# SUBPART E - POWERPLANT

## Section 4. Oil System

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## Section 4. Oil System

## Section 25.1011 General.

**a. Rule Text.**

*(a) Each engine must have an independent oil system that can supply it with an appropriate quantity of oil at a temperature not above that safe for continuous operation.*

*(b) The usable oil capacity may not be less than the product of the endurance of the airplane under critical operating conditions and the approved maximum allowable oil consumption of the engine under the same conditions, plus a suitable margin to ensure system circulation. Instead of a rational analysis of airplane range for the purpose of computing oil requirements for reciprocating engine powered airplanes, the following fuel/oil ratios may be used:*

*(1) For airplanes without a reserve oil or oil transfer system, a fuel/oil ratio of 30:1 by volume.*

*(2) For airplanes with either a reserve oil or oil transfer system, a fuel/oil ratio of 40:1 by volume.*

*(c) Fuel/oil ratios higher than those prescribed in paragraphs (b)(1) and (2) of this section may be used if substantiated by data on actual engine oil consumption.*

b. **Intent of Rule.** The intent of this rule is to ensure that adequate oil is available for each engine to complete the intended mission of the airplane.

c. **Background.**

(1) The regulatory history shows that this requirement was stated within Civil Air Regulations (CAR) Part 4a, dated November 1, 1947, as follows:

> Each engine shall have an independent oil supply. The oil capacity of the system shall be at least 1 gallon for every 25 gallons of fuel but shall not be less than 1 gallon for each 75 maximum (except takeoff) rated horsepower of the engine or engines. A special ruling concerning the capacity will be made by the Administrator when oil may be transferred between engines in flight or when a suitable reserve is provided. The suitability of the lubrication system shall be demonstrated in flight tests in which engine temperature measurements are obtained.

> The system shall provide the engine with an ample quantity of oil at a temperature suitable for satisfactory engine operation.

(2) Amendment 25-AD was published in the Federal Register on December 24, 1964 (29 FR 18289), which added Part 25 [New] to the Federal Aviation Regulations and replaced Part 4b of the CAR (which previously had replaced Part 4a). It was part of the Agency recodification program announced in Draft Release 61-25, published in the Federal Register on November 15, 1961 (26 FR 10698). Part 25 [New] was published as a notice of proposed rule making in the Federal Register on June 2, 1964 (29 FR 7169), and given further distribution as Notice No. 64-28. This rule was recodified from the CAR without any substantive changes.

d. **Policy/Compliance Methods**.

(1) ***Engine Oil System Independence***. The following guidance is from an FAA memorandum dated August 15, 1995:

> This section requires that --
>
> > "*Each engine must have an independent oil system that can supply it with an appropriate quantity of oil at a temperature not above that safe for continuous operation*."
>
> The intent of the requirement for independent oil systems was relative to engine independence and that the FAA would consider the acceptability of transferring oil between engines. The rule was not intended to preclude utilizing engine oil for other engine accessories, but merely to require separate, independent oil systems for each engine. This interpretation is consistent with the wording of § 25.1027 ("Propeller Feathering System"), which states --
>
> > "*If the propeller feathering system depends upon engine oil, there must be a means to trap an amount of oil in the tank if the supply becomes depleted due to failure of any part of the lubricating system other that the tank itself*."
>
> This wording indicates that it is acceptable to utilize engine oil for the propeller system. Based on current application of the rule, engine oil can be shared with engine accessory systems, provided sharing of engine oil with accessories does not result in an unsafe feature.
>
> Although the regulatory basis of § 25.1011 does not preclude sharing of engine oil with accessories, sharing of engine oil may affect compliance with other regulations. For example, the reliability of the Auxiliary Power Units (APU) or engine may be affected if failure of the accessory caused engine shutdown. Any reliability data, particularly for use in Extended Range Twin-Engine Operations (ETOPS) approvals, should include the effects of accessories on engine shutdown rates. The Part 33 engine block runs should include actual operation of all accessories that could impact durability or operability. In addition, care should be taken to assess the impact of accessory operation on the required oil cooling/heating capabilities.

(2) ***§ 25.1011(c) Fuel/Oil Ratios Higher Than § 25.1011(b)(1) and (b)(2)***. The following guidance was developed from Advisory Circular 23.1011-1, "Procedures for Determining Acceptable Fuel/Oil Ratio as Required by FAR § 23.1011(b)," and provides information developed within an FAA Issue Paper that was applied to a recent certification project. The following definitions are applicable:

(a) *Usable Oil*. The minimum oil level must assure satisfactory engine operation for expected airplane attitudes and during airplane acceleration and deceleration maneuvers. The usable quantity of oil is the quantity of oil in the oil tank, or sump in the case of wet sump engines, in excess of the minimum quantity of oil required to keep the oil outlet covered under the most adverse of the following two operating conditions with the aircraft at a zero degree roll angle:

- the nose up pitch angle required for the sea level best rate-of-climb speed with maximum continuous power, or
- the nose down pitch angle required for the 1.3 $V_{SO}$ power-off landing configuration.

For most wet sump engines, the usable oil quantity for various pitch angles is listed on the appropriate FAA Engine Type Certificate Data Sheet, and this quantity may be used in lieu of a determination of usable oil as described above. If the usable quantity is not listed, it may be determined by contacting the engine manufacturer or conducting a usable oil test with the critical operating conditions. In addition:

1 For a conventional oil system (no transfer system provided), only the usable oil tank or sump capacity should be considered in the determination of the usable oil supply. The usable oil quantity may only include the oil within the oil system from the minimum dispatchable level down to the point where the oil quantity indicator reads zero. The quantity of oil in the engine oil lines, in the oil radiator, and/or in a propeller feathering reserve, should not be included.

2 Oil System Circulation and Cooling: A suitable oil quantity margin for system circulation is necessary for either reciprocating engine or turbine engine installations. It should be determined that the oil system is capable of maintaining the engine within its operating limitations; i.e., oil temperature with the minimum oil quantity provided for circulation. It is not intended that cooling tests be performed with a low usable oil supply unless it is determined the cooling capabilities of the engine are not adequate to assure oil cooling between full oil supply and the point of near exhaustion of the usable oil.

3 When an oil reserve system is installed and its transfer pump is located so that it can pump some of the oil in the transfer lines into the main engine oil tanks, the quantity of oil in these lines that can be pumped by the transfer pump may be considered in the determination of the usable oil supply, in addition to the usable oil in the reserve tank.

(b) *Oil Consumption Rate*. The maximum oil consumption rate for turbine engines typically varies by engine power setting and should be obtained from the engine manufacturer, or from the engine installation manual. The engine power setting that should be assumed in establishing the oil consumption rate should be based on the airplane configuration and intended operating mission. For example, if the intended operation of the airplane is ETOPS (extended twin-engine operations), the oil consumption calculation should be based on operating the engine at Maximum Continuous Thrust (or that power needed to make a safe diversion). The maximum oil consumption rates established for reciprocating or turbine engines are the values substantiated by the engine manufacturers. If no substantiated oil consumption rates are available, a maximum oil consumption of 0.012 pounds per b.hp. per hour may be used for reciprocating engines. No similar maximum oil consumption rate is available for turbine engines. A lower rate is acceptable when substantiated either by tests under conditions acceptable to the FAA or by statistical analysis of actual consumption rates based on service experience. Tests for a lower oil consumption rate should include:

<u>1</u> A positive demonstration that a lower oil consumption rate will not jeopardize the airworthiness of the engine.

<u>2</u> A statistical analysis should include observed data on the actual oil consumption from a number of engines of the same model. These data should be obtained from engines with high time or high oil consumption just prior to removal for overhaul.

(c) *Usable Fuel*. The usable quantity of fuel is the total quantity of fuel in all fuel tanks less the fuel quantity necessary to establish compliance with the unusable fuel quantity per section § 25.959 (“Usable Fuel Supply”). Fuel usage is expressed in pounds per hour.

(d) *Airplane Endurance*. Airplane endurance should be based on airplane performance data, calculating the longest flight possible. Input parameters should include minimum payload, full fuel tanks, burning of fuel reserves, and optimal engine fuel burn rates. The usable quantity of fuel is the total quantity of fuel in all fuel tanks less the fuel quantity necessary to establish compliance with the unusable fuel quantity per § 25.959. For turbine powered airplanes, a nominal fuel density of 6.82 lbs. per gallon and a net heat of combustion of 18,550 Btu per lb. may be assumed.

(e) *Specific Fuel Consumption (SFC).* The fuel consumption established for the engine based on available engine power expressed in pounds per brake horsepower per hour (lbs./b.hp/hr).

(f) *Specific Oil Consumption (SOC).* The maximum oil consumption established for the engine determined during engine certification expressed in pounds per brake horsepower per hour (lbs./b.hp/hr).

(3) ***Acceptable Means of Compliance.*** Based on the definitions above, an acceptable method of demonstrating compliance is as follows:

(a) The minimum allowable usable oil capacity can be determined from calculation of airplane endurance and the maximum allowable oil consumption. For either wet or dry sump engines, the maximum allowable usable fuel/oil supply ratio is equal to the minimum obtainable fuel/oil consumption ratio. This is expressed mathematically as follows:

$$\frac{\text{Maximum Allowable Usable Fuel Capacity (LBS.)}}{\text{Minimum Allowable Usable Oil Capacity (LBS.)}} \leq \frac{\text{Minimum Obtainable SFC}}{\text{Maximum Allowable SOC}}$$

Therefore, for both wet and dry sump engines, fuel/oil supply ratios equal to or less than the minimum obtainable fuel/oil consumption ratios are considered acceptable.

(b) *Multiengine Installations*. Unless an adequate oil reserve is provided, the endurance of a multiengine airplane employing a fuel crossfeed system or common fuel tank should be established on the basis that 50 percent of the specified total initial fuel capacity provided for a shutdown engine will be available to the other engine(s). The engine power levels to be considered for a multiengine airplane having a crossfeed system are those that will allow maximum published endurance with all engines operating and adjusted as necessary (including mixture setting) to complete safely the flight with one engine inoperative after 50 percent of the fuel supply is consumed.

e. **References**.

(1) Civil Air Regulations (CAR) Part 4a, November 1, 1947.

(2) Amendment 25-AD (29 FR 18289, December 24, 1964).

(3) Advisory Circular 23.1011-1 “Procedures for Determining Acceptable Fuel/Oil Ratio as Required by FAR § 23.1011 (b),” dated November 14, 1983.

## Section 25.1013 Oil tanks.

a. **Rule Text.**

*(a) Installation. Each oil tank installation must meet the requirements of § 25.967.*

*(b) Expansion space. Oil tank expansion space must be provided as follows:*

*(1) Each oil tank used with a reciprocating engine must have an expansion space of not less than the greater of 10 percent of the tank capacity or 0.5 gallon, and each oil tank used with a turbine engine must have an expansion space of not less than 10 percent of the tank capacity.*

*(2) Each reserve oil tank not directly connected to any engine may have an expansion space of not less than two percent of the tank capacity.*

*(3) It must be impossible to fill the expansion space inadvertently with the airplane in the normal ground attitude.*

*(c) Filler connection. Each recessed oil tank filler connection that can retain any appreciable quantity of oil must have a drain that discharges clear of each part of the airplane. In addition, each oil tank filler cap must provide an oil-tight seal.*

*(d) Vent. Oil tanks must be vented as follows:*

*(1) Each oil tank must be vented from the top part of the expansion space so that venting is effective under any normal flight condition.*

*(2) Oil tank vents must be arranged so that condensed water vapor that might freeze and obstruct the line cannot accumulate at any point.*

*(e) Outlet. There must be means to prevent entrance into the tank itself, or into the tank outlet, of any object that might obstruct the flow of oil through the system. No oil tank outlet may be enclosed by any screen or guard that would reduce the flow of oil below a safe value at any operating temperature. There must be a shutoff valve at the outlet of each oil tank used with a turbine engine, unless the external portion of the oil system (including the oil tank supports) is fireproof.*

*(f) Flexible oil tank liners. Each flexible oil tank liner must be approved or must be shown to be suitable for the particular application.*

*(Doc. No. 5066, 29 FR 18291, Dec. 24, 1964, as amended by Amdt. 25-19, 33 FR 15410, Oct. 17, 1968; Amdt. 25-23, 35 FR 5677, Apr. 8, 1970; Amdt. 25-36, 39 FR 35460, Oct. 1, 1974; Amdt. 25-57, 49 FR 6848, Feb. 23, 1984; Amdt. 25-72, 55 FR 29785, July 20, 1990)*

b. **Intent of Rule.** The purpose of this rule is to ensure the safety of engine and APU oil tank installations.

c. **Background**. The following extracts provide insight into established FAA policy and compliance methods:

(1) The requirements of this section originated prior to Civil Air Regulations (CAR) 4b, Section 441. The 1934 Aeronautics Bulletin No. 7-A, "Airworthiness Requirements for Aircraft," stated the following requirements for oil tanks:

> Oil tanks shall be capable of withstanding an internal test pressure of 5 pounds per square inch without failure or leakage. They shall be suitably vented and shall be provided with expansion space which cannot be inadvertently filled with oil. This expansion space shall be at least 10 percent of the total tank volume, except that it shall be in no case less than one half gallon.

(2) Amendment 25-AD was published in the Federal Register on December 24, 1964 (29 FR 18289), which added Part 25 [New] to the Federal Aviation Regulations and replaced Part 4b of the CAR. It was part of the Agency recodification program announced in Draft Release 61-25, published in the Federal Register on November 15, 1961 (26 FR 10698). Part 25 [New] was published as a notice of proposed rule making in the Federal Register on June 2, 1964 (29 FR 7169), and given further distribution as Notice No. 64-28. This rule was recodified from CAR 4b without any substantive changes.

(3) Minor modifications to this regulation were incorporated to address the introduction of turbine engines. The following excerpt is from Notice of Proposed Rulemaking 68-3 (33 FR 3641, March 1, 1968), which amended paragraph (a). Since the FAA's determinations as to the fire protection required for integral oil sumps did not involve oil sumps having a large oil capacity, the Notice proposed to revise the regulation to make it clear that this regulation applied to reciprocating engines having an integral oil sump of less than 20 quart capacity. The following text is from the preamble to the Notice:

> Paragraph 25.1013(a), in pertinent part, allows an engine oil tank to be in a designated fire zone if the tank and its supports are fireproof to the extent that damage by fire to any non-fireproof part will not cause leakage or spillage of oil. This rule was originally adopted as Section 4b.443 of the Civil Air Regulations to provide fire protection for the oil tanks associated with large, dry-sump radial engines. Because the main supply of oil for such an engine is contained in a separate tank that is not an integral part of the engine, the large quantity of oil involved makes fireproofing of the tank a safety necessity.
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> In recent times, the use of smaller, highly efficient, horizontally opposed reciprocating engines used extensively in light FAR Part 23 airplanes, has found increasing favor in the design of FAR Part 25 airplanes. In these engines, the oil

> tank is an oil sump, designed and built as an integral part of the engine. The supply of oil is small and is contained entirely within the sump located in the lower compartment of the engine. The sumps are generally made of either aluminum or magnesium, neither of which is considered fireproof. Aluminum will melt when subjected to intense heat, and magnesium under those conditions will melt and eventually ignite. However, the FAA is unaware of any instance of fire in light airplanes involving these engines where fire damage, attributable to the material of which the sump was constructed, resulted in leakage or spillage of oil. Moreover, the sump itself, whether made of aluminum or magnesium, serves as a heat sink for the dissipation of heat produced by fire.
>
> In addition to the foregoing considerations of sump material, the sump location in the lower compartment of the engine has not been shown to contribute to fires in Part 23 airplanes. Thus, in the event of fire within the engine compartment resulting from failure of a cylinder or fuel line, the direction of airflow around the engine will direct the flames away from the sump. Furthermore, even in the unlikely event there is leakage or spillage of oil, the relatively small quantity of oil would not contribute significantly to an engine fire. In view of the satisfactory service experience with wet sump engines in the small airplanes, the FAA proposes to permit such installation in airplanes certificated under Part 25 without requiring the oil sumps to be fireproof.

(4) Amendment 25-19 (33 FR 15410, October 17, 1968) followed Notice 68-3 and incorporated the changes to this regulation described below. The following text is from the preamble to Amendment 25-19:

> The comments received in response to Notice 68-3 generally favored the proposal. However, one commenter recommends that the proposal be changed to require a showing, either by demonstration or analysis, that the possibility of fire originating within or being exaggerated by the oil in the wet sump is extremely remote. According to the commenter, the best indication of this would probably be the operational history of engines with integral oil sumps. In response to this comment, it should be pointed out that Notice 68-3 was issued on the basis of the satisfactory service experience with integral oil sumps on reciprocating engines used in small airplanes.
>
> As stated in the preamble to Notice 68-3, the FAA has determined that (1) because of the relatively small quantity of oil that can be carried in the integral sumps; (2) the fact that the oil sump itself serves as a heat sink to assist in dissipating heat from a fire near the sump; and (3) the fact that in reciprocating engines the direction of airflow around the engine will direct the flames away from the sump; the fireproofing of the integral oil sump is unnecessary. Since these conditions are characteristic of all reciprocating engines having integral oil sumps, there is no need to require a separate showing by each applicant for a type certificate for an aircraft equipped with such engines.
>
> As previously indicated, the proposal was based in part on the fact that the capacities of oil sumps currently installed on reciprocating engines are relatively small. In this connection, none of the existing reciprocating engines or reciprocating engines currently being considered for certification have integral oil sumps with capacities greater than 20 quarts. Since the FAA’s determinations as to the fire protection required for integral oil sumps did not involve oil sumps having a large oil capacity, it is considered appropriate to revise the proposed regulation to make it clear that this regulation applies to reciprocating engines having an integral oil sump of less than 20 quart capacity.

Finally, it is noted that § 25.1185(a) ("Flammable fluids") contains powerplant fire protection requirements for tanks and reservoirs containing flammable fluid which in some respects parallel the oil tank requirements of § 25.1013(a). Therefore, in order to fully implement the proposed regulation, it is also necessary to exclude the integral oil sumps covered by this amendment from the requirements of § 25.1185(a).

d. **Policy/Compliance Methods.**

(1) ***Oil Tank Expansion Space***. The requirements of § 33.71(c) ("Lubrication system") and § 25.1013(b) are nearly identical. Therefore, both the engine manufacturer and the installer must show compliance to the expansion space requirement. Compliance with this regulation at the Part 25 level has traditionally been shown by submitting an analysis for the installed engine that is predicated on Part 33 compliance data.

The analysis should account for any installation affects, including wing dihedral, installed engine droop, and yaw angles, in demonstrating compliance. This may require a ground test of both a left and right wing engine if adequate data is not available from the Part 33 compliance demonstration. Section 25.1013(b)(3) requires that it must be impossible to fill the expansion space inadvertently with the airplane in the normal ground attitude. The normal ground attitude ranges typically are limited by airport ramp attitudes and have been limited to ± 2 degree pitch and or roll. In some instances compliance with § 25.1013(b)(3) has been affected by the conditions that existed when the engine was serviced.

(2) ***Oil Hiding***. In some cases the quantity of oil in the tank changes as the engine operating condition changes. For example, the oil quantity in the tank may fall during engine rotation. In some instances this "oil hiding or gulping" phenomenon can result in overfilling of the engine oil tank and reduction of the tank expansion space below the required 10 percent value if the engine oil tank is serviced (filled) soon after engine rotation has stopped. Section § 25.1013(b)(3) requires: *"It must be impossible to fill the expansion space inadvertently with the airplane in the normal ground attitude."* Therefore, it should not be possible to overfill the oil system during servicing. The hiding phenomenon should be considered when establishing compliance with this paragraph. Testing that includes servicing of an installed engine immediately following dry motoring and shutdown from an operating condition may be necessary to establish if this condition exists.

If the condition is found to exist, the applicant may choose to place a limitation of servicing the oil system following engine shutdown or dry motoring. If specific procedures and/or limitations are required to avoid overfilling of the tank, these procedures/limitations should be included in the appropriate maintenance manuals, the engine installations manual, and graphic placards placed near the oil fill location warning servicing personnel of the limitation. The placards should be located near the fill point and be visible to maintenance personnel when the fill port is exposed for servicing.

e. **References.**

(1) Aeronautics Bulletin No. 7-A, “Airworthiness Requirements for Aircraft,” 1934.

(2) Civil Air Regulations 4b, December 31, 1953.

(3) Amendment 25-AD (29 FR 18289, December 24, 1964).

(4) Notice of Proposed Rulemaking 68-3 (33 FR 3641, March 1, 1968).

(5) Amendment 25-19 (33 FR 15410, October 17, 1968).

## **Section 25.1015 Oil tank tests.**

a. **Rule Text.**

*Each oil tank must be designed and installed so that-*

*(a) It can withstand, without failure, each vibration, inertia, and fluid load that it may be subjected to in operation; and*

*(b) It meets the provisions of § 25.965, except-*

*(1) The test pressure --*

*(i) For pressurized tanks used with a turbine engine, may not be less than 5 p.s.i. plus the maximum operating pressure of the tank instead of the pressure specified in § 25.965(a); and*

*(ii) For all other tanks may not be less than 5 p.s.i. instead of the pressure specified in § 25.965(a); and*

*(2) The test fluid must be oil at 250°F. instead of the fluid specified in § 25.965(c).*

*(Doc. No. 5066, 29 FR 18291, Dec. 24, 1964, as amended by Amdt. 25-36, 39 FR 35461, Oct. 1, 1974)*

b. **Intent of Rule.** The intent is self-evident.

c. **Background.**

(1) The regulatory history shows that this requirement originated from Section 442 of Civil Air Regulations (CAR) Part 4b, December 31, 1953. Amendment 25-AD was published in the Federal Register on December 24, 1964 (29 FR 18289); it added Part 25 [New] to the Federal Aviation Regulations and replaced Part 4b of the CAR. It was part of the Agency recodification program announced in Draft Release 61-25, published in the Federal Register on November 15, 1961 (26 FR 10698). Part 25 [New] was published as a notice of proposed rule making in the Federal Register on June 2, 1964 (29 FR 7169), and given further distribution as Notice No. 64-28. This rule was recodified from CAR 4b.442 without any substantive changes.

(2) Amendment 25-36 (39 FR 35452, October 1, 1974), which was based upon the Notice of Proposed Rulemaking No. 71-12 (36 FR 8383, May 5, 1971), incorporated consideration of pressurized oil tanks used with turbine engines into paragraph (b). No substantive comments or discussion of the proposal were provided within the notice or preamble.

d. **Policy/Compliance Methods.** The regulation provides detailed requirements and, therefore, no additional guidance has been developed for transport category airplanes. It should be noted that Advisory Circular 29-2B allows the use of air for pressure testing of the tank. This method has not been accepted for transport category airplanes.

e. **References.**

(1) Civil Air Regulations 4b, December 31, 1953.

(2) Amendment 25-AD (29 FR 18289, December 24, 1964).

(3) Advisory Circular 29-2B, "Certification of Transport Category Rotorcraft," July 30, 1997.

## Section 25.1017 Oil lines and fittings.

a. **Rule Text.**

*(a) Each oil line must meet the requirements of § 25.993 and each oil line and fitting in any designated fire zone must meet the requirements of § 25.1183.*

*(b) Breather lines must be arranged so that --*

*(1) Condensed water vapor that might freeze and obstruct the line cannot accumulate at any point;*

*(2) The breather discharge does not constitute a fire hazard if foaming occurs or causes emitted oil to strike the pilot's windshield; and*

*(3) The breather does not discharge into the engine air induction system.*

b. **Intent of Rule.** This regulation outlines the certification requirements for oil lines and fittings to ensure fire protection integrity and proper operation of the oil system plumbing.

c. **Background.** The regulatory history shows that this requirement originated from Section 444 of Civil Air Regulations (CAR) Part 4b, December 31, 1953. Amendment 25-AD was published in the Federal Register on December 24, 1964 (29 FR 18289), which added Part 25 [New] to the Federal Aviation Regulations and replaced Part 4b of the CAR. It was part of the Agency recodification program announced in Draft Release 61-25, published in the Federal Register on November 15, 1961 (26 FR 10698). Part 25 [New] was published as a notice of proposed rule making in the Federal Register on June 2, 1964 (29 FR 7169), and given further distribution as Notice No. 64-28. This rule was recodified from CAR 4b.444 without any substantive changes.

**d. Policy/Compliance Methods.** The following excerpt is based upon guidance provided in Advisory Circular (AC) 29-2B, "Certification of Transport Category Rotorcraft" ( paragraph 501, Section 29.1017). (Although that AC provides guidance for transport rotorcraft, it may provide insight into acceptable compliance methodology useful for other category aircraft.)

*Oil Lines and Fittings*.

The oil system lines and fittings are required to meet the requirements of § 25.993 ("Fuel system lines and fittings"); therefore, the routing and clamping described in Paragraph 709, Chapter 14, Section 2, of Advisory Circular 43.13-1A ["Acceptable Methods, Techniques, and Practices -- Aircraft Inspection and Repair"] may be utilized as guidance for the system design. An evaluation carried out through the development and certification test period will usually surface many problems of interference and/or vibration. However, interference and/or vibration problems can still be found after years of in-service experience.

1) When flexible hoses are used in the lubrication system, they must be substantiated. Hoses listed in TSO C53a may be used, which would preclude certain substantiation requirements.

2) Location of the breather lines and discharge should be carefully evaluated to determine that the requirements of this paragraph are followed.

3) The routing of fluid lines should be such that drooping lines and fluid traps that are undrainable are avoided.

e. **References**.

(1) Civil Air Regulations 4b, December 31, 1953.

(2) Amendment 25-AD (29 FR 18289, December 24, 1964).

(3) Advisory Circular 29-2B, “Certification of Transport Category Rotorcraft,” July 30, 1997.

(4) Advisory Circular 43.13-1A, “Acceptable Methods, Techniques, and Practices -- Aircraft Inspection and Repair,” 1972.

## **Section 25.1019 Oil strainer or filter.**

a. **Rule Text.**

*(a) Each turbine engine installation must incorporate an oil strainer or filter through which all of the engine oil flows and which meets the following requirements:*

*(1) Each oil strainer or filter that has a bypass must be constructed and installed so that oil will flow at the normal rate through the rest of the system with the strainer or filter completely blocked.*

*(2) The oil strainer or filter must have the capacity (with respect to operating limitations established for the engine) to ensure that engine oil system functioning is not impaired when the oil is contaminated to a degree (with respect to particle size and density) that is greater than that established for the engine under Part 33 of this chapter.*

*(3) The oil strainer or filter, unless it is installed at an oil tank outlet, must incorporate an indicator that will indicate contamination before it reaches the capacity established in accordance with paragraph (a)(2) of this section.*

*(4) The bypass of a strainer or filter must be constructed and installed so that the release of collected contaminants is minimized by appropriate location of the bypass to ensure that collected contaminants are not in the bypass flow path.*

*(5) An oil strainer or filter that has no bypass, except one that is installed at an oil tank outlet, must have a means to connect it to the warning system required in § 25.1305(c)(7).*

*(b) Each oil strainer or filter in a powerplant installation using reciprocating engines must be constructed and installed so that oil will flow at the normal rate through the rest of the system with the strainer or filter element completely blocked.*

*(Amdt. 25-36, 39 FR 35461, Oct. 1, 1974, as amended by Amdt. 25-57, 49 FR 6848, Feb. 23, 1984)*

b. **Intent of Rule.** The purpose of this rule is to protect the engine from the effects of contaminated oil.

c. **Background.**

(1) The regulatory history shows that this requirement originated from Section 442 of Civil Air Regulations (CAR) Part 4b, December 31, 1953. Amendment 25-AD was published in the Federal Register on December 24, 1964 (29 FR 18289), which added Part 25 [New] to the Federal Aviation Regulations and replaced Part 4b of the CAR. It was part of the Agency recodification program announced in Draft Release

61-25, published in the Federal Register on November 15, 1961 (26 FR 10698). Part 25 [New] was published as a notice of proposed rule making in the Federal Register on June 2, 1964 (29 FR 7169), and given further distribution as Notice No. 64-28. This rule was recodified from CAR 4b.442 without any substantive changes.

(2) Notice of Proposed Rulemaking 71-12 (36 FR 8383 May 5, 1971) proposed a requirement that each engine have an oil filter, and defined the indications that were necessary for the oil filter. Concurrent with that proposal, the FAA proposed similar amendments of Parts 23 and 33. The following text, from the preamble to the Notice, explains proposed new requirements:

> This proposal would introduce comprehensive oil system requirements for turbine engines. The requirements for turbine engines correspond to those applied to or proposed for the engine fuel system filtration capability and would protect the engine in the same manner from the effects of contaminated engine oil. . .

Amendment 25-36 (39 FR 35452, October 1, 1974) followed Notice 71-12 and adopted the proposed requirements. The following text is excerpted from the preamble to that amendment:

> Several commenters express the belief that the proposed amendment might be interpreted to require that each and every oil strainer or filter in the system, including small so called "last chance filters," conform to all the requirements of paragraph (a). The intent of the FAA is to require at least one oil strainer or filter that will filter all the oil that passes through the lubricating system while conforming to the requirements of the section. The rule, as adopted, has been reworded to make this clear.
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> Another commenter objects to the word "normal" [i.e., ". . .*oil will flow at the normal rate"]* as inappropriate in . . . proposed paragraph (a). The FAA does not agree . . . and used the word "normal" to mean normal for the system within its operating range. Therefore, the wording as proposed has been retained.
>
> One commenter states that filters should be serviced on a routine and normal maintenance basis rather than relying upon an indicator as proposed in subparagraph (a)(3). In this connection, it should be noted, however, that the rule does not call for relaxing of any maintenance procedures, but adds an additional item that will contribute to safety by providing a quick means of inspecting for possible filter contamination.
>
> It was assumed in one comment that the standard engine oil pressure gauge would qualify as an indicator as required in proposed subparagraph (a)(3). While it was considered that a separate indicator would be provided, nevertheless, if the applicant can demonstrate that the oil pressure gauge would adequately perform the function of the indicator, a separate indicator would not be required. Upon further consideration, the function of the indicator in terms of contamination of the screen has been reworded for clarity.
>
> Several commenters question whether the wording of subparagraph (a)(4) was realistic in requiring that no contaminants be released through the filter bypass. As proposed, the requirement stated an absolute prohibition against release of

> contaminants. The FAA agrees that the intended purpose may be met by requiring the bypass to be designed to minimize release of contaminants, and the requirement is reworded accordingly.

d. **<u>Policy/Compliance Methods.</u>** The FAA has issued policy regarding the indication requirements of § 25.1019(a)(3) and (a)(5), as documented in the following:

(1) <u>Methods of Compliance with FAR § 23.1019(a)(3) and § 25.1019(a)(3); Indication of Oil Screen Contamination</u>: The following is an excerpt from an internal FAA memorandum, dated April 14, 1981, concerning the use of oil pressure indicator for showing compliance with § 25.1019(a)(3).

> The FAA agrees that the interpretation of subparagraphs § 23.1019(a)(3) and § 25.1019(a)(3) should be the same, since the wording of each is identical. Both subparagraphs state that the oil strainer or filter must incorporate an indicator that will indicate contamination of the screen before it reaches the capacity established in the previous paragraph. There is no requirement in either rule for an indicator, which does not require continuous monitoring. Therefore, an oil pressure gauge which would move out of the normal operating range before the filter bypass opens, signaling oil screen contamination, would be considered an acceptable indicator for Part 23 and Part 25 aircraft. Such an interpretation is supported by the preamble to Amendments 23-15 and 25-36, which incorporated subparagraphs § 23.1019(a) and § 25.1019(a)(3) into FAR 23 and 25, respectively. The discussion of significant comments in these preambles states, in part:
>
>> It was assumed in one comment that the standard engine oil pressure gauge would qualify as an "indicator" as required in proposed subparagraph (a)(3). While it was considered that a separate indicator would be provided, nevertheless, if the applicant can demonstrate that the oil pressure gauge would adequately perform the function of the indicator, a separate indicator would not be required.
>
> The clear implication of this wording is that the intent of the regulations can be satisfied by an oil pressure gauge. Of course, the applicant must demonstrate to the satisfaction of the certifying region that such an oil pressure gauge adequately performs the function of a separate indicator under the performance conditions specified in § 23.1019 or § 25.1019.
>
> An oil pressure warning light set to illuminate at a differential pressure sufficiently below the 'pressure at which the filter will bypass would be one acceptable means of compliance with § 23.1019(a)(3). However, other types indicators, including an oil pressure gauge, could also be shown as acceptable means compliance with both these regulations."

(2) <u>Use of Pop-Out Indicators for Showing Compliance with § 25.101(a)(3)</u>. The following is an excerpt from an FAA letter, dated May 22, 1985, related to this subject:

> This is in response to your inquiry concerning whether there is a requirement for a cockpit indication of contamination of the main oil filter for a [*model*] engine in

the [*model*] aircraft. You indicated that the engine oil system was similar to the [*another model*] engine oil system used in similar [*model*] aircraft. You also indicated both of the model aircraft do not use a cockpit indication but, rely on a pop-up flag for warning of contamination and impending oil filter bypass. It was also reported that [*another airplane manufacturer*] considered the cockpit indication to be a requirement for their [*model*] aircraft.

Federal Aviation Regulations (FAR) § 25.1019(a)(3) requires indication of contamination of the oil strainer or filter screen unless it is installed at the oil tank outlet. Section 25.1019(a)(5), together with § 25.1305(c)(7), further requires cockpit indication if the strainer or filter has no bypass. By omission, the indication provided for strainers or filters that do have bypasses need not be located in the cockpit. It must, however be in an area accessible for inspection. Note that the oil pressure gage cannot serve as the warning means in either case.

Thus, the pop-up flag on the main oil filter is an acceptable means of warning indication of oil system contamination.

(3) Oil Filter Bypass Indication Requirements for Auxiliary Power Unit (APU). The following guidance was developed within an FAA Issue Paper in 1994 to address oil filter bypass indication requirements for APU's:

**Statement of Issue:** APU Technical Standard Order (TSO) C77a, Appendix 1, paragraph 6.5.2, requires that a means must be provided to indicate oil filter bypass. The airplane currently has an APU that was certificated in the mid-1980's. There was no requirement, at that time, for an oil filter bypass indication; therefore the APU has not met this TSO C77a requirement. The purpose of this Issue Paper is to explicitly define acceptable methodologies for the indication of APU oil filter bypass.

**Background:** Technical discussions between the Federal Aviation Administration (FAA) and the applicant highlighted the fact that the APU oil filter system does not currently meet the FAA TSO C77a requirement for indicating an oil filter bypass condition.

The philosophy of requiring an oil filter bypass is based on the scenario that, if no oil bypass exists, oil sludge, bearing spall particles, and other various debris could clog the filter, and if left uncorrected, could result in a flooded sump and possible fire or possibly APU oil starvation. The philosophy of incorporating an *impending* oil filter bypass *indication* is based on the scenario that, after oil filter clogging and the resulting bypass of oil around the filter, the debris that clogged the filter would then be allowed to circulate through the oil system, possibly contaminating the main APU bearings or possibly clogging the various components of the oil system, thereby disrupting oil flow and possibly resulting in bearing or shaft failure. Therefore both an oil filter bypass and a means of indicating impending bypass are seen as necessary. This CRI [Certification Review Item] will focus on the various indication methods that are currently employed.

**FAA Position:** The following information represents various acceptable methods that are currently used by APU manufacturers for indicating APU oil filter impending bypass. Technical Standard Order (TSO) C77a does require a bypass indication, but does not require an impending bypass indication; most, if not all, manufacturers choose the more conservative impending bypass indication approach. The FAA believes that an impending bypass indication is a preferred approach relative to the bypass indication, and therefore recommends it. The impending bypass system typically utilizes a method of measuring oil filter inlet to outlet pressure differential and triggers an indicator when the differential pressure is slightly less than that required to open the bypass valve and bypass the filter. Thus after impending bypass annunciation, a maintenance action can be performed prior to the potential bypass of oil around the filtering system and thus averting further possible contamination throughout the rest of the oil system which could result in rapid deterioration of lubricated components. Conversely, the simple bypass indication (i.e. non-impending) only indicates after the oil filter has become completely clogged and becomes bypassed, thus exposing the oil system to the contaminated oil.

One manufacturer utilizes a pop-up type impending bypass indicator. This pop-up indicator is spring loaded and is mounted on the oil filter housing. The ground maintenance crew then periodically (e.g. daily) inspect this pop-up indicator to determine if the oil filter is clogged and possibly being bypassed.

Another method currently employed is utilizing an impending bypass sensor that sends a signal to either the electronic engine control or an electronic maintenance indicator box, commonly known as a “byte box”. A built-in-test (BIT) is then periodically performed, normally during APU startup or shutdown, and the impending bypass fault is then stored in the maintenance computer until the next periodic inspection by the ground crew.

Finally, it is also possible to send the oil filter impending bypass indication signal directly to the cockpit where either an indicator light is illuminated or the signal is stored in a cockpit maintenance computer. Again, the stored signal would be detected at the next inspection by the ground crew. Ideally, as with any of the previously described indication systems, ground crew inspection and corrective action should occur soon after the indication signal is generated.

The applicant should propose an APU oil filter impending bypass indicator as required in TSO C77a, Appendix 1, paragraph 6.5.2.

(4) Installation of Multiple Large Capacity Filters without Bypass -- Compliance with § 25.1019 (a)(5). The FAA recently has received requests to certificate engine oil filter designs that incorporate multiple and /or large capacity filters. In one case the applicant installed a dual element filter within the oil scavenge system. The primary filter incorporated a bypass and a maintenance indication was provided to the flight crew to preclude dispatch with the primary filter impending bypass indication present. The secondary filter element did not incorporate a bypass. The use of dual element filters was not envisioned when this regulation was developed. Therefore, the applicant requested an equivalent safety finding as shown below, to the requirement of § 25.1019 to provide cockpit indication of impending clogging of a filter that has no bypass.

The second unusual design incorporated two filters: One filter was installed in the oil scavenge system and also included a bypass with an associated impending bypass maintenance message to the flight crew to preclude dispatch. A second non-bypassing filter was installed in the oil supply system downstream of the oil tank and high-pressure pump. This filter also included a filter differential pressure indication and associated maintenance message to the flight crew to preclude dispatch. Discussion of this design is provided in the following excerpt from an Equivalent Safety Finding on a high bypass ratio twin engine airplane, dated April 11, 1995:

> **Statement of Issue:** The engine oil filtration system for the airplane incorporates a two-stage filter system. A 65-micron primary filter stage is bypassed to a 150-micron secondary stage when the pressure drop across the primary filter stage exceeds a set level. Impending bypass of the primary filter stage is indicated on the airplane flight deck display system by a status message (status messages are used to determine dispatchability of the airplane and are not normally displayed in flight). The 150-micron secondary filter stage has no bypass means, and no indication to the flight crew of excessive pressure drop across the filter stage. The oil filtration system does not directly comply with the provisions of § 25.1019(a) and § 25.1305(c)(7).
>
> **Background:** Section 25.1305(c)(7) requires
>
> > *"A warning means for the oil strainer or filter required by § 25.1019, if it has no bypass, to warn the pilot of the occurrence of contamination of the strainer or filter screen before it reaches the capacity established in accordance with § 25.1019(a)(2)."*
>
> No such warning for the secondary filter stage appears to be present on the proposed system; and the filter impending bypass indication for the primary filter cannot be considered a warning means [in the context of § 25.1305(c)(7)] for contamination of the secondary stage because it is not normally displayed to the flight crew. The proposed oil filter indication scheme for the engine installation was not envisioned at the time the referenced regulatory provisions were promulgated and the two-stage filter design does not comply.
>
> On turbine engine powered transport airplanes, a warning of a contaminated oil filter or strainer is required where no bypass exists so that the pilot will receive warning of an impending oil flow and pressure loss condition. The contaminated filter warning is intended to be an advance warning of possible engine failure, which allows the pilot to take appropriate action - such as diverting on a twin engine airplane before the engine must be shut down due to low oil pressure.
>
> The current procedure for other engine installations equipped with a single stage oil filter with a bypass, following an oil filter impending bypass indication, is to reduce engine power until the indication no longer appears. If the indication remains when the engine is pulled back to idle, the engine is shut down. The proposed configuration lacks any preliminary warning and would allow operation until the low oil pressure indication was displayed, and then require immediate shutdown of the engine.
>
> The design of the indication system is intended to preclude unnecessary airplane diversions due to false oil filter impending bypass indications. The status level message provided is intended to be used only for preflight and maintenance actions.
>
> **FAA Position:** Section 25.1305(c)(7) requires
>
> > *"A warning means for the oil strainer or filter required by § 25.1019, if it has no bypass, to warn the pilot of the*

> *occurrence of contamination of the strainer or filter screen before it reaches the capacity established in accordance with § 25.1019(a)(2).”*

No such warning for the oil filter appears to be present on the engine installation, and the proposed system therefore does not comply with § 25.1305(c)(7). Compliance with § 25.1305(c)(7) or a finding of equivalent safety is required for the FAA to approve the proposed configuration.

**Applicant Position and Discussion:** The FAA has indicated that the engine indication of oil filter contamination and blockage does not meet the letter of § 25.1305(c)(7). Specifically, indication “before” filter capacity is reached is not provided.

Recent high bypass engine experience has shown that indication-related in-flight shutdowns (false indications) are a significant portion of fleet total IFSD’s. Early in the design and development, a concerted effort was made to revise instrumentation design and indication system architecture. The current implementation of filters and blockage indications were planned specifically to address this issue and are as discussed below.

The engine uses a dual oil filter where the primary element (65 Micron) has a bypass (and a status message for impending bypass) and the secondary element (150 micron) has no bypass. The primary element with its status annunciation is treated strictly as a maintenance aid/tool. Secondary filter blockage is annunciated by decreasing oil pressure, ultimately causing automatic display via a secondary page pop-up and a low oil pressure message.

During a development test, the primary held about one cubic inch, or 55 grams, of material in it prior to blockage and bypass. The secondary filter can hold more than twice that amount without losing its ability to pass sufficient oil flow to the engine.

For most foreseen impending engine failure conditions, the expected contamination levels coupled with the added filter capacity (over and above that provided on previous installations) would allow the airplane to continue the flight and land before the indication of low oil pressure would mandate an engine shutdown. Prior to the next flight, the primary filter bypass status message would be investigated and proper action taken.

For impending failure conditions where contaminants are being generated at a higher rate than the filters can accommodate in one flight, the advance warning, which would have been provided by a filter clogging indication, would be relatively short. In this scenario, the filter clog indication would provide little time advantage in initiating a diversion. In addition, when low oil pressure is annunciated, the resultant IFSD would be safe as evidenced by the extensive in-service experience on previous airplane models.

The above information provides the mitigating design features necessary to ensure the safety of the engine oil filter system. The applicant requests an equivalent safety finding be granted on FAR § 25.1305(c)(7).

**FAA response to applicant’s position:** The FAA has reviewed the applicant’s position described above and the data provided to the Engine Certification Office concerning the engine oil filtration system failure modes and effects analysis and capacity. We have determined that, while the proposed system does not provide indication of impending bypass for the secondary filter stage, the systems provides many compensating features. These features include:

1) the no dispatch status message which indicates impending bypass of the primary filter stage;

2) the large capacity of the secondary filter stage should ensure that a flight will be completed (and the filter replaced) prior to the secondary filter becoming completely plugged; and

3) the demonstrated ability of the oil system to maintain acceptable levels of oil system flow with the secondary filter stage almost completely blocked.

The filter capacity of the secondary filter, which is nearly one-and-a-half that of the primary filter, has been found to be adequate to preclude clogging of the filter from all foreseeable contamination levels during a flight, except those that may occur as a result of failures of the engine. The effects of extended operation of the engine, without flight crew action to shutdown the engine, until the engine low oil pressure indication is provided, has been found by the Engine Certification Office to not result in an unsafe condition. In addition, the secondary filter will:

1) eliminate additional engine damage due to debris that would typically be bypassed to the downstream turbomachinery by a typical single stage bypass filtration system; and

2) reduce the number of unnecessary single engine diversions due to false indications.

Although the oil filter indication system as proposed by the applicant does not strictly comply with § 25.1305(c)(7), it does provide additional filtration system features which we consider to provide adequate compensation for the lack of the required indication. These compensating features are sufficient to justify a finding of equivalent level of safety to § 25.1305(c)(7).

**Conclusion:** After reviewing the data submitted by the applicant to the ACO and by the engine manufacturer to the Engine Certification Office, under the provisions of § 21.21(b)(1), we have determined that the oil filtration system has compensating design features which are sufficient to warrant a finding of equivalent safety to the provisions of § 25.1019(a) and § 25.1305(c)(7). This issue is considered closed."

e. **References**.

(1) Civil Air Regulations 4b, December 31, 1953; per amendment 4b-12 (17 FR 2986, March 30, 1952).

(2) Civil Air Regulations 4b, Section 442 (CAR 4b.442) (19 FR 4464, July 20, 1954).

(3) Civil Air Regulations 4b, Section 447 (CAR 4b.447) (27 FR 2986, March 30, 1962).

(4) Amendment 25-AD (29 FR 18289, December 24, 1964).

(5) Amendment 25-36 (39 FR 35452, October 1, 1974).

(6) Amendment 25-57 (49 FR 6832, February 23, 1984).

(7) FAA memorandum, “Methods of Compliance with FAR § 23.1019(a)(3) and § 25.1019(a)(3); Indication of Oil Screen Contamination,” dated April 14, 1981.

(8) FAA letter, “Use of Pop-Out Indicators for Compliance with § 25.1019(a)(3),” dated May 22, 1985.

(9) FAA Certification Review Item, “Oil Filter Bypass Indication Requirements for Auxiliary Power Unit (APU),” 1994.

(10) FAA Equivalent Safety Finding, “Warning Means for Engine Oil Filter Contamination,” dated April 11, 1995.

(11) FAA Issue Paper, “Oil Filter Indication for Secondary Filter,” dated June 22, 1995.

## Section 25.1021 Oil system drains.

a. **Rule Text.**

*A drain (or drains) must be provided to allow safe drainage of the oil system. Each drain must --*

*(a) Be accessible; and*

*(b) Have manual or automatic means for positive locking in the closed position.*

*(Amdt. 25-57, 49 FR 6848, Feb. 23, 1984)*

b. **Intent of Rule.** The intent of this rule is self-evident.

c. **Background.**

(1) The regulatory history shows that this requirement originated from Section 448 of Civil Air Regulations (CAR) Part 4b, December 31, 1953. Amendment 25-AD was published in the Federal Register on December 24, 1964 (29 FR 18289), which added Part 25 [New] to the Federal Aviation Regulations and replaced Part 4b of the CAR. It was part of the Agency recodification program announced in Draft Release 61-25, published in the Federal Register on November 15, 1961 (26 FR 10698). Part 25 [New] was published as a notice of proposed rule making in the Federal Register on June 2, 1964 (29 FR 7169), and given further distribution as Notice No. 64-28. This rule was recodified from CAR 4b.448 without any substantive changes.

(2) Amendment 25-57 (49 FR 6848, February 23, 1984) revised this regulation to permit the use of multiple drains to provide more efficient drainage.

d. **Policy/Compliance Methods.**

(1) FAA policy on this topic has been limited. Policy governing this part is predicated on mutual acceptance of the requirements governing the installation of lines (§ 25.993) and fittings in the engine environment, on lines and fittings (§ 25.1017), and on governing flammable fluid-carrying components (§ 25.1183).

(2) The following guidance was developed from material contained in Advisory Circular 27-1 C3, “Certification of Normal Category Rotorcraft.” (Although that AC provides guidance for normal category rotorcraft, it may also provide insight into acceptable compliance methodology useful for other category aircraft.)

- The design of the oil system must provide a means for safe drainage of the entire oil system. This may require one or more drains depending on the design of the system. The routing of fluid lines should be such that drooping lines and fluid traps that are undrainable are avoided.

- The drain(s) must provide a means for a positive lock in the closed position. The method by which the lock is accomplished may be manual or automatic.

e. **References.**

(1) Civil Air Regulations 4b, December 31, 1953.

(2) Amendment 25-AD (29 FR 18289, December 24, 1964).

(3) Amendment 23-29 (49 FR 6847, February 23, 1984).

(4) Amendment 25-57 (49 FR 6848, February 23, 1984).

(5) Amendment 23-43 (58 FR 18973, April 9, 1993).

(6) Advisory Circular 27-1 C3, “Certification of Normal Category Rotorcraft,” September 12, 1991.

## Section 25.1023 Oil radiators.

a. **Rule Text.**

*(a) Each oil radiator must be able to withstand, without failure, any vibration, inertia, and oil pressure load to which it would be subjected in operation.*

*(b) Each oil radiator air duct must be located so that, in case of fire, flames coming from normal openings of the engine nacelle cannot impinge directly upon the radiator.*

b. **Intent of Rule.** The intent of this rule is self-evident.

c. **Background.** The regulatory history shows that this requirement originated from Section 446 of Civil Air Regulations (CAR) Part 4b, December 31, 1953. Amendment 25-AD was published in the Federal Register on December 24, 1964 (29 FR 18289), which added Part 25 [New] to the Federal Aviation Regulations and replaced Part 4b of the CAR. It was part of the Agency recodification program announced in Draft Release 61-25, published in the Federal Register on November 15, 1961 (26 FR 10698). Part 25 [New] was published as a notice of proposed rule making in the Federal Register on June 2, 1964 (29 FR 7169), and given further distribution as Notice No. 64-28. This rule was recodified from CAR 4b.446 without any substantive changes.

d. **Policy/Compliance Methods**.

(1) Policy governing this part is predicated on mutual acceptance of the requirements governing the installation of lines (§ 25.993) and fittings in the engine environment, on lines and fittings (§ 25.1017), and on governing flammable fluid-carrying components (§ 25.1183).

(2) The following extract is published in Advisory Circular 29-2B, "Certification of Transport Category Rotorcraft." (Although that AC provides guidance for transport rotorcraft, it may also provide insight into acceptable compliance methodology useful for other category aircraft.)

- The primary concern with respect to oil radiators is that they are sized to provide the required heat rejection and to provide adequate fluid flow within the prescribed pressure limits.
- The structural design of the radiator must consider the system oil pressure requirements and the service involvement of the intended application. The selection of the location of the radiator can have a significant bearing on its ability to withstand the vibration and inertia loads.
- If the system design incorporates an air duct to direct the airflow, the effects of a fire as defined in this regulation must be considered.

e. **References.**

(1) Civil Air Regulations 4b, Section 446 (CAR 4b.446), December 31, 1953.

(2) Amendment 25-AD ( 29 FR 18289, December 24, 1964).

(3) Advisory Circular 29-2B, "Certification of Transport Category Rotorcraft," July 30, 1997.

## Section 25.1025 Oil valves.

a. **Rule Text.**

*(a) Each oil shutoff must meet the requirements of § 25.1189.*

*(b) The closing of oil shutoff means may not prevent propeller feathering.*

*(c) Each oil valve must have positive stops or suitable index provisions in the ''on'' and ''off'' positions and must be supported so that no loads resulting from its operation or from accelerated flight conditions are transmitted to the lines attached to the valve.*

b. **Intent of Rule.** The intent of this requirement is self-evident.

c. **Background.** The regulatory history shows that this requirement originated from Section 445 of the Civil Air Regulations (CAR) Part 4b, December 31, 1953. Amendment 25-AD was published in the Federal Register on December 24, 1964 (29 FR 18289), which added Part 25 [New] to the Federal Aviation Regulations and replaced Part 4b of the CAR. It was part of the Agency recodification program announced in Draft Release 61-25, published in the Federal Register on November 15, 1961 (26 FR 10698). Part 25 [New] was published as a notice of proposed rule making in the Federal Register on June 2, 1964 (29 FR 7169), and given further distribution as Notice No. 64-28. This rule was recodified from CAR 4b.445 without any substantive changes.

d. **Policy/Compliance Methods.**

(1) Policy governing this section is predicated on mutual acceptance of the requirements governing the installation of lines (§ 25.993) and fittings in the engine environment, on lines and fittings (§ 25.1017), and on governing flammable fluid-carrying components (§ 25.1183 and § 25.1189).

(2) The following excerpt is from Advisory Circular 29-2B, "Certification of Transport Category Rotorcraft." (Although that AC provides guidance for transport rotorcraft, it may also provide insight into acceptable compliance methodology useful for other category aircraft.)

> As stated in the regulation, the closing of an oil shutoff valve may not prevent propeller feathering. Compliance with this requirement is best accomplished in the design phase. This can be accommodated by proper orientation of the valve and/or system plumbing routing. The design of the oil shutoff valve must consider the stop or index provisions of this rule. The installation must be such that no loads are transmitted to the lines attached to the valve.

e. **References**.

(1) Civil Air Regulations 4b, Section 445 (CAR 4b.445) December 31, 1953.

(2) Amendment 25-AD (29 FR 18289, December 24, 1964).

(3) Advisory Circular 29-2B, “Certification of Transport Category Rotorcraft,” July 30, 1997.

## Section 25.1027 Propeller feathering system.

a. **Rule Text.**

*(a) If the propeller feathering system depends on engine oil, there must be means to trap an amount of oil in the tank if the supply becomes depleted due to failure of any part of the lubricating system other than the tank itself.*

*(b) The amount of trapped oil must be enough to accomplish the feathering operation and must be available only to the feathering pump.*

*(c) The ability of the system to accomplish feathering with the trapped oil must be shown. This may be done on the ground using an auxiliary source of oil for lubricating the engine during operation.*

*(d) Provision must be made to prevent sludge or other foreign matter from affecting the safe operation of the propeller feathering system.*

*(Doc. No. 5066, 29 FR 18291, Dec. 24, 1964, as amended by Amdt. 25-38, 41 FR 55467, Dec. 20, 1976)*

b. **Intent of Rule.** Propeller feathering is considered a flight critical function. This section requires that the oil supply needed to accomplish propeller feathering is available.

c. **Background.**

(1) This rule originated from Section 449 of Civil Air Regulations (CAR) Part 4b, December 31, 1953. Amendment 25-AD was published in the Federal Register on December 24, 1964 (29 FR 18289), which added Part 25 [New] to the Federal Aviation Regulations and replaced Part 4b of the CAR. It was part of the Agency recodification program announced in Draft Release 61-25, published in the Federal Register on November 15, 1961 (26 FR 10698). Part 25 [New] was published as a notice of proposed rule making in the Federal Register on June 2, 1964 (29 FR 7169), and given further distribution as Notice No. 64-28. This rule was recodified from CAR 4b.449 without any substantive changes.

(2) Notice of Proposed Rulemaking 75-10, published in the Federal Register on March 7, 1975 (40 FR 10802), proposed adding a new [paragraph (d)] requirement for consideration of sludge. The explanation given was:

> The proposal is identical to § 23.1027(d), and it is directed at protecting propeller feathering system operation from the adverse effects of sludge and other foreign matter.

Amendment 25-38 (41 FR 55467, December 20, 1976) followed Notice 75-10, and adopted the proposed addition.

d. **Policy/Compliance Methods.** Compliance with § 25.1027 often requires analysis and inspection of the oil tank installation, and may require flight or ground testing. Analysis must show that adequate oil will be available to feather the propeller during oil system failures (excluding the tank itself) with the airplane at attitudes likely to occur during an engine failure. The analysis should be supported by tests to demonstrate that the oil reserve for propeller feathering is adequate to accomplish the feathering procedure. Ground testing may be accomplished by using an auxiliary source of lubricating oil for the engine during its operation. Provisions for compliance with § 25.1027(d) include location of the feathering system outlet from the tank in areas where the flow of oil would prevent build-up of sludge (i.e., the area is constantly washed with oil). Analytical and test data should be submitted to substantiate compliance.

e. **References.**

(1) Civil Air Regulations 4b, December 31, 1953.

(2) Amendment 25-AD (29 FR 18289, December 24, 1964).

(3) Notice of Proposed Rulemaking 75-10 (40 FR 10802, March 7, 1975).

(4) Amendment 25-38 (41 FR 55467, December 20, 1976).