SUBPART G –
OPERATING LIMITATIONS AND INFORMATION

Section 2. Markings and Placards

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Section 25.1541 General.

a. **Rule Text.**

(a) The airplane must contain --

(1) The specified markings and placards; and

(2) Any additional information, instrument markings, and placards required for the safe operation if there are unusual design, operating, or handling characteristics.

(b) Each marking and placard prescribed in paragraph (a) of this section --

(1) Must be displayed in a conspicuous place; and

(2) May not be easily erased, disfigured, or obscured.

b. **Intent of Rule.** The rule specifies which markings and placards must be displayed and, in § 25.1541(a)(2), requires that any additional information, placards, or markings required for safe operation. Note that some placard requirements are placed in other requirements.

c. **Background.** The regulatory history shows that this requirement originated from Section 730 of the Civil Air Regulations (CAR) 4b, December 31, 1953. Amendment 25-AD (29 FR 18289, December 24, 1964) added Part 25 [New] to the Federal Aviation Regulations and replaced Part 4b of the Civil Air Regulations. 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. This rule was recodified from CAR 4b.730 without substantive changes and has remained virtually unchanged since that time.

d. **Policy/Compliance Methods.** There is no established policy for this regulation.

e. **References.**

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

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

Section 25.1549 Powerplant and auxiliary power unit instruments

a. **Rule Text.**

For each required powerplant and auxiliary power unit instrument, as appropriate to the type of instrument --

(a) Each maximum and, if applicable, minimum safe operating limit must be marked with a red radial or a red line;

(b) Each normal operating range must be marked with a green arc or green line, not extending beyond the maximum and minimum safe limits;

(c) Each takeoff and precautionary range must be marked with a yellow arc or a yellow line; and

(d) Each engine, auxiliary power unit, or propeller speed range that is restricted because of excessive vibration stresses must be marked with red arcs or red lines.

(Amdt. 25-40, 42 FR 15044, March 17, 1977)

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 734 of the Civil Air Regulations (CAR) 4b, December 31, 1953. Amendment 25-AD (29 FR 18289 December 24, 1964) added Part 25 [New] to the Federal Aviation Regulations and replaced Part 4b of the Civil Air Regulations. 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. This rule was recodified from CAR 4b.734 without substantive change.

(2) Amendment 25-40 (42 FR 15034, March 17, 1977) followed two Notices of Proposed Rulemaking:

- Notice 75-10 (40 FR 10802, March 7, 1975) and
- Notice 75-19 (40 FR 21866, May 19, 1975).

These Notices proposed clarifications to the requirements for powerplant instrument markings and included auxiliary power units. The following excerpts from the preamble to Amendment 25-40 provide insight into the intent of this rule:

> One commenter concurs with [the proposal], but points out that, while it accommodates vertical scale instruments, it does not accommodate horizontal scale instruments. The FAA agrees and § 25.1549, as adopted, will provide

marking standards appropriate to circular, horizontal, and vertical scale powerplant instruments.

Another commenter believes that the proposal to provide specific requirements for marking vertical tape instruments, to provide for cockpit instrument standardization, is not appropriate for today's turbine engines. The commenter indicates that the requirement could produce overlapping markings that could he misleading and, under certain operating conditions, could indicate that an unsafe condition is safe. The commenter recommends that markings for vertical tape engine instruments not be specified because such standardization is not in the best interest of safety. The FAA believes that overlap markings on tape instruments, similar to the overlap markings on round face instruments, will provide an adequate and safe presentation.

d. **Policy/Compliance Methods.** Compliance has been demonstrated through proper design with adherence to FAA guidelines. Advisory Circular (AC) 20-88A, "Marking of Aircraft Powerplant Instruments (Displays)," provides guidance regarding this section. Additional guidance is provided within the following excerpts from Issue Papers and internal FAA memorandums.

(1) The following material is taken from an FAA Generic Issue Paper and provides guidance on a proposal to use a digital-only presentation of high/intermediate pressure rotor speed. It was the FAA's position that the digital-only presentation of high/intermediate pressure rotor speed ($N_{2/3}$) may unacceptably limit the flight crew's ability to properly monitor and operate the engines.

Background. The primary engine displays on turbine engine powered transport aircraft have traditionally displayed the engine rotor speeds required by § 25.1305(c)(3) in an analog-only or an analog and digital format. Standby Engine Indicators (SEI), when provided, have typically displayed these parameters in either analog-only or digital-only format. An increasing demand to conserve primary display space has led to digital-only primary displays for those rotor speeds not normally used for power setting [1]. This situation may result in a small, cluttered, low-resolution primary display.

In addition, it is generally accepted that digital-only displays are often less effective than conventional analog displays at providing the crew with: discernible indication of the parameter during a rapid transient; and quick intuitive indication of the parameters approximate level, direction and rate of change, proximity to limits, and relationship to other parameters on the same engine or the same parameter on other engines. This is why Advisory Circular 20-88A, paragraph 4(c), states that *"digital indicators are most valuable when integrated with an analog display."*

FAA Position. In general, if the primary display of any rotor speed required by § 25.1305(c)(3) is being proposed in a digital-only format, then the visibility, relative location, criticality, and functionality of this display will be stringently reviewed during certification to assure that the proposed design does not require any of the explicit or implicit benefits of a traditional analog display [2]. Also, the availability of the display must be shown to be commensurate with its criticality. However, since this aspect is not unique to the digital-only format, it will not be discussed further here.

Consequently, it must be clearly demonstrated that, given the noted shortcomings of a digital-only display format, the proposed model digital-only $N_{2/3}$ display still meets the intent of all applicable regulations, including:

- § 25.901(c) and § 25.1309(b): These rules collectively limit the acceptable effects of foreseeable failures and malfunctions. Where compliance with these regulations is reliant on the effective use of the subject rotor speed display, then that assumed capability must be verified.

- § 25.1309(a): This rule requires that the displays "perform their intended functions under any foreseeable operating condition." Therefore, the design must be shown to effectively provide any intended functions, including those related to flight manual procedures, normal engine monitoring functions, and failure intervention.

- § 25.1309(c): This rule requires that *"warning information must be provided to alert the crew to unsafe system operating conditions, and to enable them to take appropriate corrective action;"* and *"monitoring and warning means must be designed to minimize crew errors which could create additional hazards."* The Part 33-approved engine type certificate, supplemented by the Part 25 type certificate as required, will establish rotor speed limits. The engine installation manual may also identify a "precautionary range." § 25.1549 restricts how this warning (limit/redline) and caution (precautionary/yellow band) information can be presented. Given the meager trend and proximity to limits information provided by a digital-only display, supplemental compensating features must be identified that will assure crew awareness prior to a limit (redline) being reached if crew intervention is required [3]. Therefore, in complying with this rule and § 25.1549, even if a "precautionary range" is not specified in the engine installation manual, a yellow precautionary range or equivalent should be implemented that would enable the crew to effectively intervene and prevent any foreseeable [4] gradual [5] engine overspeed.

- § 25.1321(c)(2): This rule requires that "powerplant instruments vital to the safe operation of the airplane must be plainly visible to the appropriate crew members." This should be specifically evaluated for all intended safety related display functions.

- § 25.1549: This rule restricts how required powerplant instruments may indicate the safe operating limits, normal operating range, and takeoff and precautionary ranges. The intent of these requirements is more difficult to meet with a digital-only display. However, the FAA have accepted the following as meeting the intent of these requirements:

  - a visible placard, stating the operating limits of the subject parameter, located such that it is clearly associated with that parameter; and
  - display digits/background that change color [6] based on the range in which the parameter is currently operating.

[1] N_1 (for EPR engines), N_2 (for N_1 engines), and N_3 (where applicable)

[2] Such as proper and repeatable engine starts, crew intervention prior to rotor limit exceedance, and crew detection and diagnosis of engine or display malfunctions/ deterioration.

[3] It must be noted that, since containment capability and other safety considerations are predicated on operational limits being observed, any redline exceedance is considered at least hazardous by the FAA. However, some engine controls may have sufficiently reliable and effective "rotor speed topping loops" that act in place of the crew to prevent limit exceedances under any foreseeable conditions.

[4] Foreseeable is intended to mean that which must be considered to occur when complying with either § 25.901(c) or § 25.1309(a)&(b).

[5] The "precautionary range" is not intended to be effective for the rapidly progressing overspeed that can result from engine rotor failures, but rather is intended to address the more common moderate acceleration rates associated with control system failures or crew error.

[6] White digits/background, to indicate the normal operating range, have been accepted in the past as providing an equivalent level of safety to the green required by the rule.

(2) The following excerpt is from an FAA Issue Paper that was developed to provide policy guidance on the issue of "Instrument Range and Limit Markings." The applicant proposed to eliminate the green arc on all cockpit instruments, contending that only non-normal indications need to be conspicuously displayed. The applicant's submittal constituted a proposed equivalent method of compliance with §§ 25.841, 25.1435, 25.1541 and 24.1549.

Discussion. Instrument range and limit markings are specifically required by certain regulations. The need for crew awareness of normal and abnormal system(s) operation is implied by other regulations. The range markings are intended to indicate to a flight crewmember, at a glance, that system(s) operation is being accomplished in a safe, desirable, undesirable but allowable, or unsafe condition.

The color **green** is required and used to indicate a safe condition for continuous operation, both ground and flight.

The color **yellow** is required and used to indicate a precautionary range where limited operation is permissible and the possibility of future crew action is required.

The color **amber** is also required for caution lights where the possibility of future crew action is required.

The color **red** is required and is used to indicate a limit or condition which must not be exceeded or at which operation is prohibited and may require immediate crew action.

In the case of powerplant and auxiliary powerplant unit (APU) instruments, section 25.1549(b) requires a green arc or green line, not extending beyond the maximum and minimum safe limits for each normal operating range. Section 25.841(b)(5), (6) and (7) for pressurized cabins and Section 25.1435(a)(2) for hydraulic systems must be complied with.

The applicant's proposal to eliminate the green markings on all flight deck instruments because only non-normal indication require crew reaction is acceptable provided the boundaries of "within limits" or "normal" and "out of limits" or "non-normal" operating ranges are completely and clearly defined.

> The use of the color amber in place of yellow is considered acceptable provided the amber color is used consistently throughout the cockpit.

(3) The following excerpt is from an FAA letter written in 1981 in response to an applicant's request for an "Equivalent Level of Safety Finding for § 25.1549."

> In response to your letter of March 14, 1981, the FAA notes that your aircraft company has requested the subject finding for the digital N2 tachometer installation in its [*model*] airplane.
>
> We understand that the [*model*] airplane incorporates two turbofan engines with a single N_2 limit for all operations. Based on this understanding and the description of the features of the digital tachometer installation presented in your letter, we concur with the finding of equivalent level of safety. This finding, of course, would not be applicable for engine models with separate takeoff and maximum continuous N_2 limits.

(4) The following excerpt is from an FAA letter, dated November 21, 1974, which provides guidance on "Engine Exhaust Gas Temperature Indicators" and (other) powerplant instrument markings.

> Recently the FAA completed certification of the [model 1 engine] installation on the [model 1 airplane] in question. One item of controversy was the engine exhaust gas temperature characteristic. You are aware that the engine was approved with, what we term, dual takeoff EGT limits, i.e., the five-minute takeoff limit of 935°C and the other a two-minute acceleration limit of 950°C. The applicant furnished data showing that the engines did exhibit these EGT characteristics in that the acceleration temperatures normally will exceed the normal day-to-day stabilized takeoff EGT within the two-minute time span. Therefore, it was felt that if the present instruments were to be utilized and the acceleration and takeoff temperature limits were to be observed, both <u>should</u> be highlighted and made more conspicuous in some manner that the crew monitoring the temperatures would have the most visible reference mark or line considered practical under day and night light conditions. We are aware of an approved EGT instrument <u>marking</u> for another airplane manufacturer's model airplane which does not include a conspicuous mark for the five-minute limit, however, it was felt that more conspicuous, as well as additional, markings should be made available to the crew for their monitoring the five-minute takeoff limit and the maximum two-minute acceleration limit. As a consequence, the applicant reviewed our position and submitted an EGT marking configuration with both limits displayed. We accepted this design, which we feel complies with § 25.1549 and the intent of § 25.1541(a)(2), in that there is the unusual dual-limit surveillance required for all operations.
>
> Concurrently with the [model 1 engine] installation program, we were reviewing a similar requirement for other [model 2 and 3 airplanes] equipped with different [model 2 engine]. Evidently some operators of these airplanes were experiencing overtemping on hot days with their [model 2 engine] installations and they requested some relief from the airplane manufacturer applicant and the engine manufacturer. Consequently, the engine manufacturer obtained approval to add a 10°C acceleration limit above the takeoff EGT limit to the specific engine type certificate. The applicant, in turn, approached the FAA for approval to use

this additional limit for airplanes in the field. We applied the same criteria to those [model 2 and 3 airplane] installations as was established for the [model 1 engine]/[model 1 airplane] installation. Although you will note some variation in design between the [model 2 and 3 airplanes] and [the model 1 airplane], we feel the difference in the design features merely reflect two acceptable marking displays made up by different airplane manufacturing entities.

Two things complicate compliance with the rules for dual-limit or multi-limit powerplant instrument markings for airframe installations: One is the physical size of the indicators, and the other is the additional marking requirements associated with multi-limits in the engine installation. The small size makes the visibility requirement difficult to accept by the pilots and the multi-limits make monitoring an additional workload for the crew. Obviously, if the engine manufacturer could eliminate multi-limit requirements without compromising safety, the effect on airframe installations would simplify the installation and crew workload. However, since multi-limits have been approved, we recommend pertinent rule changes be made to establish standardized criteria for marking the multi-limits on powerplant instruments.

Proposed changes are as follows:

In addition to the requirements of § 25.1541 and § 25.1549, each required powerplant instrument marking for maximum limits steady state and transient, must be distinctively marked so that the markings will not be confused with other required markings.

A new requirement which identifies transient limits and includes the color and shape of the related marking.

(5) The following excerpt is from an FAA letter, dated July 19, 1982, and provides compliance guidance for "Powerplant Instruments."

The reference letters provide interesting insight on your company's philosophy of flight deck design. They do not, however, show that a blank lower Engine Indication and Crew Alert System (EICAS) display screen with selected caution and warning annunciations provides a level of safety equivalent to continuous display of the engine data.

It is the position of the FAA that continuously visible engine instruments provide the flight crew with important subliminal cues on impending engine related problems. These cues result from repetition of the normal instrument scan procedures and would be absent with a blank EICAS lower Display Unit (DU). With the blank lower DU, the first crew awareness of impending malfunction becomes an EICAS caution or warning message. Unfortunately, as in the case of oil quantity, even this does not occur. In the event of an oil system leak or high engine oil consumption, the first warning of a problem is loss of oil pressure and an immediate requirement to shut down one engine.

In an earlier letter dated July 1, 1982, the applicant states that they wish to discourage in-flight trouble shooting of engine and airplane systems. The FAA position is that all information that will allow the flight crew to recognize and respond to an engine related problem must be continuously displayed. It is the position of the FAA that early detection of abnormal conditions serves to minimize the development of serious in-flight emergencies through compounding of relatively minor problems and circumstances.

The FAA position continues to be that the EICAS lower DU must be operative for dispatch and must continuously display the parameters until a way is found to provide the same crew cues to an impending problem that is provided by continuous display of engine data.

(6) The following excerpt is from an FAA letter, dated July 9, 1982, to an engine manufacturer and provides guidance on "EICAS Engine Instrument warning and Caution Annunciation Trigger Levels."

FAA flight test pilots have reported an Engine Indication and Crew Alert System (EICAS) caution annunciation on exhaust gas temperature (EGT) during climbout at maximum continuous thrust (MCT) or less on the engine model 1 powered airplane. Because an amber or yellow warning arc on an EGT instrument is universally interpreted as imposing a five minute or less time limitation on operation within that area, crew reaction to this EGT caution annunciation is to cut back power and continue climbout at some lower power level. The effect of this amber annunciation is to impose a MCT limit on the engine which is lower than that contained in the proposed airplane flight manual. This conflict between flight manual data and engine caution data visible to the flight crew is unacceptable.

At the reference meeting with the airplane manufacturer on June 29, 1982, the airplane manufacturer's personnel explained that the EGT warning annunciation was based on EGT's that might be expected at many takeoff conditions. This level was stated to be 525°C, compared with the engine Type Certificate Data Sheet (TCDS) maximum continuous limit of 600°C. This choice of annunciation levels was apparently due to a misinterpretation of § 25.1549(c), which requires yellow arcs for takeoff and cautionary ranges. This regulation is correctly interpreted to mean the time-limited takeoff power ranges defined by the engine TCDS, plus other cautionary ranges related to either engine or airframe.

Your proposal at the reference meeting to reprogram EICAS to provide EGT caution annunciations which match the engine TCDS is considered an acceptable means of resolving the subject caution annunciation problem. In addition, inasmuch as engine rotor speeds (N1 and N2) have only a maximum assigned limit (red line), we consider your proposal at this meeting to remove the amber bands from the N1 and N2 tachometers to be acceptable. All other engine parameter displays should be consistent with this approach.

This EGT problem has highlighted another FAA concern: The EICAS engine data displays contain numerous symbols, cautionary data, and warning data, some of which are intermittently displayed. It will be necessary for the airplane manufacturer to supply a description of these engine display data, an explanation of the reason for selection of each warning or caution range, and an explanation of the rationale for intermittent displays. It is not necessary that this description contain the overall philosophy for limit selection, but ***only*** that the source of the limit be identified. For instance, the N1 tachometer description should identify all data, which can be displayed. This would include the upper red line value and its source, presumably the engine TCDS. The description of the N1 display should continue with a discussion of the low idle speed cautionary warning including the selected warning speed(s) and the source of those speeds, whether engine manufacturer data or airplane manufacturer requirements. If this cautionary display is intermittent, the conditions which result in this display should also be

identified (e.g., nacelle thermal anti-ice on, altitude, etc.). Any other N1 displays should be described in a similar manner.

These data are required by the FAA prior to certification of the [model 1 airplane]. Because of the very short time remaining to the scheduled certification date, the airplane manufacturer's response to this FAA data requirement may take the form of a letter which provides a short description of the display for each engine parameter.

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) Notice of Proposed Rulemaking 75-19 (40 FR 21866, May 19, 1975).

(5) Amendment 25-40 (42 FR 15034, March 17, 1977).

(6) Advisory Circular 20-88A, "Guidelines on the Marking of Aircraft Powerplant Instruments (Displays),"dated September 30, 1985.

Section 25.1551 Oil quantity indication.

a. **Rule Text.**

Each oil quantity indicating means must be marked to indicate the quantity of oil readily and accurately.
(Amdt. 25-72, 55 FR 29786, July 20, 1990)

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 735 of the Civil Air Regulations (CAR) 4b, December 31, 1953. Amendment 25-AD (29 FR 18289 December 24, 1964) added Part 25 [New] to the Federal Aviation Regulations and replaced Part 4b of the Civil Air Regulations. 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. This rule was recodified from CAR 4b.735 without substantive change.

(2) Notice of Proposed Rulemaking 84-21 (49 FR 47358, December 3, 1984) proposed further clarification of the rule. Amendment 25-72 (55 FR 29756, July 20, 1990) adopted the proposed clarification.

d. **Policy/Compliance Methods**. Compliance has been demonstrated through proper design with adherence to FAA guidelines.

(1) The following excerpt from Advisory Circular 29-2B, "Certification of Transport Category Rotorcraft," provides insight into the guidance developed for transport category rotorcraft and may also provide insight into compliance guidance development for transport category airplanes.

Oil Quantity Indicators.

a. Background. This section states that each oil quantity indicator must be marked with enough increments to indicate oil quantity readily and accurately. The oil quantity gage should be calibrated based upon tank full and empty values determined per guidance provided for § 25.1011.

b. Procedures. There are several different methods that have been accepted for indication of oil quantity. These include:

(1) Cockpit-mounted oil quantity indicator. (As noted above in the background to this regulation, it was intended that a cockpit indicator be provided when large amounts of reserve oil are required.)

(2) Oil quantity dip stick. (Commonly used on small short-range turbopropeller transport category airplanes.)

(3) Oil quantity sight indicator. (Generally used for measuring transmission and gearbox oil quantities.)

c. The oil quantity indicator should be marked so that the oil quantity can be accurately determined. This can range from increments marked in gallons, such as oil quantity indicators for large amounts of oil, to oil quantity indicators marked in quarts with full and add marks, such as engine dip sticks. Sight indicators with full and add marks have been used successfully for gearboxes. Sight indicators normally do not reflect quantities. These are some of the methods currently in use to indicate the oil quantity. In all cases, those methods identified above have proved to be an acceptable method of showing compliance with § 25.1551.

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 84-21 (49 FR 47358, December 3, 1984).

(4) Amendment 25-72 (55 FR 29756, July 20, 1990).

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

Section 25.1553 Fuel quantity indicator.

a. **Rule Text.**

If the unusable fuel supply for any tank exceeds one gallon, or five percent of the tank capacity, whichever is greater, a red arc must be marked on its indicator extending from the calibrated zero reading to the lowest reading obtainable in level flight.

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

c. **Background.** The regulatory history shows that this requirement originated from Section 736 of the Civil Air Regulations (CAR) 4b, December 31, 1953. Amendment 25-AD (29 FR 18289, December 24, 1964) added Part 25 [New] to the Federal Aviation Regulations and replaced Part 4b of the Civil Air Regulations. 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. This rule was recodified from CAR 4b.736 without substantive change.

d. **Policy/Guidance Methods.**

(1) Compliance has been demonstrated through proper design with adherence to FAA guidelines, as reflected in the following excerpt from Section 17 of Advisory Circular 25-8, "Auxiliary Fuel System Installations," which has been incorporated in total into Section 25.952 of this Propulsion Mega AC.

Airplane Placard and Instrument Marking Evaluation:

b Instrument, Instrument Identification, Lighting and Calibration 25.1305, 25.1337, 25.1381, 25.1541, 25.1543, 25.1553, 25.1555 and 25.1583).

(1) A fuel quantity indicator should be installed for each independent auxiliary fuel tank which provides indication to the flightcrew of the quantity, in gallons or equivalent units, of usable fuel in each tank during flight (see also Chapter 4, paragraph 11b(4)). Indicators should be as accurate and compatible with the existing airplane fuel quantity indicators as possible and calibrated using the same units of volume (metric or English).

(2) Instrument and switch markings should be easily readable with instrument lights.

(3) Each instrument, indicator and switch must have markings/placards which permit the crew to easily identify it. Markings and placards shall be displayed in conspicuous places and shall be such that they cannot be easily erased, disfigured or obscured.

(4) If the instrument markings are on the cover glass of the instrument, there must be means to maintain the correct alignment of the glass cover with the face of the dial.

(5) Each fuel tank selector control, if used, must be marked to indicate the position corresponding to each tank.

(2) The following excerpt from Advisory Circular 29-2B, "Certification of Transport Category Rotorcraft," provides insight into the guidance developed for transport category rotorcraft and may also provide insight into compliance guidance development for transport category airplanes.

Fuel Quantity Indicator.

a. This section describes the markings necessary to identify the portion of unusable fuel that cannot be used in level flight. Unusable fuel may be present in a design due to the relative configuration of the fuel tank to the fuel outlet (e.g., sumps, unusual elevations and/or configurations dictated by aircraft contours, etc.). If the unusable fuel supply for any tank is less than or equal to 1 gallon or is less than or equal to 5 percent of the tank capacity, whichever is greater, this section does not apply.

b. Procedures. For each fuel tank which has an unusable fuel capacity exceeding 1 gallon or 5 percent of the tank capacity, whichever is greater, the following should be accomplished:

(1) Calibration computations, measurements, and/or tests should determine the zero (empty) position on the fuel quantity indicator. *(See guidance for § 25.1337.)*

(2) The lowest reading obtainable in level flight must be determined by computation, measurement, and/or testing.

(3) Once the instrument readings defined by paragraphs b(1) and (2) above have been determined, a red arc (or in the case of a digital gage a low fuel indication) should be placed between the readings on the fuel quantity indicator.

(4) Appropriate notations should be made in the flight manual to define the intent of the red arc (or low fuel indication) to the flightcrew. *[Reference § 25.1585(e)]*.

e. **References.**

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

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

(3) Advisory Circular 25-8, "Auxiliary Fuel System Installations," May 2, 1986. [Incorporated in total into Section 25.952 of this Propulsion Mega AC].

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

Section 25.1555 Control markings.

a. **Rule Text.**

(a) Each cockpit control, other than primary flight controls and controls whose function is obvious, must be plainly marked as to its function and method of operation.

(b) Each aerodynamic control must be marked under the requirements of § 25.677 and § 25.699.

(c) For powerplant fuel controls --

(1) Each fuel tank selector control must be marked to indicate the position corresponding to each tank and to each existing cross feed position;

(2) If safe operation requires the use of any tanks in a specific sequence, that sequence must be marked on, or adjacent to, the selector for those tanks; and

(3) Each valve control for each engine must be marked to indicate the position corresponding to each engine controlled.

(d) For accessory, auxiliary, and emergency controls --

(1) Each emergency control (including each fuel jettisoning and fluid shutoff must be colored red; and

(2) Each visual indicator required by § 25.729(e) must be marked so that the pilot can determine at any time when the wheels are locked in either extreme position, if retractable landing gear is used.

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

c. **Background.** The regulatory history shows that this requirement originated from Section 737 of the Civil Air Regulations (CAR) 4b, December 31, 1953. The regulation included the specific requirement of 4b.737(c)(2) that

> Emergency controls, including fuel jettisoning and fluid shutoff controls, shall be colored red and shall be marked to indicate their function and method of operation.

Amendment 25-AD (29 FR 18289, December 24, 1964) added Part 25 [New] to the Federal Aviation Regulations and replaced Part 4b of the Civil Air Regulations. 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. This rule was recodified from CAR 4b.737 without substantive change and has been basically unchanged since that time.

d. **Policy/Compliance Methods.** The following guidance is provided regarding determination of what controls would be considered emergency controls and therefore be required to be colored red.

It has been suggested that the following qualifiers be used to make the determination of what controls would be considered emergency controls and therefore be required to be colored red:

- The use of an emergency control is referenced in an emergency procedure.
- The emergency procedure requires immediate use of the control for the emergency condition being addressed.
- The use or misuse of the emergency control for conditions, other than that addressed in the emergency procedure, may create a hazard or unsafe condition (examples: fuel jettisoning and fluid shutoff).

Based on the above qualifiers, the Electronic Locator Transmitter (ELT) switch need not be red if the unit does not have a cockpit switch. For a cockpit mounted manual ELT switch (on, armed and off) where the pilot may wish to activate the ELT before crashing, locating a switch painted red may save a few seconds from hunting and thus allow for the Search and Rescue Satellite System (SARSAT) to receive a signal or two while the airplane is going down. This is a benefit if the ELT or ELT antenna does not survive the emergency landing.

Certain emergency procedures call for turning off the emergency lights, to save the emergency lighting batteries and then turning them on just before the emergency landing. However, it is questionable whether the use of the cockpit switch requires “immediate use of the control.” Further, of the limited survey we have made, none of the emergency lighting switches located in the cockpit have been painted red. Therefore, we suggest that the cockpit emergency lighting switches need not be colored red. If an emergency lighting switch is located at the flight attendant station, we suggest that these switches be colored red to indicate they are to be used in an emergency and not used otherwise (to prevent misuse).

An alternative to a red switch, is a switch located on a panel that has been colored red local to the switch.

e. **References.**

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

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

Section 25.1557 Miscellaneous markings and placards.

a. **Rule Text.**

(a) Baggage and cargo compartments and ballast location. Each baggage and cargo compartment, and each ballast location must have a placard stating any limitations on contents, including weight, that are necessary under the loading requirements. However, underseat compartments designed for the storage of carry-on articles weighing not more than 20 pounds need not have a loading limitation placard.

(b) Powerplant fluid filler openings.

(1) Fuel filler openings must be marked at or near the filler cover with --

(i) The word ‘‘fuel’’;

(ii) For reciprocating engine powered airplanes, the minimum fuel grade;

(iii) For turbine engine powered airplanes, the permissible fuel designations; and

(iv) For pressure fueling systems, the maximum permissible fueling supply pressure and the maximum permissible defueling pressure.

(2) Oil filler openings must be marked at or near the filler cover with the word ‘‘oil’’.

(3) Augmentation fluid filler openings must be marked at or near the filler cover to identify the required fluid.

(c) Emergency exit placards. Each emergency exit placard must meet the requirements of § 25.811.

(d) Doors. Each door that must be used in order to reach any required emergency exit must have a suitable placard stating that the door is to be latched in the open position during takeoff and landing.

(Doc. No. 5066, 29 FR 18291, Dec. 24, 1964, as amended by Amdt. 25-32, 37 FR 3972, Feb. 24, 1972; Amdt. 25-38, 41 FR 55468, Dec. 20, 1976; Amdt. 25-72, 55 FR 29786, July 20, 1990)

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 738 of the Civil Air Regulations (CAR) 4b, December 31, 1953. Amendment 25-AD (29 FR 18289, December 24, 1964) added Part 25 [New] to the Federal Aviation

Regulations and replaced Part 4b of the Civil Air Regulations. 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. This rule was recodified from CAR 4b.738 without substantive change.

(2) Notice of Proposed Rulemaking 75-10 (40 FR 10208, March 7,1975) proposed both substantive and clarifying changes. The proposed substantive changes would require marking of maximum permissible pressure differentials for both fueling and defueling at pressure fueling points, and would delete as unnecessary the requirement for marking fuel and oil tank capacities at the filler openings. In addition, the rule would be revised to clarify that the term "minimum fuel grade" applies only to reciprocating engine powered airplanes and that fuel "designation" applies to turbine engine powered airplanes.

Amendment 25-38 (41 FR 55468, December 20, 1976) followed Notice 75-10 and adopted the proposal without substantive change. The following excerpt from the preamble to Amendment 25-38,describes the change:

> One commenter takes exception to the proposed deletion of the requirement for marking fuel and oil tank capacities at the filler openings in § 25.1557(b). The FAA believes this method of providing the usable fuel tank capacity and the oil tank capacity is no longer necessary. The pilot has the fuel quantity gage and the Airplane Flight Manual, and the servicing personnel usually have no interest in the usable fuel tank capacity. The determination of oil level in oil tanks is usually accomplished with the dipstick.

(3) Notice of Proposed Rulemaking 84-21 (49 FR 47358, December 3, 1984) proposed to revise the heading of paragraph (b) to "Powerplant fluid filler openings." It also proposed that the requirement for marking the augmentation system tank filler openings be transferred from § 25.945 to § 25.1557 for editorial convenience and clarity.

Amendment 25-72 (55 FR 29786, July 20, 1990) followed Notice 84-21 and adopted the proposal. The following excerpt from the preamble to that Amendment provides further insight into the regulatory change:

> One commenter opposes deletion of marking requirements based on the rationale that the requirements are redundant. The commenter notes that, in other sections of Part 25, the FAA proposes to add references to requirements to ensure that important requirements are not overlooked and states that this policy is preferable from an airworthiness standpoint. The FAA concurs that references are appropriate, in some instances, to ensure that important requirements are not overlooked. In other instances, however, references are unnecessary and merely serve to obscure other requirements. The FAA does not concur that the transfer of the marking requirements of § 25.945(b)(4) to § 25.1557 and the elimination of the cross reference in § 25.979 will adversely affect airworthiness since the requirement continues to exist in another section appropriately identified as a marking section.

d. **Policy/Compliance Methods.** The following excerpts from Advisory Circular 20-16, "Marking Aircraft Fuel Filler Openings with Color Coded Decals," dated September 17, 1982, discuss the conditions under which color coded decals may be used to comply with the requirements in FAR Parts 23, 25, 27, and 29 for marking fuel filler openings.

Background. Aviation accident statistics compiled by the National Transportation Safety Board (NTSB) and the FAA indicate that a number of accidents have been caused by the use of improper fuel. Most of these accidents occur in general aviation operations and have been related to misfueling with a fuel not intended for use with that airplane. Misfueling a reciprocating engine powered aircraft with turbine fuel has had catastrophic results with engine failure occurring during the critical takeoff phase of flight. Several major fatal accidents occurred when transport airplanes were fueled with the wrong kind of fuel and crashed immediately after takeoff.

The General Aviation Manufacturers Association (GAMA) has proposed a method to minimize the misfueling of general aviation aircraft. A specification for a color coded decal has been developed (GAMA Specification No. 3 issued on July 1, 1982) to provide a standard for decals to be affixed adjacent to aircraft fuel filler ports to alert servicing personnel of the proper fuel to be used. This is part of an overall scheme of color matching decals at aircraft fuel filler ports and fuel filler nozzles.

Discussion. Color coded decals meeting the material requirements, test conditions, and application and removal requirements for decals in GAMA Specification No. 3 are acceptable for use on small airplanes, transport airplanes and helicopters under the following conditions:

The color coded decal may be affixed to any certificated airplane or helicopter as an additional fuel filler marking as long as the required fuel filler markings approved for that airplane or helicopter are retained and the information on the color coded decal does not conflict with the information provided under the certification basis.

The color coded decal may be used to show compliance with the fuel filler marking requirements of §§ 23.1557, 25.1557, 27.1557, and 29.1557 in the certification of reciprocating engine powered airplanes and helicopters provided that the decal contains all of the information required by the regulations applied during the airplane or helicopter certification. Additional information such as "useable fuel capacity" may be required under the airplane or helicopter certification basis. Any information that is required to supplement the information on the color coded decal must be marked in an acceptable manner at or near the filler cover. The term "Avgas" on the decal is considered to be equivalent to the word "Fuel" specified in the regulations.

The color coded decal may be used to supplement the markings provided to show compliance with the fuel filler marking requirements of FAR's §§ 23.1557, 25.1557, 27.1557, and 29.1557 in the certification of turbine engine powered airplanes and helicopters. Such information as fuel designation, fuel additives, and maximum permissible fueling and defueling pressures which may be required by the applicable regulations, must be marked in an acceptable manner at or near the filler cover.

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 10208, March 7,1975).

(4) Amendment 25-38 (41 FR 55468, December 20, 1976).

(5) Notice of Proposed Rulemaking 84-21 (49 FR 47358, December 3, 1984).

(6) Amendment 25-72 (55 FR 29756, July 20, 1990).

(7) Advisory Circular 25-8, "Auxiliary Fuel System Installations," May 2, 1986. [Incorporated in total into Section 25.952 of this Propulsion Mega AC].

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

(9) GAMA Specification No. 3, "Specification for Decal to Minimize the Misfueling of General Aviation Aircraft," July 1, 1982. *[Note: Copies of this specification may be obtained from General Aviation Manufacturers Association 1400 K Street NW, Suite 801 Washington DC, 20005 or by calling (202) 393-1500.]*

Section 25.1581 General.

a. **Rule Text.**

(a) Furnishing information. An Airplane Flight Manual must be furnished with each airplane, and it must contain the following:

(1) Information required by § 25.1583 through § 25.1587.

(2) Other information that is necessary for safe operation because of design, operating, or handling characteristics.

(3) Any limitation, procedure, or other information established as a condition of compliance with the applicable noise standards of part 36 of this chapter.

(b) Approved information. Each part of the manual listed in 25.1583 through 25.1587, that is appropriate to the airplane, must be furnished, verified, and approved, and must be segregated, identified, and clearly distinguished from each unapproved part of that manual.

(c) (Reserved)

(d) Each Airplane Flight Manual must include a table of contents if the complexity of the manual indicates a need for it.

(Amdt. 25-42, 43 FR 2323, Jan. 16, 1978; Amdt. 25-72, 55 FR 29786, July 20, 1990)

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 740 of the Civil Air Regulations (CAR) 4b, December 31, 1953. Amendment 25-AD (29 FR 18289, December 24, 1964) added Part 25 [New] to the Federal Aviation Regulations and replaced Part 4b of the Civil Air Regulations. 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. This rule was recodified from CAR 4b.740 without substantive change.

(2) This regulation was modified by Amendment 25-42, (43 FR 2302, January 16, 1978), which was based upon two Notices of Proposed Rulemaking:

- Notice 75-10 (40 FR 10802, March 7, 1975); and
- Notice 75-25 (40 FR 24664, June 9, 1975).

The intent of this amendment was to add [in § 25.1581(a)(2)] a requirement for the inclusion of other information that is necessary for safe operation because of design, operating, or handling characteristics into the airplane flight manual. In addition, this

amendment added a new § 25.1581(d), which required the presence of a table of contents for complex manuals.

(3) Notice of Proposed Rulemaking 84-21 (49 FR 47358, December 3, 1984) proposed further revision of the rule to specify that the Airplane Flight Manual must contain any limitation established as a condition of compliance with the applicable noise standards of Part 36.

Amendment 25-72 (55 FR 29756, July 20, 1990) followed Notice 84-21 and adopted the proposal. The following excerpts from the preamble to that Amendment provide insight into the intent of this rule:

> Under this proposal, § 25.1581 would be amended to specify that the Airplane Flight Manual must contain any limitation established as a condition of compliance with the applicable noise standards of Part 36 of this chapter.
>
> The sole commenter recommends insertion of the word "airworthiness" between "any" and "limitation," asserting that the insertion would clearly delineate other aspects of noise findings from Part 25 certification. The FAA does not concur with this recommendation because it would negate the intent of the proposal. The limitations in question are those established for noise certification purposes, not those established for airworthiness.
>
> Since the time Notice 84-21 was issued, it has been noted that § 36.1581 also specifies that the Airplane Flight Manual (AFM) must also contain procedures and other information approved under § 36.1501. Section 25.1581 is, therefore, amended as proposed, except that paragraph(a)(3) reads, "Any limitation, procedure, or other information established for consistency with § 36.1581." This addition presents no additional burden, as § 36.1581 already contains the same requirement.

c. **Policy/Compliance Methods.** Compliance has been demonstrated through proper design with adherence to FAA guidelines. In addition, these guidelines are reflected in Section 18 of Advisory Circular (AC) 25-8, "Auxiliary Fuel System Installation," May 2, 1986, as follows. (Note that the entire text of AC 25-8 is incorporated in this Propulsion Mega AC at Section 25.952.)

> 18. **AIRPLANE FLIGHT MANUAL (AFM)** (§§ 25.1581 through 25.1587).
>
> a. Auxiliary fuel tanks installed after initial certification of the airplane require an FAA-approved AFM supplement or an appendix to the existing basic AFM to provide appropriate operating information, procedures and limitations. Generally, an appendix to an AFM is appropriate when written by the manufacturer of the basic airplane, and a supplement is appropriate when the applicant for an auxiliary fuel tank installation is other than the manufacturer.
>
> b. The applicant is responsible for preparing the AFM supplement or appendix which will be incorporated into the basic AFM. The operating procedures and limitations will be evaluated by the FAA flight test crew as part of the flight test evaluations prescribed by the Type Inspection Authorization (TIA). Crew workload also will be evaluated to determine whether it is still acceptable with the addition of an auxiliary fuel system. Crew workload should be considered early

in the design of the system, with FAA participation, to ensure that all considerations are properly coordinated.

c. Sufficient information and data should be provided in the AFM to assure that the flightcrew will be able to understand and operate the system during normal, abnormal, and emergency operations of the airplane.

d. Abnormal procedures are those that are not normal procedures and also are not emergency procedures. They include procedures for foreseeable failure situations in which the use of special systems, or the use of regular systems, may be expected to maintain an acceptable level of airworthiness. Immediate action is not usually required. Since most auxiliary fuel systems are add-on systems, which are not included in the flight training syllabus of the airplane, the AFM supplement or appendix must be complete in providing the required information. To assure completeness of the AFM supplement (or appendix) the following discussion and format are provided as a guide for the type of information that should be considered.

In general, the AFM follows the format as shown below:

AIRPLANE FLIGHT MANUAL FORMAT

- **INTRODUCTION**
- **PART I, FAA APPROVED:**

  Section 1 Limitations

  Section 2 Emergency Procedures

  Section 3 Normal Procedures/Abnormal Procedures

  Section 4 Performance Data

  Section 5 Auxiliary Fuel System Description.

- **PART II, MANUFACTURER'S DATA**

  Section 6 Weight and Balance Manual Information. [In either AFM supplement or in a separate weight and balance control and loading document which will be referenced in the AFM. Reference § 25.1583]

  Section 7 Maintenance Manual

  (1) *Limitations*.

  (i) WEIGHT LIMITATIONS. Maximum zero fuel weight changes and weight and center of gravity limits should be specified. It should be emphasized that when fuel is loaded into fuselage auxiliary tanks, the maximum zero fuel weight must be reduced by the weight of the added fuel.

  (ii) FUEL LOADING LIMITATIONS. The maximum allowable fuel in each auxiliary tank should be specified. Loading limitations may be required to maintain weight/C.G.. within limits, i.e., certain main fuel tanks may be required to

be loaded before the auxiliary tanks and the auxiliary tanks may be required to be loaded in a particular sequence depending on the design of the system.

(iii) FUEL MANAGEMENT LIMITATIONS.

(A) Specific fuel usage procedures may be required to maintain the weight and balance of the airplane within limits. Additionally, flight planning limitations may be required if a single failure can trap fuel in the auxiliary fuel system; the main fuel system must still provide sufficient fuel to the engines for the remainder of the flight, i.e., to reach the airport of destination or to an alternate airport.

(B) A specific sequence of transferring auxiliary fuel may be required as a result of fuel flow rates.

(C) If auxiliary fuel is used for ballast, a placard indicating the amount of ballast fuel is required in the cockpit.

(iv) OPERATING LIMITATIONS.

(A) Maneuvering limitations should be specified.

(B) Tank pressurization or transfer of fuel during takeoff and landing are usually prohibited because of the crashworthiness fire hazard.

(C) Transfer of fuel during climb or descent may be prohibited because of usable fuel considerations.

(v) MISCELLANEOUS LIMITATIONS. Cargo and floor loading restrictions may be required due to the auxiliary fuel tank installation.

(2) *Emergency Procedures*.

(i) DITCHING. If applicable, procedures must be provided regarding transfer of fuel from auxiliary fuel tanks and placement of controls and switches prior to ditching.

(ii) NO FUEL TRANSFER. Should fuel not transfer and become trapped in the auxiliary tanks, procedures should be included to regain transfer capability. If transfer is still not available, management procedures should specify how to maintain weight/C.G.. within limits.

(iii) ENGINE INOPERATIVE. In the event of an engine failure, auxiliary fuel systems which use engine bleed air for fuel transfer may lose transfer capability. In order to restore transfer, procedures must be included which define the steps required for obtaining bleed air from the remaining operating engine(s). These procedures should also define engine operating restrictions, if required, which apply during transfer following engine-out conditions. Continued use of bleed air for fuel transfer may be affected by the engine-out enroute climb performance requirements of Part 25.

(3) *Normal Procedures/Abnormal Procedures.*

(i) FUEL LOADING. Instructions necessary to enable loading of the airplane within the established limits of weight and center of gravity, and to maintain the loading within these limits in flight must be provided.

(ii) EXTERNAL PREFLIGHT CHECK. Detailed procedures should be specified.

(iii) COCKPIT PREFLIGHT CHECK. Detailed procedures should be specified. (iv) Fuel Management and Transfer Procedures.

(A) Detailed procedures should be specified for each fuel transfer schedule approved and should include normal fuel transfer rates for use.

(B) Flow Check. Procedures to determine that auxiliary fuel transfer is available should be specified, where required.

(C) Fuel Jettison. (If installed). Procedures should be established to dump fuel, if desired, listing airspeed, altitude, and configuration.

(v) USABLE FUEL. Maximum usable fuel should be specified.

(vi) UNUSABLE FUEL. The unusable fuel should be specified.

(4) *Performance*. Any change in airplane performance should be provided. For instance, if engine bleed air is used to pressurize the auxiliary fuel system, its effects should be accounted for.

(5) *Auxiliary Fuel System Description*. A detailed description and functional arrangement schematic should be provided. This information may be provided in an unapproved section of the AFM supplement (or appendix) or may be included in the approved SECTION 3, NORMAL PROCEDURES. A suggested outline includes the following:

(i) Fuel Transfer System.

(ii) Control Panel.

(iii) Refueling System.

(iv) Electrical System.

(v) Schematics.

19. **WEIGHT AND BALANCE MANUAL INFORMATION**. Weight and loading distribution information including loading instructions must be presented either in the AFM supplement or in a separate weight and balance control and loading document which will be referenced in the AFM. Reference § 25.1583(c).

20. **MAINTENANCE MANUAL** (§ 25.1529). The inspections, tests, repairs and related intervals upon which compliance with the applicable certification basis is based should be included in a maintenance manual supplement supplied by the applicant. The manual should also contain complete servicing information for the auxiliary tanks and systems. If the applicant proposes to have a system where a tank(s) may be removed or made inoperable for maintenance purposes and the remainder of the system remains airworthy (as where more than one tank configuration is an approved configuration) or where the entire system is classified as removable,

complete maintenance instructions should also be provided detailing tile methods of system modification or removal, resealing and restoring the compartments, and other considerations necessary to make the airplane airworthy. The applicant should refer to Part 25, Appendix H, Instructions for Continued Airworthiness, when providing maintenance instructions.

e. **References.**

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

(2) Amendment 25-42 (43 FR 2302, January 16, 1978).

(3) Amendment 25-72 (55 FR 29756, July 20, 1990).

(4) Advisory Circular 25-8, "Auxiliary Fuel System Installations," May 2, 1986 [Incorporated in total in this Propulsion Mega AC at Section 25.952].

Section 25.1585 Operating procedures.

a. **Rule Text.**

(a) Information and instructions regarding the peculiarities of normal operations (including starting and warming the engines, taxiing, operation of wing flaps, landing gear, and the automatic pilot) must be furnished, together with recommended procedures for --

(1) Engine failure (including minimum speeds, trim, operation of the remaining engines, and operation of flaps);

(2) Stopping the rotation of propellers in flight;

(3) Restarting turbine engines in flight (including the effects of altitude);

(4) Fire, decompression, and similar emergencies;

(5) Ditching [including the procedures based on the requirements of §§ 25.801, 25.807(d), 25.1411, and 25.1415(a) through (e)];

(6) Use of ice protection equipment;

(7) Use of fuel jettisoning equipment, including any operating precautions relevant to the use of the system;

(8) Operation in turbulence for turbine powered airplanes (including recommended turbulence penetration airspeeds, flight peculiarities, and special control instructions);

(9) Restoring a deployed thrust reverser intended for ground operation only to the forward thrust position in fight or continuing fight and landing with the thrust reverser in any position except forward thrust; and

(10) Disconnecting the battery from its charging source, if compliance is shown with §§ 25.1353(c)(6)(ii) or (c)(6)(iii).

(b) Information identifying each operating condition in which the fuel system independence prescribed in § 25.953 is necessary for safety must be furnished, together with instructions for placing the fuel system in a configuration used to show compliance with that section.

(c) The buffet onset envelopes determined under § 25.251 must be furnished. The buffet onset envelopes presented may reflect the center of gravity at which the airplane is normally loaded during cruise if corrections for the effect of different center of gravity locations are furnished.

(d) Information must be furnished which indicates that when the fuel quantity indicator reads ‘‘zero’’ in level flight, any fuel remaining in the fuel tank cannot be used safely in flight.

(e) Information on the total quantity of usable fuel for each fuel tank must be furnished.

(Doc. No. 5066, 29 FR 18291, Dec. 24, 1964, as amended by Amdt. 25-11, 32 FR 6913, May 5, 1967; Amdt. 25-23, 35 FR 5680, Apr. 8, 1970; Amdt. 25-40, 42 FR 15044, Mar. 17, 1977; Amdt. 25-42, 43 FR 2323, Jan 16, 1978; Amdt. 25-46, 43 FR 50598, Oct. 30, 1978)

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 742 of the Civil Air Regulations (CAR) 4b, December 31, 1953. Amendment 25-AD (29 FR 18289, December 24, 1964) added Part 25 [New] to the Federal Aviation Regulations and replaced Part 4b of the Civil Air Regulations. 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. This rule was recodified from CAR 4b.742 without substantive change.

(2) Notice of Proposed Rulemaking 65-43 (31 FR 93, January 5, 1966) proposed to revise this rule to address issues regarding fuel system operating procedures. Amendment 25-11 (32 FR 6913, May 5, 1967) followed Notice 65-32 and adopted the proposal.

(3) Notice of Proposed Rulemaking 68-18 (33 FR 11913, August 22, 1968) proposed revising this rule to establish turbulence criteria for turbine-engine-powered airplanes per modifications in the Airplane Flight Manual, which contains the applicant's recommended information regarding operating procedures in turbulence. Amendment 25-23 (35 FR 5665, April 8, 1970) followed Notice 68-18 and adopted the proposal.

(4) This regulation was further modified by:

- Amendment 25-38 (41 FR 55454, December 20, 1976),
- Amendment 25-40 (42 FR 15034, March 17, 1977),
- Amendment 25-42 (43 FR 2302, January 16, 1978), and
- Amendment 25-46 (43 FR 50578, October 30, 1978).

These Amendments were based on various proposals contained in the following Notices of Proposed Rulemaking:

- Notice 75-10 (40 FR 10802, March 7, 1975)
- Notice 75-19 (40 FR 21866, May 19, 1975),
- Notice 75-25 (40 FR 24664, June 9, 1975),
- Notice 75-23 (40 FR 23048, May 27, 1975);
- Notice 75-26 (40 FR 24802, June 10, 1975); and

- Notice 75-31 (40 FR 29410, July 11, 1975).

[NOTE: The amendments based on Notice 75-10 were deferred from the series of amendments titled "Miscellaneous Amendments" (issued as Amendment 25-38) so that they could be considered in conjunction with the final disposition of certain proposals contained in the later Notices that were subsequently issued. A discussion of the comments received in response to Notice 75-10 are included in the preambles to the later Notices].

Among other things, these Amendments:

- established the requirement that VMCL and VMCL|2, be furnished in the Airplane Flight Manual pursuant to the provisions of § 25.1585(a)(1); and

- established requirements for usable fuel quantity indicators §§ 25.1585(d), and 25.1585(e), as shown in the following excerpt from Amendment 25-46:

> Accordingly, proposed § 23.1585(e) is revised by adding the language "in level flight" so that the section reads in part *". . . when the fuel quantity indicator reads 'zero' in level flight, any fuel remaining in the fuel tank cannot be safely used in flight."*
>
> Similar revisions are made to proposed §§ 25.1585(d), 27.1585(d), and 29.1585(d). Proposed §§ 23.1585(f), 25.1585(e), 27.1585(e), and 29.1585(e) are adopted without substantive change.

d. **Policy/Compliance Methods.** Compliance has been demonstrated through proper design with adherence to FAA guidelines. In addition, these guidelines are reflected in Section 18 of Advisory Circular (AC) 25-8, "Auxiliary Fuel System Installations.". [See Section 25.1581 of this Propulsion Mega AC for the text of Section 18 of AC 25-8; or see Section 25.952 of this Propulsion Mega AC for the complete text of AC 25-8.]

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 65-43 (31 FR 93, January 5, 1966).

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

(5) Notice of Proposed Rulemaking 75-19 (40 FR 21866, May 19, 1975).

(6) Notice of Proposed Rulemaking 75-25 (40 FR 24664, June 9, 1975).

(7) Notice of Proposed Rulemaking 75-23 (40 FR 23048, May 27, 1975).

(8) Notice of Proposed Rulemaking 75-26 (40 FR 24802, June 10, 1975).

(9) Notice of Proposed Rulemaking 75-31 (40 FR 29410, July 11, 1975).

(10) Amendment 25-11 (32 FR 6913, May 5, 1967).

(11) Amendment 25-23, 35 FR 5680, April 8, 1970.

(12) Amendment 25-40, 42 FR 15044, March 17, 1977.

(13) Amendment 25-42, 43 FR 2323, January 16, 1978.

(14) Amendment 25-46, 43 FR 50598, October 30, 1978.

(15) Advisory Circular 25-8, “Auxiliary Fuel System Installations,” May 2, 1986 [Incorporated in total in this Propulsion Mega AC at Section 25.952].