Exemption No. 9906

UNITED STATES OF AMERICA
DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
WASHINGTON, DC 20591

In the matter of the petition of

CESSNA AIRCRAFT COMPANY

for an exemption from § 23.979(b)(2) of Title 14, Code of Federal Regulations

Regulatory Docket No. FAA-2009-0444

GRANT OF EXEMPTION

By letter dated May 01, 2009, Mr. Kim Hackett, Cessna Aircraft Company, One Cessna Boulevard, P.O. Box 7704, Wichita, Kansas 67277-7704 petitioned for an exemption from § 23.979(b)(2) of Title 14 of the Code of Federal Regulations (CFR) to permit type certification of the Cessna model 525C airplanes without a warning system indicating a failure of the pressure refueling automatic shutoff system as specified in the rule. The proposed exemption would permit relief from the requirement to provide indication at each fueling station of failure of the shutoff means to stop the fuel flow at the maximum quantity approved for that tank for the model 525C airplanes. The current design of the refueling panel of the model 525C airplanes provides a pre-check feature, but there is no dedicated failure indication when fuel quantity increases beyond the tank's maximum. The proposed exemption, if granted, would permit type certification approval of the model 525C airplanes with this non-compliant type design for a limited time.

The petitioner requires relief from the following regulation:

Section 23.979(b)(2), in pertinent part, requires a warning system indicating a failure of the pressure refueling automatic shutoff system.

The petitioner supports its request with the following information:

General

Cessna Aircraft Company requests an exemption from the requirements of 14 CFR 23.979(b)(2) for the model 525C on the grounds that the model 525C single point refuel/defuel system as designed offers a higher safety level of protection from potential ignition sources and it is therefore in the public interest to grant this petition. Requiring redesign of the fueling station to add an electrical indication of a failure of the shutoff means to stop the fuel flow at the maximum quantity approved for each tank would result in a reduction in safety due to increased potential ignition sources, which is contrary to the public interest, and would not provide compensating safety benefits.

Background:

Cessna Aircraft Company has designed and certified multiple 14 CFR part 25 aircraft models and their derivatives with single point pressure refuel/defuel systems. It is the intent of Cessna to apply this proven design history and field experience to the certification of a single point refuel/defuel system for the model 525C, which is a 14 CFR part 23 Commuter Category aircraft. To this end, components and system architecture have been selected that are identical to those employed in previous Cessna single point refuel/defuel systems which have established compliance with § 25.979. The certification basis for the model 525C includes proposed special condition Docket No. CE294, Notice No. 23-09-01-SC, which applies the requirement from § 25.979(e), thereby rendering the single point refuel/defuel requirements for the model 525C virtually identical to those of § 25.979, with only minor verbage differences. For reference, § 23.979 and § 25.979 are included below:

14 CFR 23.979 Pressure fueling systems.

For pressure fueling systems, the following apply:

(a) Each pressure fueling system fuel manifold connection must have means to prevent the escape of hazardous quantities of fuel from the system if the fuel entry valve fails.

(b) An automatic shutoff means must be provided to prevent the quantity of fuel in each tank from exceeding the maximum quantity approved for that tank. This means must—

(1) Allow checking for proper shutoff operation before each fueling of the tank; and

(2) For commuter category airplanes, indicate at each fueling station, a failure of the shutoff means to stop the fuel flow at the maximum quantity approved for that tank.

(c) A means must be provided to prevent damage to the fuel system in the event of failure of the automatic shutoff means prescribed in paragraph (b) of this section.

(d) All parts of the fuel system up to the tank which are subjected to fueling pressures must have a proof pressure of 1.33 times, and an ultimate pressure of at least 2.0 times, the surge pressure likely to occur during fueling.

[Amdt. 23–14, 38 FR 31823, Nov. 19, 1973, as amended by Amdt. 23–51, 61 FR 5137, Feb. 9, 1996]

14 CFR 25.979 Pressure fueling system.

For pressure fueling systems, the following apply:

(a) Each pressure fueling system fuel manifold connection must have means to prevent the escape of hazardous quantities of fuel from the system if the fuel entry valve fails.

(b) An automatic shutoff means must be provided to prevent the quantity of fuel in each tank from exceeding the maximum quantity approved for that tank. This means must—

(1) Allow checking for proper shutoff operation before each fueling of the tank; and

(2) Provide indication at each fueling station of failure of the shutoff means to stop the fuel flow at the maximum quantity approved for that tank.

(c) A means must be provided to prevent damage to the fuel system in the event of failure of the automatic shutoff means prescribed in paragraph (b) of this section.

(d) The airplane pressure fueling system (not including fuel tanks and fuel tank vents) must withstand an ultimate load that is 2.0 times the load arising from the maximum pressures, including surge, that is likely to occur during fueling. The maximum surge pressure must be established with any combination of tank valves being either intentionally or inadvertently closed.

(e) The airplane defueling system (not including fuel tanks and fuel tank vents) must withstand an ultimate load that is 2.0 times the load arising from the maximum permissible defueling pressure (positive or negative) at the airplane fueling connection.

[Amdt. 25–11, 32 FR 6913, May 5, 1967, as amended by Amdt. 25–38, 41 FR 55467, Dec. 20, 1976; Amdt. 25–72, 55 FR 29785, July 20, 1990]

Model 525C Hydromechanical Single Point Refueling (SPR) System Component History:

A complete model 525C fuel system schematic is shown in Figure 3. All of the operational components of the model 525C single point refuel/defuel system are identical to those used on existing Cessna aircraft with certified pressure refueling systems. A summary of component utilization on other Cessna models is found in Table 1.

SPR System Components	Utilization on Cessna Models					
	M560	**M560XL**	**M650**	**M750**	**M680**	**M525C**
9914168-2 Single Point Refueling Housing/Adapter	**X**	**X**	**X**		**X**	**X**
9914107-3 Refuel Shutoff Valve	**X**		**X**	**X**	**X**	**X**
9914107-1 High Level Pilot Valve (HLPV)	**X**	**X**	**X**	**X**	**X**	**X**
61084-2 Defuel Valve	**X**		**X**	**X**	**X**	**X**
9036-351-2 Precheck Valve	**X**	**X**			**X**	**X**

Table 1: SPR Component Utilization on Cessna Aircraft

All of the operational components and the system architecture of the model 525C single point refuel/defuel system are identical to those of the Cessna model 680 and the Cessna model 560. The hydromechanical automatic shutoff system operation is also identical, and has been found to comply with 14 CFR 25.979(b)(2) in both cases. For reference, the model 680 statement of compliance in Cessna Report PP-680-016 Rev. A, which was submitted as FAA approved via 8110-3 on May 10, 2004, and received FAA concurrence on May 25, 2004, reads as follows:

> *Failure of the precheck system to stop refuel flow is the primary indication that the automatic shutoff system has failed. In the event that the precheck test is not conducted after an automatic shutoff failure, then fluid will discharge through the relief valve port and the vent scoop of the affected tank. This is a secondary indication to the operator that the SPR system failed to shutoff at the maximum approved quantity for the affected tank, thereby, establishing compliance with 14 CFR/JAR 25.979(b)(2).*

Model 525C Hydromechanical SPR System Operation:

The model 525C single point refuel/defuel system is designed to provide a simple, safe, and effective means of pressure refueling and defueling the aircraft. A primary feature of this system is the ability to perform refuel and defuel operations without entering the cabin or powering on any aircraft systems, which provides a significant safety benefit in eliminating potential ignition sources while fueling.

Another benefit to the simple hydromechanical configuration of the system is the proven reliability of the components and the limited number of failure modes. Single point refueling is accomplished by connecting the refuel equipment to the refuel/defuel adapter and applying positive pressure. Single point defueling is

accomplished by connecting defuel equipment to the refuel/defuel adapter, opening the respective precheck lever for the tank to be defueled, and applying negative pressure.

The model 525C single point refueling system incorporates an automatic HLPV. Iron bird testing on a production representative fuel system test article will show that at both minimum and maximum refuel nozzle pressures, the HLPV will shut off the refuel flow at tank quantities lower than the maximum approved fuel quantity.

The HLPV is installed in the outboard wing. A cross section of the HLPV is shown in Figure 1.

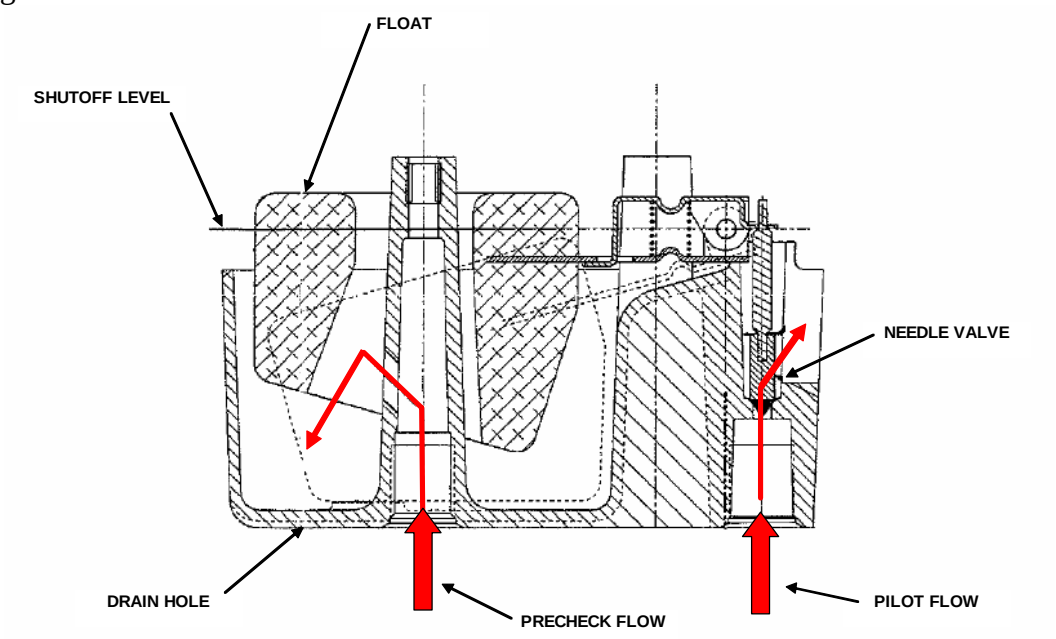

Figure 1: High Level Pilot Valve X-Section

As the airplane is fueled, fuel is allowed to enter the bowl of the HLPV through the drain hole in the bottom of the HLPV and over the top edge, causing the float in the HLPV to rise with fuel level. Refueling is accomplished through the refuel valve. Pressurized flow is applied at the SPR adapter. The pressure is great enough to overcome the spring force of the refuel valve, causing the refuel valve to open, allowing refuel flow. Refueling is only possible if the pilot port on the refuel valve is open. The pilot flow is the only relief in the refuel valve that allows the valve to open. Because of this, during the refuel process, pilot flow is continuously flowing to the HLPV from the refuel valve. A cross section of the refuel valve is shown in Figure 2.

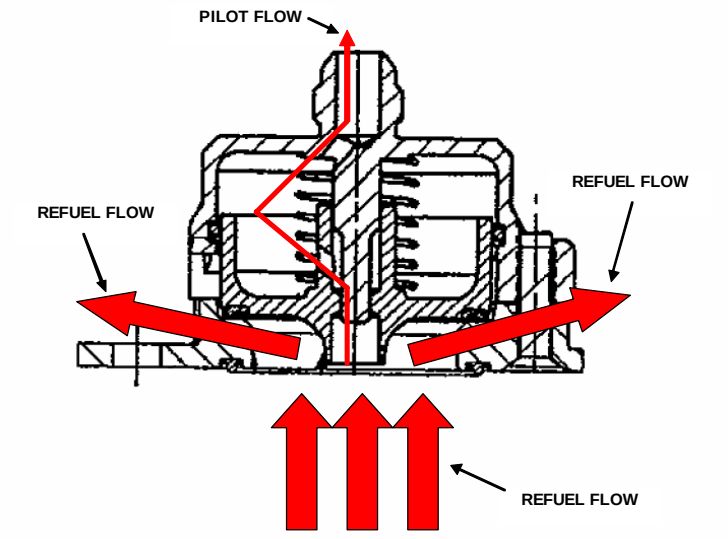

Figure 2: Refuel Valve X-Section

When the fuel level in the wing reaches the shutoff level of the HLPV, the needle valve closes, shutting off the pilot flow, closing the refuel valve, and thus shutting off refuel flow. The shutoff level of the HLPV is determined by analysis, and verified by test. Past SPR design experience indicates that some refuel overshoot occurs after the HLPV has reached the shutoff level. This overshoot is accounted for in the HLPV placement. The shutoff level of the HLPV is placed sufficiently below the maximum fuel quantity approved for the wing to account for the worst case overshoot due to varying refuel pressures.

The model 525C single point refueling system incorporates a precheck system to test the functionality of the automatic shutoff means of the HLPV. As shown in Figure 1, a precheck port is included in the HLPV. At the refueling station, next to the refuel adapter, a separate valve is incorporated for left-hand (LH) and right-hand (RH) precheck function. The precheck system tests the automatic shutoff means of the HLPV. Plumbing from the precheck valve is routed to the precheck port on the HLPV. Precheck plumbing is sized to allow sufficient flow to fill the bowl in the HLPV, and keep it full, to simulate a full wing tank. When the precheck valve is opened, a portion of the refuel flow is sent down the precheck plumbing to the HLPV. This flow fills the bowl in the HLPV, raising the HLPV float, closing the needle valve and subsequently closing the refuel valve. As long as the precheck valve is open and refuel pressure is applied, the HLPV bowl will remain full, and the refuel valve will be closed. The shutoff means of the HLPV tested using the precheck system are exactly the same shutoff means as when the fuel level in the wing reaches full during refueling.

Iron bird testing on a production representative fuel system test article will show that at both minimum and maximum refuel nozzle pressures, the precheck system functions properly to test the automatic shutoff means of the HLPV, and will safely and positively indicate, at the refuel station, a failure of the HLPV, prior to fueling.

Per placarded refueling procedures, prior to refueling both precheck levers (LH and RH) are opened, and the automatic shutoff means of each HLPV are verified. If a successful precheck is NOT completed within 30 seconds, single point refueling is not permitted. The precheck test verifies the shutoff means of the HLPV before refueling begins. It takes approximately 7 minutes to refuel the wing with the SPR system. If a failure occurs after the precheck test, the positive/negative relief valve (installed to comply with the requirements of 14 CFR 23.979(c)) would give a secondary indication of a failure of the HLPV shutoff means and protect the wing from structural damage.

The model 525C single point refueling system incorporates a positive/negative relief valve. This valve will vent the wing under excess positive or negative pressure. Iron bird testing on a production representative fuel system test article will show that, at the maximum refuel nozzle pressures, the positive/negative relief valve will actuate to prevent internal wing pressures in excess of the structural limitations of the wing, even if refueling is continued after the tank overfills.

Model 525C Refueling Automatic Shutoff Failure Modes

Due to the hydromechanical nature of the model 525C refueling system, the failure modes which would result in a failure of the automatic shutoff means during refueling are limited to:

- Failure of the high level pilot float in the down position
- Refuel valve failure in the open position
- Pilot line leak

All of these failures are detectable via operation of the precheck system, which is mandated by placarded operational procedures prior to every refueling event. Fleet service history on these components demonstrates that the Mean Time Between Failure (MTBF) for the HLPV is 147,748 hours, and the MTBF for the refuel shutoff valve is 133,869 hours. These conservative values encompass all failures, including those which would not result in overfilling the wing during refueling. Accounting for potential pilot line leaks, summing these probabilities results in an overall failure probability of the automatic shutoff means that is well within the improbable range. Considering the precheck requirement, the maximum time exposure for failure of the automatic shutoff system is approximately seven minutes when filling from empty to

full, which further reduces the probability of exceeding the maximum quantity approved for that tank.

A failure of the automatic shutoff means will result in rapid application of pressure to the wing tank, which both the vent system and the pressure relief valve are designed to accommodate. However, this will result in rapid fuel discharge overboard during a failure scenario. Indication that the wing is overfull does not prevent discharge of fuel during a refuel automatic shutoff failure. Therefore an electrical indication of exceeding the maximum allowed quantity in the wing does not increase the level of safety but rather adds potential ignition sources to the failure condition.

Petitioner's Public Interest Statement

Cessna Aircraft Company states that granting this exemption would be in the public interest for the following reasons:

1. The current hydromechanical nature of the model 525C SPR system allows refueling and defueling without the use of any aircraft or external power sources, eliminating potential ignition sources. This results in significantly lower hazards overall.

2. Requiring the addition of an electrical indication of a failure of the shutoff means to stop the fuel flow at the maximum quantity approved for each tank would result in an increase in potential ignition sources during refueling, increasing the hazard to crew and passengers, which is counter to the public interest.

3. An indication of an exceedance of the maximum approved quantity during refueling operations would be followed rapidly by a discharge of fuel from the wing pressure relief valve and/or vent scoop, which does not provide a significant safety increase beyond the existing reliable, field proven system. This also results in additional potential ignition sources due to aircraft power always being on during refueling in the event of an automatic shutoff failure.

4. The probability of a failure of the automatic refueling shutoff provisions in the model 525C aircraft has been demonstrated to be well into the improbable range based on established service history of identical components on other Cessna aircraft with identical SPR system architectures previously certified to § 25.979(b)(2). In addition, the automatic shutoff system operation is verified prior to every refueling event, and the maximum exposure to failure (immediately after successful precheck shutoff operation) is no more than seven minutes.

5. The denial of this petition for exemption would result in the delay of certification and delivery of a significant number of model 525C airplanes. This would result in the loss of revenue for partners and suppliers, and the potential need for workforce reductions, all of which would be counter to the public interest.

6. Cessna's customers have made utilization plans based on the agreed upon delivery schedule of these airplanes. Delay in the delivery date due to redesign or retrofit would impose significant financial penalties upon our customers and their businesses without commensurate safety benefits, which would also be counter to the public interest.

Notice and Public Procedure Provided

A summary of the petition was published in the FEDERAL REGISTER on June 17, 2009 (74 FR 28772). No comments were received.

The FAA's analysis is as follows:

To obtain this exemption, the petitioner must show, as required by 14 CFR part 11, §§ 11.81(d) and 11.81(e): (1) the reasons why granting your request would be in the public interest; that is, how it would benefit the public as a whole, and (2) the reasons why granting the exemption would not adversely affect safety, or how the exemption would provide a level of safety at least equal to that provided by the rule from which you seek the exemption.

A similar petition for exemption to 14 CFR, part 25, § 25.979(b)(2) for the Embraer Empresa Brasileira de Aeronáutica S.A. (Embraer) model EMB-135BJ and EMB-145XR series airplanes was granted on October 18, 2002. The exemption was issued with the following conditions:

- The exemption was granted for a limited time, October 18, 2002, through June 30, 2003, and was later extended to September 30, 2003.

- The exemption required:

  1. Embraer to certify and incorporate into the production line requirements a pressure refueling panel, fully compliant with the requirements of § 25.979(b)(2), into the model EMB-135BJ and EMB-145XR series airplanes no later than June 30, 2003.

  2. Embraer to retrofit the model EMB-135BJ and EMB-145XR series airplanes delivered under the terms of the exemption with the new pressure refueling panel described in Condition 1 above no later than June 30, 2004.

3. Until the incorporation of the changes required in the above Conditions 1 and 2 of this exemption have been completed, Embraer must display a placard at each of the refueling stations and add to the airplane flight manual (AFM) "Limitations" section for the model EMB-135BJ and EMB-145XR series airplanes the limitation prohibiting any kind of vehicle or equipment inside defined areas of fuel vent discharge during airplane refueling operations.

4. For airplanes subject to Condition 2 of this exemption, the operating limitations section of the AFM must include the following statement:

   "No person may operate this airplane after June 30, 2004, unless the pressure refueling panel has been modified in accordance with the terms of Exemption No. 7909."

The FAA has carefully reviewed the information contained in the petitioner's request for exemption.

The FAA disagrees with the petitioner's argument.

- The compliance with the rule is not counter to the public interest. The purpose of § 23.979(b)(2) is to require a means to alert personnel when the maximum fuel quantity is exceeded so that corrective action may be taken before a hazardous situation develops. The primary hazard is discharge of the fuel in the event of a failure of the automatic shutoff system, which creates a fire hazard. The FAA is cognizant that the discharge of fuel from the aircraft's fuel tank can create a hazard, and as such, there are regulatory requirements to limit this discharge.
- Compliance with the rule does not require an electrically powered warning system; however, there are other electrically powered systems within the fuel tank (fuel pumps, fuel temperature probes, fuel quantity probes), and the certification rules provide adequate mitigation from fuel tank ignition with these systems. The addition of a warning system does not increase the probability of fuel tank ignition, but rather mitigates the chance of an external aircraft fire in the event of a failure of the automatic shutoff system.
- Citing the design as identical to aircraft certificated in accordance with 14 CFR part 25 illustrates that the design is also non-compliant to the requirements of § 25.979(b)(2).
- The FAA recognizes the economic impact that the denial of the exemption will have on the Cessna Aircraft Company. It is not in the public interest to grant a permanent exemption; however, the FAA has previously granted a time limited exemption for non-compliance to the same rule contained in 14 CFR part 25 and we have determined that this design will not adversely affect safety for the limited time of exposure ending August 1, 2011.

The FAA's Decision

In consideration of the foregoing, I find that a grant of exemption is in the public interest. Therefore, pursuant to the authority contained in 49 U.S.C. §§ 40113 and 44701, delegated to me by the Administrator, Cessna Aircraft Company is granted an exemption with time-limited conditions from 14 CFR § 23.979(b)(2) to the extent necessary to allow type certification of the Cessna model 525C airplanes with a pressure refueling system not in compliance with the requirements of § 23.979(b)(2) as they relate to the indication of failure of the shutoff means. For the model 525C airplanes, this exemption is subject to the following conditions and limitations:

Conditions and Limitations

1. Cessna Aircraft Company must certify and incorporate into the production line requirements a pressure refueling panel, fully compliant with the requirements of § 23.979(b)(2), into the model 525C airplanes no later than August 1, 2010.

2. Cessna Aircraft Company must retrofit the model 525C airplanes delivered under the terms of the exemption with the new pressure refueling panel described in Condition 1 above no later than August 1, 2011.

3. Until the incorporation of the changes required in the above Conditions 1 and 2 of this exemption have been completed, Cessna Aircraft Company must display a placard at each of the refueling stations and add to the AFM "Limitations" section for the model 525C airplanes the limitation prohibiting any kind of vehicle or equipment inside defined areas of fuel vent discharge during airplane refueling operations.

4. For airplanes subject to Condition 2 of this exemption, the operating limitations section of the AFM must include the following statement:

   > "No person may operate this airplane after August 1, 2011, unless the pressure refueling panel has been modified in accordance with the terms of Exemption No. 9906."

   This statement may be removed from the AFM after the required modification has been made.

This exemption terminates on August 1, 2010, unless sooner superseded or rescinded.

Issued in Kansas City, Missouri on July 30, 2009.

s/

James E. Jackson
Acting Manager, Small Airplane Directorate
Aircraft Certification Service