-5624 JP 4 (see Note 1)	MIL-T-5624 JP-5 or MIL-T-83133 JP-8	Gasoline all types Limit 50 hrs (see Note 2)
OV-1C	T53-L-7/A/15	Same	Same	Same
OV-1D	T53-L-701	Same	Same	Same
(UTE)				
RU-21A	T74-CP-700	Same	Same	MIL-G-5572 Any AVGAS Limit 150 hrs (see Note 2)
RU-21D	Same	Same	Same	Same
RU-21E	Same	Same	Same	Same
U-21A/G	Same	Same	Same	Same
RU-21B/C	T74-CP-702	Same	Same	MIL-G-5572 Any AVGAS Limit 10 hrs
U-21 F	PT6A-28	Same	Same	(See Note 2) Same
RU-21H	T74-CP-700	Same.	Same	MIL-G-5572 Any AVGAS Limit 150 hrs (see Note 2)
EU-21A	Same	Same	Same	Same

Table 2-43. Turbine Engine Fuels (Cont)

Rotary Wing Aircraft

Aircraft	Engine	Army standard fuel	Alternate fuel	Emergency fuel
C12A	PT6A-W	MIL-T-5824 JP-4 (See Note 1)	MIL-T-5824 JP- or MIL-T43133 JP-8 Jet A Jet A-1 Jet B	MIL-G-5572 Any AVGAS Limit 150 hrs (See Note 2)
(COBRA)				
AH-1G/Q	T53-L-13/AB	MIL-T 4 (see Note 1)	MIL-T-5624 JP-5 or MIL-T-83133 JP-8	MIL-G-5572 Any AVGAS Limit 50 hrs (see Note 2)
AH-1S/R	T53-L-703	Same	Same	Same
TH-1G	Same	Same	Same	Same
(APACHE)	T700-GE-701	Same	MI-T-5624 JP-5	None
AN-64A	T700-GE-701	Same	or MIL-T-83133 JP-8 JET A JET A-1	
(IROOUOIS)				
UH-1B	T53-L-11/ B/C/D	Same	Same	Same
UH-1C	T53-L-11/ B/C/D	Same	Same	Same
UH-1D	T53-L-11/ B/C/D	Same	Same	Same
UH-1H	T53-L-13/A/B	Same	Same	Same
UH-IM	Same	Same	Same (See Note 12)	Same
(BLACKHAWK)				
UH-60A	T700-GE-700	Same	MIL-T-5624JP-3 or MIL-T-83 133 JP-8 JET A JET A-1	
(CAYUSE)				
OH-6A	T63-A-5A,700	Same	MIL-T-124 JP- or MIL-T43133 JP-8 (see Note 3)	MIL-G-5572 Any AVGAS No TCP Limit 6 hrs (see Note 2)

(CHINOOK)				
CH-47A	T55-L-7/7B	MIL-T-24 JP-4 (on note 1)	NONE	Unleaded gasoline (White gasoline) Limit 50 hours (see note 4)
CH47A	T55-L-7C	SAME	NONE	MIL-T-5624 JP-5 Limit 300 hours (see notes 2, 8, 7)
CH-47B	TS6-L-7C	SAME	NONE	MIL-T-5624 JP4 Limit 300 hours (see notes 2, 6, 7)
CH-47C	SAME	SAME	NONE	SAME
CH-47C	T55L-11ASA/ 11D	SAME	MIL-T-5824 JP-5 or MIL-T-83133 JP-8	100 LL (Low Lead) AVGAS Limit 6 hours (see notes 18, 19)
T55-L-712	SAME	SAME	SAME	
CH-47D or MIL-T-83133	T-55-L-712	Same	MIL-T-5624 JP-5 JP-8 JET A JET A-1	None
(TARHE)				
CH-54A	T-73-P-1	MIL-T-5624 JP-4 (see Note 1)	MIL-T-5624 JP-5 JET A JET A-1	MIL-0-5572 Any AVG AS (See Notes 2, 5, and 8)
CH-54B	T73-P-700	Same	Same	Same
(KIOWA)				
OH-58A	T63-A-700	Same	Same	MIL-G-5572 Any AVGAS
ON-SIA	T6J*A-TOO	Same	Same	No TCP Limit 6 hrs (see Note 2)
OHN5SC	T63-A.720	Same	Same	Same
OH-5SD	T703-AD-700	Same	MIL-T-5624 JP-5 or MIL-T-83133 JP-8 JET A JET A-1	None

Notes:

1. This underlined fuel corresponds to that recommended by the engine manufacturer as most suitable for use in a particular engine for maximum efficiency and longest engine life.

2. Continued use of emergency fuel past specified limits may cause significant danger to the engine or other aircraft fuel components. All Army Standard AVGAS Is leaded gasoline.

3. Use of JP-5 and JP-8 fuel s limited to temperature between 0° and 125°F (-18°C and +52°C) in the T63 engine (OH-6 and OH-58 aircraft).

4. Unleaded gasoline Is covered by U.S. Federal Specification WVG-109. Hot end inspection required after emergency use.

5. Two (2) hour flight maximum before engine fuel system inspection per TM 551520-217-20.

6. Refer to applicable operators manuals for operating limitations when using this fuel.

7. Hot end inspection Is required after accumulating 300 hours use of either JP-5 or JP-8 fuel or combination thereof In the T55L-7C engine.

8. AVGAS (without TCP, MIL-G-5572) may be used as an emergency fuel for a one-time flight up to a maximum of two-hour duration. All engine operation time using AVGAS shall be recorded on DA Form 2408-13 (Aircraft Inspection and Maintenance Record) in Faults and/or Remarks Section, block 17. Upon reaching the two-hour maximum or completion of flight, whichever occurs first, a "fuel system Inspection" shall be performed (TM 55-1520-217-20-1 or -20-2). When refueling with AVGAS, minimum fuel shall be taken on board to reach available let-type fuel.

9. Operation using 100LL AVGAS shall be limited to 6 hours cumulative time with return to the overhaul facility required after exceeding this limit.

10. All engine operating time using 100LL AVGAS shall be recorded on DA Form 2408-13 (Aircraft Inspection and Maintenance Record) with the following note entered In the remarks section (See Block 17).

11. When starting in ambient temperatures below -34°C (-29°F), do not use JP-5 or JP-8.

12. Do not use JP-5 In ambient temperatures below -25°F (-32°C).

NOTE:
This Engine has been operated for _____ hours on leaded gasoline (10LL AVGAS).

Table 2-4. Approved Turbine Engine Fuels

PRIMARY OR STANDARD FUEL		ALTERNATE FUEL	
US MILITARY FUEL NATO CODE NO.	**JP-4 (MIL-T-5624) F-40 (WIDE CUT TYPE)**	**JP-5 (MIL-T-M4) or JP48 (MIL-T83133) f-44 or f-34 (HIGH FLASH TYPE)**	
COMMERCIAL FUEL (ASTM-D-1655)	**JET B**	**JET A**	**JET A-1 NATO F-34**
American Oil Co.	American JP-4	American Type A	
Atlantic Richfield	Arcojet B	Arcojet A	Arcojet A-1
Richfield Div		Richfield A	Richfield A-1
B.P. Trading	B.P.A.T.G.		B.P.A.T.K.
Caltex Petroleum Corp.	Caltex Jet B		Caltex Jet A-1
Cities Service Co.	CITGO A		
Continental Oil Co.	Conoco JP-4	Conoco Jet-50	Conoco Jet-60
Gulf Oil	Gulf Jet B	Gulf Jet A	Gulf Jet A-1
EXXON Co, USA	EXXON Turbo Fuel B	EXXON A	EXXON A-1
Mobil Oil	Mobil Jet B	Mobil Jet A	Mobil Jet A-1
Phillips Petroleum	Philjet JP-4	Philjet A-50	
Shell Oil	Aeroshell JP-4	Aeroshell 640	Aeroshell 650
Sinclair		Superjet A	Superjet A-1
Standard Oil Co		Jet A Kerosine	Jet A-1 Kerosine
Chevron	Chevron B	Chevron A-50	Chevron A-1
Texaco	Texaco Avjet B	Avjet A	Aviet A-1
Union Oil	Union JP-4	76 Turbine Fuel	
FOREIGN FUEL	**NATO F-40**	**NATO F-44**	
Belgium	BA-PF-2B		
Canada	3GP-22F	3-P-24e	
Denmark	JP-4 MIL-T-5624		
France	Air 3407A		
Germany (West)	VTL-9130-006	UTL-9130-007/UTL 9130-010	
Greece	JP-4 MIL-T-5624		
Italy	AA-M-1421	AMC-143	
Netherlands	JP-4 MIL-T-5624	D. Eng RD 2493	
Norway	JP-4 MIL-T-5624		
Portugal	JP-4 MIL-T-5624		
Turkey	JP-4 MIL-T-5624		
United Kingdom (Britain)	D. Eng RD 2454	D. Eng RD 2498	

Note:

Anti-icing and Biocidal Additive for Commercial Turbine Engine Fuel. The additive provides anti-icing protection and functions as a biocide to kill microbial growths in aircraft fuel systems. Icing inhibitor conforming to MIL-1-27686 shall be added to commercial fuel, not containing an icing inhibitor. During refueling operations, even though the engine or aircraft has a fuel heater and regardless of ambient temperatures. Refueling operas shall be accomplished in accordance with accepted commercial procedures. This additive (Prist) is not available thru the Army Supply System, but is to be locally procures when needed.

Table 2-5. Aviation Gasoline Designations

NATO symbol	US Military Spec MIL-G-5572 grades	US Commercial Spec ASTM D-910-65T grades	Color
F-12	80/87	80/87	Red
F-18	100/130	100/130	Green
		100LL (low lead)	Blue
F-22	115/145	115/145	Purple

Table 2-6. Reciprocating Engine Fuel

Note:
If there is a conflict between specific aircraft manuals and this table, the aircraft manual takes precedence.

Fixed Wing Aircraft

Aircraft	Engine	Army standard fuel	Alternate fuel	Emergency fuel
U-3A	0-470-M	MIL-G-5572 100/130 (see Note 1)	MIL-G-5572 S15/145 (See Note 2)	None
U-3B	10-470-D	Same	MIL-G-5572 115/145	None
(SEMINOLE)				
RU-8D	0-480-1A/B	ASTMD910 (see Note 1)	ASTMD910 115/145	None
U-8D	Same	Same	Same	None
U-8G	Same	Same	Same	None
U-8F	0-480-3/A	Same	Same	None
(AERO COMMANDER)				
U-9C	GSO-480-B1A6	Same	Same	None
(COURIER)				
U-10A	GO-480-G1D6	Same	Same	None

Table 2-6. Reciprocating Engine Fuel (Cont)

Aircraft	Engine	Army standard fuel	Alternate fuel	Emergency fuel
(MESCALERO)				
T-41B	10-360-D	Same	Same	None
(COCHISE)				
T-42A	10-470-L	Same	Same	None
		Rotary Wing Aircraft		
(OSAGE)				
TH-55A	HIO-360-BIA	ASTMD910 (see Note 1)	ASTMD910 115/145 (see Note 2)	None

Notes

1. This underlined fuel corresponds to that recommended by the engine manufacturer as most suitable for use in a particular engine for maximum efficiency and longest engine life.

2. Refer to applicable operator's manuals for operating limitations when using this fuel.

CHAPTER 3

LUBE OILS AND OIL ADDITIVES

Section I. GENERAL

3-1. Servicing.

a. The lubricating oils listed herein for each aircraft component will be used as specified in the tables of this bulletin.

b. When proper servicing equipment is available, aircraft components will be serviced through an oil servicing unit. If this equipment is not available and cans are used, these cans will be thoroughly cleaned prior to each servicing to prevent contamination. Thoroughly agitate the oil in the can prior to adding oil to the system either at an oil change or during routine servicing to ensure anti-foam additives are uniformly dispersed in the oil.

c. Gas turbine engine powered aircraft should be serviced with oil through a 10 micron or finer filter to remove contaminants.

d. When oil servicing units are used to service reciprocating engine powered aircraft, the oil should be filtered through a 240 micron (approximately 60 mesh) or finer, screen to remove coarse contaminants.

e. Under no circumstances will synthetic oils, MILL-7808 or MIL-L-23699, be mixed with mineral base oils MIL-L-6082, MIL-L-22851, or MIL-L-2104. Mixing of synthetic and mineral oils is prohibited.

3-2. Approved Commercial Engine Oils.

a. When the Army standard oils specified in tables 3-1 and 3-2 are not available, the approved commercial engine oils may be used as listed in table 3-3.

b. During long cross-country flights with destination at civilian airports, preflight planning will dictate that it is good practice to carry a reserve of Army standard oil.

c. Table 3-4 lists lube oil by US Military specification, grade or type, DA symbol, NATO number, NSN, unit of issue and pertinent comments.

d. Commercial oils for reciprocating aircraft engines conforming to Continental Motors Specification MHS-24 engines are listed by company and company product in table 3-5.

Section II. Turbine Engine Lube Oil.

3-3. Synthetic Oils.

WARNING

Lubricating oil, Military Specification MIL-L-7808 or MIL-L-23699, contains an additive which Is poisonous and absorbed readily through the skin. Do not allow oil to remain on skin longer than necessary.

CAUTION

To avoid contamination, do not use previously opened cans of lubricating oil. A new sealed can of oil must be opened and used.

a. Turbine engines require oils which have a lower pour point, or better viscosity-temperature characteristics, and a higher degree of resistance to oxidation or thermal decomposition than petroleum derived lubricants. MIL-L-23699 oil and MIL-L-7808 oil are synthetic oils that meet these requirements and perform satisfactorily under conditions which are too severe for petroleum products.

b. MIL-L-23699 oil and MIL-L-7808 are the oils used in the engines of turbine engine powered aircraft as indicated in table 3-1. These oils are compatible and can be mixed. However, it is recommended these oils not be mixed as a normal practice.

c. Gear and transmission lubricants and their specific application are listed in table 3-1.

3-4. Mixing Precautions.

a. Adding MIL-L-7808 oil to MIL-L-23699--oil will reduce the MIL-L-23699 oil high temperature and gear load carrying capability to the MIL-L-7808 oil capability.

b. Adding MIL-L-23699 oil to MIL-L-7808 oil which is used at very low ambient temperatures will increase the oil viscosity which may cause oil starvation at cold temperatures (-40°F, -40°C or colder).

3-5. Conversion to MIL-L-23699.

For most turbine engine powered aircraft components, MIL-L-23699 has replaced MIL-L-7808 oil at temperatures above -25°F (-32°C). To reduce potential problems and provide for a more orderly conversion to MIL-L-23699 oil, the following is recommended: Use MIL-L-23699 oil in all new and newly overhauled turbine engines.

3-6. Compatibility of Turbine Oils.

MIL-L-7808 and MIL-L-23699 oils are required by specifications to be compatible with each other. However, adding MIL-L-7808 oil to a system which has been converted to MIL-L-23699 should be avoided, if possible, since the addition of MILL-7808 oil will lower the concentration of MIL-L23699 oil and thus will tend to nulify the benefits derived from the MIL-L-23699 oil. In addition, indiscriminate mixing of the two oils may result in pressures and flow limits different from the published values for either oil. When operating conditions necessitate reservicing with MIL-L-7808 the system or components should be drained and reserviced as soon as MIL-L-23699 oil is available.

During the initial transitioning period some residual MIL-L-7808 oil will remain in the engine oil systems and some degradation of the MIL-L23699 is considered acceptable in order to eliminate costly and time consuming flushing procedures.

3-7. Color of MIL-L-23699 Oils.

The approved MIL-L-23699 oils vary in color depending on the supplier. The color of these oils is due in part to the additives used by different manufacturers. Some of the additives used may turn the oil a dark color or in some cases give the oil a reddish appearance. Therefore, the color of the oil should not be used as the basis for deciding if the mechanical condition of engines or components is suspect. In the past, color has been used to detect hydraulic fluid contamination of the oil in an engine. However, chemical methods are available for this purpose and should be used if necessary.

3-8. Turbine Engine Oil Changes.

a. Oil change intervals for turbine engines will vary from model to model depending on the operating oil temperature resulting from specific airframe installations and engine configurations. MIL-L-23699 should provide a much greater oil life than MIL-L-7808. Operating experience will be used as a guide in determining if oil changes are necessary between overhauls. In the interim the recommendations of the applicable service instruction manual should be followed.

b. When changing from MIL-L-7808 oil to MIL-L-23699 oil, the following procedure should be used if specific instructions are not provided in the applicable aircraft maintenance manual:

(1) Drain the MIL-L-7808 oil from the component oil system.

(2) Inspect, clean, and reinstall all component oil filters and strainers.

(3) Fill component oil system with MILL-23699 oil, and operate aircraft for a period of 30 minutes to one hour.

(4) Shutdown aircraft.

(5) Inspect, clean, and reinstall all component oil filters and strainers. If oil filter(s) was heavily contaminated, comply with (6) through (10) below. If oil filter was not heavily contaminated, comply with (8) through (10) below.

(6) Drain all MIL-L-23699 oil from component oil system and dispose of oil.

(7) Fill component oil system with new MIL-L-23699 oil and release aircraft for service use.

(8) After 5 hours of aircraft operation, inspect and clean all component oil filters and strainers.

(9) After 15 hours aircraft operation since oil change, inspect, clean, and reinstall all component oil filters and strainers.

(10) Revert to normal filter and strainer inspection interval.

c. When changing from MIL-L-23699 oil to MIL-L-7808 oil, the following procedure should be used:

(1) Drain the MIL-L-23699 oil from the component oil system.

(2) Inspect, clean, and reinstall all component oil filters or strainers.

(3) Fill component oil system with MIL-L-7808 oil, and release aircraft for service use.

CAUTION

Synthetic oils, such as MIL-L-23699, MIL-L-7808 and 0-149, may soften paint or stain clothing upon contact. If synthetic oil is spilled on painted surfaces, those surfaces should be cleaned Immediately. Skin should be thoroughly washed after contact and saturated clothing should be removed immediately. Prolonged skin contact with synthetic oils may cause a skin rash. Areas where synthetic oils are used should have adequate ventilation to keep mist and fumes to a minimum. Synthetic oils are highly toxic and should not be ingested.

3-9. Corrosion Preventive Concentrate.

Page 3-4 deleted.

Section III. RECIPROCATING ENGINE LUBE OILS

3-10. Standard Oils.

a. Standard oils for reciprocating engines are specified in table 3-2.

b. During cross-country flights. use tables 3-3, 3-4, and 3-5 for the commercial oil conforming to the grade and specification required. Such local purchase oil must not contain detergent additives, but may contain dispersant additives if replenishing a dispersant oil such as MIL-L-22851. MIL-L-22851 ashless dispersant oil is designed to hold newly formed sludge in suspension. It does not soften or disturb caked sludge which has previously settled out.

3-11. Alternate Oil.

a. MIL-L-6082 oil is an alternate for MIL-L22851.

b. In order to prevent clogging by the sludges which may be formed while using MIL-L6082, the following procedure may be used when changing back to MIL-L-22851:

(1) Clean all strainers first.

(2) Add dispersant oil MIL-L-22851 to the MIL-L-6082 oil already in the crank-case, as needed; these oils are compatible and can be mixed in all proportions.

(3) Check oil strainers every 10 hours for cleanliness over a period of 50 hours operation, and then revert to the normal oil change schedule.

(4) At scheduled oil change, clean strainer prior to filling with dispersant oil and ground run the engine for 20 minutes. Check strainers for sludge; if contaminated, clean and repeat ground run until strainers are clean. After first flight, arid after every 10 flight hours thereafter. Check screens until clean.

(5) It is to be noted that the desludging method outlined above is not a purging procedure, but a gradual process.

(6) If major sludge problems occur that cannot be corrected by the above procedure, contact Commander, USAAVSCOM, ATTN: DRSAVFEP for a desludging procedure.

Section IV. TABLES, LUBRICATING OILS.

Table 3-1. Lubricating Oils, Turbine Engine Aircraft

Note:
If there is a conflict between specific aircraft manuals and this table, the aircraft manual takes precedence.

Fixed Wing Aircraft

Aircraft	Engine	Engine oils Seasonal Temperature Limits and Specifications (see Notes 1 and 2)	Transmission and gear oils Seasonal Temperature Limits and Specifications (see Notes 1 and 2)
(MOHAWK)			
OV-1B	T53-L-7/A	Above -32°C (-25°F) use MIL-L-23699 Below -32°C (-25°F) use MIL-L-7808 Same	Part of engine oil system Same
OV-1C	T53-L-7/A/15	Same	Same
OV-1D	T53-t-701	Same	Same
RV-1D	Same	Same	Same

Table 3-1. Lubricating Oils, Turbine Engine Aircraft (Cont)

(UTE)			
U-21A/G	T74'-CP-700	Above -40°C (40°F) use MIL-L-23699 Below -40°C (-40° F) use MI L-L-7808	None
RU-21A	Same	Same	None
RU-21 D	Same	Same	None
RU-21E/H	Same	Same	None
EU-21A	Same	Same	None
RU-21 B/C	T74-CP-702	Same	None
U-21F	PT6A-28	Same	None
		Rotary Wing Aircraft	
(COBRA)			
AH-1G/Q	T53-L-13/ A/B	Above -32°C (-25°F) use MIL-L-23699 Below -32°C (-25°F) use MIL-L-7808	Same as engine oil system
TH-1G	Same	Same	Same
(IROQUOIS)			
UH-1 B	T53-L-11/ B/C/D	Same	Same
UH-IC	T53-L-11/ B/C/D	Same	Same
UH-LD	T53-L-11/ B/C/D	Same	Same
UH-LH	T53-L-13/ A/B	Same	Same
UH-LM (CAYUSE)	Same	Same	Same
OH-6A (CHINOOK) (TARHE)	T63-A-700	Same	Same
CH-54A	T73-P-1	Above -1.0°C (+30°F) use MIL-L-23699 Below -1°C (+30°F) use MIL-L-7808 (see Note 3)	For main, intermediate, tail, and cargo hoist gear boxes use MIL-L-23699 as primary oil, and NATO Standard 0-149 and MIL-L-7808 as alternates (see Note 4) For tail rotor use MIL-L-21260A, Type 1, Grade 30

Table 3-1. Lubricating Oils, Turbine Engine Aircraft (Cont)

			For main rotor use MIL-G-25537 grease Alternate oil for tail rotor, MIL-L-21260A Type 1, Grade 50
CH-54B	T73-P-700	Same	For main, intermediate, and tail gear boxes use 7.5 centistoke (cs) (see Note 4) For main and tail rotors use MIL-L-21260A, Type 1, Grade 30 For main rotor use MIL-G-25537 grease Alternate oil for tail rotor, MIL-L-21260A Type 1, Grade 50
(KIOWA)			
OH-58A	T63-A-700	Above -32°C (-25°F) use MIL-L-23699 Below -32°C (-25"F) use MIL-L-7808	Same as engine oil system
OH-58C	T63-A-720	Same	Same

Notes:

1. Allowable temperature tolerance is plus or minus 5 ℉ (3 ℃).

2. CAUTION Lubrication oil made to MIL-L-7808 by the Shell Oil Company under their part number 307, qualification number 7D-1, contains additives that are harmful to seals made of silicone, and shall not be used in those engines and transmissions which contain silicone seals. These applications are listed below:

Aircraft	Component
UTE	
U-21, EU-21A, RU-21A,B,C,D,E,H, U-21F	Engine
TARHE	
CH-54A, B	Engine
MOHAWK	
OV-1A,B,C,D, RV-1D	Engine
COBRA	
AH-1G	Engine, transmission, gear boxes
IROQUOIS	
UH-1A, B, C, D, H, M	Engine, transmission, gear boxes
CAYUSE	
OH-6A	Engine, transmission, gear boxes
KIOWA	
OH-58A	Engine, transmission, gear boxes
| OH-58C	Engine, transmission, gear boxes
CHINOOK	

Table 3-1. Lubricating Oils, Turbine Engine Aircraft (Cont)

3. TheC-54 aircraft models A and B, without the winterization kit installed, are designed to operate only from -20°F to 125°F (-7° to 52°C).

4. Formaingear box, use MIL-L-23699 above +30°F (-1.1°C). MIL-L-23699 requires ASOAP sampling at 10 hour intervals when used in Main Gear Box. Below +30°F (-1.1°C) and in arctic operations, use NATO Standard 0-149. This latter oil is supplied under NSN 9150-00-935-4090 (55 gal dr.) or NSN 9150-00-180-6278 (5 gal cn.). Commercially available comparable oils are SATO-35 (Texaco). Turbo-35 (Exxon), Turbo-750 (Shell), and Turbo TJ-37 (Exxon) oil. The above commercial oils are compatible and may be mixed with no restrictions. For intermediate, tail rotor, and cargo hoist gear boxes, use MIL-L-23699 when operating above -40°F (40°C). When operating in arctic conditions (-40°F, -40° C or below), lubricating oil NATO Standard 0-149 or MIL-L-7808 must be used. MIL-L-23699 is the principal lubricant to be used in all new or newly overhauled intermediate, tail rotor, and cargo hoist gear boxes. If MIL-L-23699 is not available, lubricating oil NATO Standard 0-149 is to be used. IMPORTANT: MIL-L-23699 and NATO Standard 0-149 lubricating oils are not compatible, and must not be mixed. If conversion between these oils is required, drain and completely flush. Refer to appropriate -20 manual for flushing procedures.

Table 3-2. Lubricating Oils, Reciprocating Engine Aircraft

Note

If there is a conflict between specific aircraft manuals and this table, the aircraft manual takes precedence.

Fixed Wing Aircraft

Aircraft	Engine	Engine oils Seasonal Temperature Limits and Specifications (see Note 1)	Transmission and gear oils Seasonal Temperature Limits and Specifications (see Note 1)
U-3A	0-470-M	Above +40°F (4.4°C), use MHS-24A. AE 50;	None
		Below +40°F (4.4°C, use MHS-24A, SAE 30. (see Note 2)	None
U-3S	10-470-0	Same	None
(SEMINOLE)			
RU-8D	0-480-1A/B	Above +60°F (16°C), use MIL-L-22851, Type II;	None
		Below +60°F (16°C). MIL-L-22851, Type lll. (see Note 4)	use
U-SD	Same	Same	None
U-8G	Same	Same	None
U-8F	0480-3/A	Same	None
(AERO COMMANDER)			
U-9C	GSO-480-B1A6	Same	None
(COURIER)			
U-10A	GO-480-G1D6	Same	None

Table 3-2. Lubricating Oils, Reciprocating Engine Aircraft (Cont)

		Fixed Wing Aircraft	
(MESCALERO)			
T-41B	10-360-D	Above +40°F (4.4°C), use MHS-24A, SAE 50; Below +40°F (4.4°C), use MHS-24A, SAE 40. (see Note 2)	None
(COCHISE)			
T-42A	10-470-L	Same	None
		Rotary Wing Aircraft	
(OSAGE)			
TH-55A	HIO-360-B1A	Above +60°F (16°C), use MIL-L-22851, Type II. Below +60°F (16°C),-use MIL-L-22851, Type Ill.	Above +40°F (4°C), use MIL-L-2105, Grade 90; Below +40°-F (4°C), use MIL-L-2105, Grade 80.

Notes

1. Allowable temperature tolerance is plus or minus 5 ℉ (3 ℃).
2. MHS-24A is the Continental Motors lube oil specification containing the commercial lube oils listed in table 3-5.
3. Dilute the crankcase oil in accordance with applicable directives.
4. In operating areas where the temperature is so low the engine will not start, the oil should be heated. Oil may be drained from aircraft and stored in a warm place until required.

Table 3-3. Approved Commercial Engine Oils

MIL-L-22851

Lubricating Oil, Aircraft Piston Engine (Ashless Dispersant)

PO Aviation Lubricant 753	Type II	American Oil and Supply Co.
Esso Aviation Oil E-120		Exxon Co.
Exxon Aviation Oil E-120		
Esso Aviation Oil AD-100		
Exxon Aviation Oil AD-100		
RM-173E		Mobil Oil Corp.
RM-180E		
RT-451		
AeroShell W 120		Shell Oil Co.
Shell Concentrate A Code 60068		Shell Oil Co.
AeroShell W 120		Shell Oil Co. of Canada
Shell Concentrate A Code 60068		
AeroShell W 120		Shell International Petroleum Co., Ltd.
Shell Concentrate Code 60068		Shell International Petroleum Co., Ltd.
Aircraft Engine Oil		Texaco, Inc.
TX-6309		
Premium AD 120		
Aircraft Engine Oil		
Premium AD 80		
Esso Aviation Oil E-80	Type III	Humble Oil and Refining Co.
Enco Aviation Oil E-80		
AeroShell W 80		Shell Oil Co.
Global Concentrate A	Delta Petroleum Co.	
Paranox 160	Paramins Division	
Paranox 165	Exxon Chemical Co.	
Chevron Aero Oil Grade 120	Chevron Oil Co.	
Chevron Aero Oil Grade 120	Standard Oil of Calif.	
Chevron Aero Oil Grade 120	Standard Oil Co. (Kentucky)	

MIL-L-7808
Lubricating Oil, Aircraft Turbine Engine, Synthetic Base

PO Turbine Oil 8365	American Oil and Supply Co.
Exxon Turbo Oil 2389	Exxon Co. USA
Esso Turbo Oil 2389	
RM-184A	
RM-201A	Mobil Oil Corp.
E-6825	Stauffer Chemical Co.
Royco 807HR	Royal Lubricants Co.
Royco 808HR	
PL-10568	Rohm and Haas Co.

Table 3-3. Approved Commercial Engine Oils (Cont)

MIL-L23699

Lubricating Oil, Aircraft Turbine Engines, Synthetic Base

PQ Turbine Lubricant 6423	American Oil and Supply Co.
PQ Turbine Lubricant 5247	
PQ Turbine Lubricant 6700	
PQ Turbine Lubricant 7731	
PQ Turbine Lubricant 8878	
PQ Turbine Lubricant 9595	
PQ Turbine Lubricant 9596	
PQ Turbine Lubricant 9597	
Brayco 899	Bray Oil Co.
Brayco 899-G	
Brayco 899-S	
Brayco 899-D	
Castrol 205	Castrol Oil Inc.
Chevron Jet Engine Oil 5	Chevron International ON Co., Inc.
STO-21919	Drew Chemical Corp.
STO-21919A	
STO-6530	
HATCOL 3211	W.R. Grace and Co.
Hatco Chemical Div.	
HATCOL 3611	
Esso Turbo Oil 2380	Humble Oil and Refining Co.
Enco Turbo Oil 2380	
2395 Turbo Oil (WS-6459)	
2392 Turbo Oil	
2393 Turbo Oil	
Guflight 20	Gulf Oil Corp.
Mobil Jet II/RM-139A	Mobil Oil Corp.
Mobil Jet Oil 254	Mobil Oil Corp.
Avrex S Turbo 260	
Avrex S Turbo 265	
Royco 899 (C-915)	Royal Lubricants Co.
Stauffer Jet II	
Royco 899SC	
AeroShell Turbine Oil 500	Shell Oil Co.
Shell Aircraft Turbine 551	
AeroShell Turbine Oil 550	Shell International Petroleum Co., Ltd.
Chevron Jet Engine Oil 5	Standard Oil Co. of California
Stauffer Jet II	Stauffer Chemical Co.
Stauffer 6924	
SATO 7377	Texaco, Inc.
SATO 7730	
Starjet 5	

Table 3-4. Lube Oil Identification

U S Military Specification and Grade (or Type)	DA Symbol	NATO Number	NSN	Unit of Issue	Comments
MIL-L-7808	LGT	0-148	9150-00-782-2627	1 qt cn	If MIL-L-7808 is not available, MIL-L-23699 may be used but not in CH-47A/BIC gear boxes. Shell Oil No. 307, Qual, No.701 has restricted usage.
			9150-40-108-5359	8 oz cn	
			9150-40-782-2679	55 gal dr	
MIL-L-7870	OGP	0-142	9150-00-542-1430	4 oz cn	None
			9150-00-263-3490	1 qt cn	
			9150-00-273-2397	1 gal cn	
			9150-00-261-9438	55 gal dr 18 gage	
MIL-L-21260A Type I	PE-3G-4	C442	9150-00-111-0209	5 gal pail	MIL-L-21260A is not to be used in aircraft engines. If MIL-L-21260A, Grade 30 is not available. MIL-L-2104, Grade 30 may be used. See Note 6. Table 3-2.
Grade 30			9150-00-111-3201	55 gal dr 6 gage	
			9150-00-111-0210	55 gal dr	
			9150-00-111-0201	1 pt cn	
MIL-L-2251 Type II	LAD-II	0-128	9150-00-935-1010	1 qt cn	If MIL-L-22851, Type II is not available. MIL-L62, Grade 1100 or any similar grade oil listed in Table 3-5 may be used.
			9150-00-082-2449	55 gal dr 18 gage	
			9150-00-753-4937	55 gal dr	
			9150-00-436-5270	55 gal dr	
MIL-L-22851, Type III	LAD-III	0-123	9150-00-019-5701	1 qt cn	If MIL-L-22851, Type III is not available, Grade 1065 or any Grade 65 or 80 oil listed in table 3-5 may be used.
			9150-00-019-5705	1 gal cn	
			9150-00-965-2303	5 gal dr	
			9150-00-965-2304	55 gal dr 16 gage	
			9150-00-965-2305	55 gal dr 18 gage	
			9150-00-436-5373	55 gal dr	
			9150-00-965-2302	Bulk.	

Table 3-4. Lube Oil Identification (Cont)

U S Military Specification and Grade (or Type)	DA Symbol	NATO Number	NSN	Unit of Issue	Comments
MIL-L-6082, Grade 1100	1100	0-117	9150-00-440-6318 9150-00-440-6484	1 pt cn 1 qt cn	None
MIL-L-6083B	OHC	C-635	9150-00-935-9807 9150-00-935-9808 9150-00-935-9809	1 qt cn 1 gal cn 5 gal pail	OHT can be used when OHC is requested.
MIL-L-6083C	OHT		9150-00-265-9413 9150-00-265-9412 9150-00-265-9414	1 qt 1 gal 5 gal	
MIL-L-6085	OA1	0-147	9150-00-257-5449 9150-00-664-6518 9150-00-223-4129	4 oz 1-1/2 oz B.T. 1 qt cn	
MIL-L-60B6, Grade L	OGL	0-153	9150-00-265-9417 9150-223-4116	1 gal cn 5 gal dr	If MIL-L-6086, Grade L is not available, MIL-L-7870 may be used.
MIL-L-6086, Grade M	OGR	0-155	9150-00-240-2235 9150-00-223-4130	1 pt cn 1 gal cn	None
MIL-L-6086, Type ll	CEN-2	_-609	6850-00-209-7235 6850-00-209-7234	5 gal 55 gal dr	None
MIL-L-23699		0-156	9150-00-985-7099 9150-00-180-6266 9150-00-681-5999 9150-00-436-5364	1 qt cn 8 oz cn 55 gal dr 18gage 55 gal dr 24 gage	
MHS-24A SAE50, Grade 100			9150-00-412-2066	1 qt	See Table 3-5 for Listing of Commercial Oils for 10-360, 10-470-D, 10-470-L, and 10-470-M continental engines.
Grade 80 SAE40,			9150-00-412-2065	1 qt	
		0-149	9150-00-180-6278 9150-00-935-4090	5 gal cn 55 gal dr	See Note 4, Table 3-1

Table 3-4. Lube Oil Identification (Cont)

U S Military Specification and Grade (or Type)	DA Symbol	NATO Number	NSN	Unit of Issue	Comments
MIL-L-2104. Grade 10	OE/HD-10	0-230	9150-00-189-6727	1 qt cn	If MIL-L-2104. Grade 10 is not available, any Grade SAE 10 automotive oil designated for API Service MS, "SC, or "CD" may be used.
			9150-00-186-6668	5 gal pail	
			9150-00-189-6728	55 gal dr 16 gage	
			9150-00-191-2772	55 gal dr 18 gag.	
			9150-00-183-7807	Bulk	
MIL-L-2104 Grade 30	OE/HDO-30	0-232	9150-00-186-6681	1 qt	It MIL-L-2104. Grade 30 is not available, any Grade SAE 30 automotive oil designated for API service "MS","SC", "SE" or "CD" may be used.
			9150-00-188-9859	55 gal dr 18 gage	
MIL-L-2105. Grade 90	GO-90	0-226	9150-00-577-5844	5 gal dr	None
			9150-00-577-5845	55 gal dr 16 gage	
			9150-00-577-5846	Same	
MIL-H-5606	OHA	H-515	9150-00-252-6883	1 qt cn	None
			9150-00-223-4134	1 gal cn	
			9150-00-265-9406	55 gal dr	
MIL-L-6062 Grade 1065	1086	0-113	9150-00-255-3929	S gal dr	None
			9150-00-436-5329	55 gal dr 24 gage	
			9150-00-231-6669	55 gal dr 18 gage	

Table 3-5. Commercial Oils for 10-360. 10-470-D, 0-470-M and 10-470-L Continental Motors Specification MHS-24 Engines

Single Viscosity

Company	Company Product
Humble Oil and Refining Co.	Enco Aviation Oil, Grade E100 Enco Aviation Oil. Grade E80 Enco Aviation Oil, Grade E65 Esso Aviation Oil, Grade E100 Esso Aviation Oil, Grade E80 Esso Aviation Oil. Grade E65
Mobil Oil Co.	Mobil Aero Oil 100 Mobil Aero Oil 80 Mobil Aero Oil 65
Shell Oil Co.	Aeroshell Oil W, Grade 100 Aeroshell Oil W, Grade 80 Aeroshell Oil W, Grade 65
Texaco Inc.	Texaco Aircraft Engine Oil. 0100 Texaco Aircraft Engine Oil, Premium AD, Grade 100 Texaco Aircraft Engine Oil, D80 Texaco Aircraft Engine Oil, Premium AD, Grade 80 Texaco Aircraft Engine Oil, Premium AD. Grade 65

* Grades listed are approximately equivalent to twice the SAE value. For example, Grade E100 is equivalent to SAE 50.

Multi-Viscosity

Company	Company Product
Phillips Petroleum Company Aviation Motor Oil, Type M SAE 20W-50	X/C Aviation Multi-Viscosity oil SAE 20W-50 X/C Aviation Multi-Viscosity oil Grade 25W40
Red Ram Limited (Canada)	Red Ram X/C Aviation Oil 20W-50
Shell Oil Company	AEROSHELL Oil W SAE 15W/50

CHAPTER 4

HYDRAULIC FLUIDS

CAUTION

To avoid contamination, do not use previously opened cans of hydraulic fluid. A new sealed can of fluid must be opened and used.

4-1. General.

Pilots of Army aircraft, while on cross-country flights, may use commercial hydraulic fluids to complete their mission when oils from Army supply channels are not available.

4-2. MIL-H-5606.

The following commercial oils may be purchased locally under the following manufacturer's designation:

MIL-H-5606
Hydraulic Fluid, Petroleum Base, Aircraft and Ordnance

Manufacturers Designation	Manufacturers Name
"PO" Hydraulic Fluid 4226	American Oil and Supply Co.
Brayco 757B	Bray Oil Co.
Brayco 756C	
Brayco 756D	
Brayco 756E	
Castrol Hyspin A	Castrol Oils Inc.
Univis J41	Humble Oil and Refining Co.
Univis J41	Exxon Co.
Mobil Aero HFB	Mobil Oil Corp.
Petrofluid 5606B	Pennsylvania Refining Co.
Petrofiuid 4607	
Royco 756C	Royal Lubricants Co.
Royco 756D	
DS-437	
PED 3565	Standard Oil Co. Of Calif.
PED 3337	
TL-5874	Texaco, Inc.
Stauffer Aero Hyaroil 500	Stauffer Chemical Co.
25606	MZF Associates
FP-221	Union Carbide Corp.

4-3. MIL-H-83282 (See TB 55-1500-334-25).

The following commercial oils may be purchased locally under the following manufacturer's designation:

Manufacturers Designation	Manufacturers Name
Brayco Micronic 882	Brayco Oil Co.
XRM-230A	Mobil Oil Corp.
XRM-231 A	Mobil Oil Corp.
Royco 782	Royal Lubricants Co.
Hanover R-2	Hanover Chemical Industries, Inc.
HF-832	Hanover Processing Co.

APPENDIX A

REFERENCES

Publication Number	Title
AR 750-13	Spectrometic Oil Analysis
ASTM D1250	Petroleum Measurement Tables
C9100-7L	Federal Supply Catalog
FM 10-68	Aircraft Refueling
MIL-HDBK-200	Military Standardization Handbook Qualify Surveillance Handbook for Fuels, Lubricants, and Related Products Military
MIL-HDBK-275(ASG)	Standardization for Handbook Guide for Selection of Lubricants Fluids, Compounds for use in Flight Vehicles and Components
TB 34 925	Code Numbers for the identifications for Fuels, Lubricants, and Allied Products used by the NATO Army Forces
TB 55-1500-334-25	Conversion of Aircraft to Fire Resistant Hydraulic Fluid
TB 55-6650-300-15	Spectrometric Oil Analysis
TM 10-1101	Petroleum Handling Operations
TM 10-1105	Inspecting and Testing Petroleum Products

APPENDIX B
CONDENSED FUELS AND LUBRICANT LIST
Appendix B may be locally reproduced for inclusion in aircraft log book.

	FUEL		LUBRICATING OILS					
ACFT	ARMY STANDARD	ALTERNATE (Note 2)	ENGINE	S.O.T. Note 1	MAIN TRANS	S.O.T. Note 1	INTER AND/OR TAIL G.B.	S.O.T. Note 1
OV-1	JP-4	JP-5 or JP-8	MIL-L-23699 or MIL-L-7808(4)	-25° F				
U-21,RU-21	"	"	" "	-40° F				
AH-1	"	"	" "	-25° F	Same as engine		Same as engine	
UH-1	"	"	" "	-25° F	" "		" " "	
OH-6	"	"(Above 10° F -12° C)	" "	-25° F	" " "		" " "	
OH-58	"	"(" ")	" "	-25° F	" " "		" " "	
CH-47	"	None (Note 3)	" "	-25° F	MIL-L-7808			
CH-54	"	JP-5 or JP-8	" "	-40° F	MIL-L-23699 (See Note 5)		MIL-L-23699 (See Note 5)	
U-3	100/130 100LL	115/145	MHS-24A,G100 or MHS-24A,G80	+40° F				
U-8,RU-8	"	"	MIL-L-22851 II or MIL-L-22851 III	+60° F				
U-9,RU-9	"	"	" "	+60° F				
U-10	"	"	" "	+60° F				
TH-55	"	"		+60° F	MIL-L-2105,G90 or MIL-L-2105,G80	+40° F	MIL-L-2105,G90 or MIL-L-2105,G80	+40° F
T-41	"	"	MHS-24A,G100 or MHS-24A,G65	+40° F				
T-42	"	"	" "	+40° F				

NOTES:
1. S.O.T. - Switch over temperature. Use top oil for ambient temp above S.O.T. Use bottom oil below S.O.T.
2. See aircraft operator's manual for limitations on use of alternate fuels.
3. T55-L-11A engine qualified for JP-5 or JP-8 as alternate fuel.
4. Although compatible, mix only in emergency. Better to drain and replace.
5. NATO O-149 and MIL-L-7808 are alternates.

APPENDIX B COMMERCIAL FUELS AND LUBRICATING OILS.

This Table identifies some popular commercial fuels and oils which are qualified to military requirements and which may be available at commercial airports.

JET B (JP-4 TYPE) (NATO F-40)

Exxon Turbo Fuel B
Mobil Jet B
Aeroshell Turbine Fuel JP-4
Standard Jet B
Texaco Avjet B
Atlantic Richfield Arcojet B
American JP4
Conoco JP-4
Chevron B
Gulf Jet B
Phillips Philjet JP-4

MIL-L-2104, G10 (NATO 0-230)

Amoco 200, 300, No. 53
CITGO 93118, 93119, 93125, 93124, 9010
Conoco Conomil LCB No. 14
Esso Motor Oil 10W
Gulflube Motor Oil XHD 10

MIL-L-7808 (NATO 0-148)

American PQ Turb Oil 6423, 5247, 6700, 7731, 8878
Exxon Turb Oil, 2389
Mobil RM-139A, MM-147A
Atlantic Richfield Arco Turbo S1523

MIL-G-5572 Aviation Gasoline

ASTM D-910-65T

NATO SYMBOL	FUEL COLOR	OCTANE RATING
F-12	Red	80/87
F-18	Green	100/130
	Blue	100LL
F-22	Purple	115/145

MIL-L-22851 (NATO 0-128)

Chevron Aero Oil Grade 120
Exxon Avn Oil E120, AD-120, AD-100
Aeroshell W120, Concentrate A Code 60068
Mobil RM-173E, RM-180E
Texaco AD 120
American Avn Lub 753

JET A & JET A-1 (JP-5 TYPE)

(JET A-1 is NATO F-34)

(Needs anti-icing additive)
American Jet Fuel Type A
Exxon Turbo Fuel A and A-1
Mobil Jet A and A-1
Aeroshell Turbine Fuel 640 and 650
Sinclair Superjet A and A-1
Standard Jet A and A-1 Kerosine
Texaco Avjet A and A-1
Phillips Philjet A-50

MIL-L-6086 Grade M (NATO 0-155)

Shell 60 428
Aeroshell Fluid 5M
Sinclair Low Temp Lub Grade M(L-1195)
Texaco Aircraft Gear Oil EP Medium

MIL-L-21260A, G30 (NATO 0-642)

Brayco 443U (30)
Mobil Formula No. NTM 379A
Refined 2600-C
Union M 5525

MIL-L-22851 III (NATO 0-123)

Esso (Enco) Avn Oil E-80
Aero Shell W80
Texaco Avn Oil Premium AD 80

MIL-L-6086 Grade L (NATO 0-153)

Shell 60 427
Aeroshell Fluid 5L
Sinclair Low Temp. Lub, Grade L (L-1194)

MIL-L-23699 (NATO 0-156)

American PQ Turb 6423, 5247, 6700, 7731, 8878, 9595
Aeroshell 500
Brayco 899, 899-G, 899-S
Humble 2380, 2392, or 2393 Turbo Oil

MHS-24A

Esso (Enco) Avn Oil Grade E100, E80, E65
Mobil Aero Oil 100, 80, 65
Aeroshell Oil W, Grade 100, 80, 65
Texaco Avn Oil D100, D80, and Premium AD (60, 80, 100)

7.5 Centi Stokes (NATO 0-149)

NSN 9150-00-935-4090 (55 gal drum)
NSN 9150-00-180-6278 (5 gal can)
Texaco Sato 35
Esso Turbo 35 and Turbo TJ-37
Shell Turbo 750

ROTOR HEAD AND APU

ACFT	MAIN ROTOR HEAD	TAIL ROTOR HEAD	APU
CH-47	MIL-L-7808	MIL-L-21260A,T1,G30 or 50	MIL-L-7808 or -23699
CH-54A	MIL-G-25537	MIL-L-21260A,T1,G30 or 50	MIL-L-7808 or -23699
CH-54B	MIL-L-21260A,T1,G30 or 50	MIL-L-21260A,T1,G30 or 50	MIL-L-7808 or -23699

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