airframe can withstand the shaking or vibratory forces imposed by the engine if a cylinder becomes inoperative. Diesel engines of conventional design typically have extremely high levels of vibration when a cylinder becomes inoperative. Data must be provided to the airframe installer/modifier so either appropriate design considerations or operating procedures, or both, can be developed to prevent airframe and propeller damage.

14. Powerplant Installation—High Energy Engine Fragments:

It may be possible for diesel engine cylinders (or portions thereof) to fail and physically separate from the engine at high velocity (due to the high internal pressures). This failure mode will be considered possible in engine designs with removable cylinders or other non-integral block designs. The following is required:

(1) It must be shown that the engine construction type (massive or integral block with non-removable cylinders) is inherently resistant to liberating high energy fragments in the event of a catastrophic engine failure; or,

(2) It must be shown by the design of the engine, that engine cylinders, other engine components or portions thereof (fragments) cannot be shed or blown off of the engine in the event of a catastrophic engine failure; or

(3) It must be shown that all possible liberated engine parts or components do not have adequate energy to penetrate engine cowlings; or

(4) Assuming infinite fragment energy, and analyzing the trajectory of the probable fragments and components, any hazard due to liberated engine parts or components will be minimized and the possibility of crew injury is eliminated. Minimization must be considered during initial design and not presented as an analysis after design completion.

Issued in Kansas City, Missouri on June 7, 2006.

**David R. Showers,**

*Acting Manager, Small Airplane Directorate, Aircraft Certification Service.*

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**BILLING CODE 4910–13–P**

## DEPARTMENT OF TRANSPORTATION

## Federal Aviation Administration

## 14 CFR Part 23

**[Docket No. CE245; Notice No. 23–06–03–SC]**

## Special Conditions: Aero Propulsion, Inc., Piper Model PA28–236; Diesel Cycle Engine Using Turbine (Jet) Fuel

**AGENCY:** Federal Aviation Administration (FAA), DOT.

**ACTION:** Notice of proposed special conditions.

**SUMMARY:** This notice proposes special conditions for the Piper Model PA28–236 airplanes with a Societe de Motorisation Aeronautiques (SMA) Model SR305–230 Aircraft Diesel Engine (ADE). This airplane will have a novel or unusual design feature(s) associated with the installation of a diesel cycle engine utilizing turbine (jet) fuel. The applicable airworthiness regulations do not contain adequate or appropriate safety standards for installation of this new technology engine. These proposed special conditions contain the additional safety standards that the Administrator considers necessary to establish a level of safety equivalent to that established by the existing airworthiness standards.

**DATES:** Comments must be received on or before July 14, 2006.

**ADDRESSES:** Comments on this proposal may be mailed in duplicate to: Federal Aviation Administration, Regional Counsel, ACE–7, Attention: Rules Docket, Docket No. CE245, 901 Locust, Room 506, Kansas City, Missouri 64106, or delivered in duplicate to the Regional Counsel at the above address. Comments must be marked: CE245. Comments may be inspected in the Rules Docket weekdays, except Federal holidays, between 7:30 a.m. and 4 p.m.

**FOR FURTHER INFORMATION CONTACT:** Peter L. Rouse, Federal Aviation Administration, Aircraft Certification Service, Small Airplane Directorate, ACE–111, 901 Locust, Kansas City, Missouri, 816–329–4135, fax 816–329–4090.

**SUPPLEMENTARY INFORMATION:**

### Comments Invited

Interested persons are invited to participate in the making of these proposed special conditions by submitting such written data, views, or arguments, as they may desire. Communications should identify the regulatory docket or notice number and be submitted in duplicate to the address specified above. All communications received on or before the closing date for comments will be considered by the Administrator. The proposals described in this notice may be changed in light of the comments received. All comments received will be available in the Rules Docket for examination by interested persons, both before and after the closing date for comments. A report summarizing each substantive public contact with FAA personnel concerning this rulemaking will be filed in the docket. Persons wishing the FAA to acknowledge receipt of their comments submitted in response to this notice must include with those comments a self-addressed, stamped postcard on which the following statement is made: ''Comments to CE245.'' The postcard will be date stamped and returned to the commenter.

### Background

On August 20, 2003, Aero Propulsion, Inc., applied for a supplemental type certificate for Piper Model PA28–236 airplanes with the installation of an SMA Model SR305–230. The airplane is powered by a SMA Model SR305–230 ADE, type certificated in the United States, type certificate number E00067EN.

Before the reintroduction of diesel engine technology into the small airplane fleet, the FAA issued Policy Statement PS–ACE100–2002–004 on May 15, 2004, which identified areas of technological concern involving introduction of new technology diesel engines into small airplanes. For a more detailed summary of the FAA's development of diesel engine requirements, refer to this policy.

The general areas of concern involved the power characteristics of the diesel engines, the use of turbine fuel in an airplane class that has typically been powered by gasoline fueled engines, the vibration characteristics and failure modes of diesel engines. These concerns were identified after review of the historical record of diesel engine use in aircraft and a review of the 14 CFR part 23 regulations, which identified specific regulatory areas that needed to be evaluated for applicability to diesel engine installations. These concerns are not considered universally applicable to all types of possible diesel engines and diesel engine installations. However, after review of the SMA installation, and applying the provisions of the diesel policy, the FAA proposes these fuel system and engine related special conditions. Other special conditions issued in a separate notice include special conditions for HIRF and application of § 23.1309 provisions to

the Full Authority Digital Engine Control (FADEC).

**Type Certification Basis**

Under the provisions of 14 CFR 21.101, Aero Propulsion, Inc., must show that the Piper Model PA28–236 airplanes with the installation of an SMA Model SR305–230 ADE meet the applicable provisions of 14 CFR part 23 and Civil Air Regulations (CAR) 3 thereto. In addition, the certification basis includes special conditions and equivalent levels of safety for the following:

Special Conditions:

- Engine torque (Provisions similar to § 23.361, paragraphs (b)(1) and (c)(3)).
- Flutter (Compliance with § 23.629, paragraphs (e)(1) and (2)).
- Powerplant—Installation (Provisions similar to § 23.901(d)(1) for turbine engines).
- Powerplant—Fuel System—Fuel system with water saturated fuel (Compliance with § 23.951 requirements).
- Powerplant—Fuel System—Fuel system hot weather operation (Compliance with § 23.961 requirements).
- Powerplant—Fuel system—Fuel tank filler connection (Compliance with § 23.973(f) requirements).
- Powerplant—Fuel system—Fuel tank outlet (Compliance with § 23.977 requirements).
- Equipment—General—Powerplant Instruments (Compliance with § 23.1305 requirements).
- Operating Limitations and Information—Powerplant limitations—Fuel grade or designation (Compliance with § 23.1521(d) requirements).
- Markings and Placards—Miscellaneous markings and placards—Fuel, oil, and coolant filler openings (Compliance with § 23.1557(c)(1) requirements).
- Powerplant—Fuel system—Fuel-Freezing.
- Powerplant Installation—Vibration levels.
- Powerplant Installation—One cylinder inoperative.
- Powerplant Installation—High Energy Engine Fragments.

*Equivalent levels of safety for:*

- Cockpit controls—23.777(d).
- Motion and effect of cockpit controls—23.779(b).
- Ignition switches—23.1145.

The type certification basis includes exemptions, if any; equivalent level of safety findings, if any; and the special conditions adopted by this rulemaking action.

In addition, if the regulations incorporated by reference do not provide adequate standards with respect to the change, the applicant must comply with certain regulations in effect on the date of application for the change. The type certification basis for the modified airplanes is as stated previously with the following modifications:

If the Administrator finds that the applicable airworthiness regulations (i.e., part 23) do not contain adequate or appropriate safety standards for the Piper Model PA28–236 airplanes with the installation of an SMA Model SR305–230 because of a novel or unusual design feature, special conditions are prescribed under the provisions of § 21.16.

In addition to the applicable airworthiness regulations and special conditions, the Piper Model PA28–236 airplanes with the installation of an SMA Model SR305–230 ADE must comply with 14 CFR 21.115 noise certification requirements of 14 CFR part 36.

Special conditions, as appropriate, as defined in § 11.19, are issued in accordance with § 11.38, and become part of the type certification basis in accordance with § 21.101.

Special conditions are initially applicable to the model for which they are issued. Should the applicant apply for a supplemental type certificate to modify any other model included on the same type certificate to incorporate the same novel or unusual design feature, the special conditions would also apply to the other model under the provisions of § 21.101.

**Novel or Unusual Design Features**

The Piper Model PA28–236 airplanes with the installation of an SMA Model SR305–230 ADE will incorporate the following novel or unusual design features:

The Piper Model PA28–236 airplanes with the installation of an SMA Model SR305–230 ADE will require the use of turbine (jet) fuel.

**Applicability**

As discussed above, these special conditions are applicable to the Piper Model PA28–236 airplanes with the installation of an SMA Model SR305–230 ADE.

**Conclusion**

This action affects only certain novel or unusual design features on one model series of airplane. It is not a rule of general applicability, and it affects only the applicant who applied to the FAA for approval of these features on the airplane.

**List of Subjects in 14 CFR Part 23**

Aircraft, Aviation safety, Signs and symbols.

**Citation**

The authority citation for these special conditions is as follows:

**Authority:** 49 U.S.C. 106(g), 40113 and 44701; 14 CFR 21.16 and 21.101; and 14 CFR 11.38 and 11.19.

**Discussion**

The major concerns identified in the development of FAA policy deal with several things. These include the installation of the diesel engine and its vibration levels under normal operating conditions and with one cylinder inoperative, the accommodation of turbine fuels in airplane systems that have generally evolved based on gasoline requirements, the anticipated use of a FADEC to control the engine, and the appropriate limitations and indications for a diesel engine powered airplane. The general concerns associated with the aircraft diesel engine installation are as follows:

Installation and Vibration Requirements.

Fuel and Fuel System Related Requirements.

FADEC and Electrical System Requirements.

Limitations and Indications.

*Installation and Vibration Requirements:* These special conditions include requirements similar to the requirements of § 23.901(d)(1) for turbine engines. In addition to the requirements of § 23.901 applied to reciprocating engines, the applicant will be required to construct and arrange each diesel engine installation according to certain restrictions. These include arranging the installation so vibration characteristics do not exceed those established during the type certification of the engine. The engine installation will also be required to not exceed vibration characteristics that a previously certificated airframe structure has been approved for, unless such vibration characteristics are shown to have no effect on safety or continued airworthiness. The engine limit torque design requirements as specified in § 23.361 are also modified.

An additional requirement to consider vibration levels and/or effects of an inoperative cylinder was imposed. Also, a requirement was added to evaluate the engine design for the possibility of, or effect of, liberating high-energy engine fragments, in the event of a catastrophic engine failure.

*Fuel and Fuel System Related Requirements:* Due to the use of turbine

fuel, this airplane must comply with the requirements in § 23.951(c).

Section 23.961 will be complied with using the turbine fuel requirements. These requirements will be substantiated by flight-tests as described in Advisory Circular AC 23–8B, Flight Test Guide for Certification of Part 23 Airplanes.

This special condition specifically requires testing to show compliance to § 23.961 and adds the possibility of testing non-aviation diesel fuels.

To ensure fuel system compatibility and reduce the possibility of misfueling, and discounting the first clause of § 23.973(f) referring to turbine engines, the applicant will comply with § 23.973(f).

Due to the use of turbine fuel, the applicant will comply with § 23.977(a)(2), and § 23.977(a)(1) will not apply. ''Turbine engines'' will be interpreted to mean ''aircraft diesel engine'' for this requirement. An additional requirement of the possibility of fuel freezing was imposed.

Due to the use of turbine fuel, the applicant will comply with § 23.1305(c)(8).

Due to the use of turbine fuel, the applicant must comply with § 23.1557(c)(1)(ii). Section 23.1557(c)(1)(i) will not apply. ''Turbine engine'' is interpreted to mean ''aircraft diesel engine'' for this requirement.

*Limitations and Indications:* Critical engine parameters for this installation that will be displayed include the following:

(1) Fuel temperature.

Due to the use of turbine fuel, the requirements for § 23.1521(d), as applicable to fuel designation for turbine engines, will apply.

**The Proposed Special Conditions**

Accordingly, the Federal Aviation Administration (FAA) proposes the following special conditions as part of the type certification basis for Piper Model PA28–236 airplanes with an SMA SR305–230 ADE installed.

1. Engine torque (Provisions similar to § 23.361, paragraphs (b)(1) and (c)(3)):

(a) For diesel engine installations, the engine mounts and supporting structure must be designed to withstand the following:

(1) A limit engine torque load imposed by sudden engine stoppage due to malfunction or structural failure.

The effects of sudden engine stoppage may alternately be mitigated to an acceptable level by utilization of isolators, dampers clutches and similar provisions, so that unacceptable load levels are not imposed on the previously certificated structure.

(b) The limit engine torque obtained in CAR 3.195(a)(1) and (a)(2) or 14 CFR 23.361(a)(1) and (a)(2) must be obtained by multiplying the mean torque by a factor of four in lieu of the factor of two required by CAR 3.195(b) and 14 CFR 23.361(c)(3).

2. Flutter—(Compliance with the requirements of § 23.629 (e)(1) and (e)(2) requirements):

The flutter evaluation of the airplane done in accordance with 14 CFR 23.629 must include—

(a) Whirl mode degree of freedom which takes into account the stability of the plane of rotation of the propeller and significant elastic, inertial, and aerodynamic forces, and

(b) Propeller, engine, engine mount and airplane structure stiffness and damping variations appropriate to the particular configuration, and

(c) The flutter investigation will include showing the airplane is free from flutter with one cylinder inoperative.

3. Powerplant—Installation (Provisions similar to § 23.901(d)(1) for turbine engines):

Considering the vibration characteristics of diesel engines, the applicant must comply with the following:

(a) Each diesel engine installation must be constructed and arranged to result in vibration characteristics that—

(1) Do not exceed those established during the type certification of the engine; and

(2) Do not exceed vibration characteristics that a previously certificated airframe structure has been approved for —

(i) Unless such vibration characteristics are shown to have no effect on safety or continued airworthiness, or

(ii) Unless mitigated to an acceptable level by utilization of isolators, dampers clutches and similar provisions, so that unacceptable vibration levels are not imposed on the previously certificated structure.

4. Powerplant—Fuel System—Fuel system with water saturated fuel (Compliance with § 23.951 requirements):

Considering the fuel types used by diesel engines, the applicant must comply with the following:

Each fuel system for a diesel engine must be capable of sustained operation throughout its flow and pressure range with fuel initially saturated with water at 80 °F and having 0.75cc of free water per gallon added and cooled to the most critical condition for icing likely to be encountered in operation.

Methods of compliance that are acceptable for turbine engine fuel systems requirements of § 23.951(c) are also considered acceptable for this requirement.

5. Powerplant—Fuel System—Fuel flow (Compliance with § 23.955(c) requirements):

In lieu of 14 CFR 23.955(c), engine fuel system must provide at least 100 percent of the fuel flow required by the engine, or the fuel flow required to prevent engine damage, if that flow is greater than 100 percent. The fuel flow rate must be available to the engine under each intended operating condition and maneuver. The conditions may be simulated in a suitable mockup. This flow must be shown in the most adverse fuel feed condition with respect to altitudes, attitudes, and any other condition that is expected in operation.

6. Powerplant—Fuel System—Fuel system hot weather operation (Compliance with § 23.961 requirements):

In place of compliance with § 23.961, the applicant must comply with the following:

Each fuel system must be free from vapor lock when using fuel at its critical temperature, with respect to vapor formation, when operating the airplane in all critical operating and environmental conditions for which approval is requested. For turbine fuel, or for aircraft equipped with diesel cycle engines that use turbine or diesel type fuels, the initial temperature must be 110 °F, −0°, +5° or the maximum outside air temperature for which approval is requested, whichever is more critical.

The fuel system must be in an operational configuration that will yield the most adverse, that is, conservative results.

To comply with this requirement, the applicant must use the turbine fuel requirements and must substantiate these by flight-testing, as described in Advisory Circular AC 23–8B, Flight Test Guide for Certification of Part 23 Airplanes.

7. Powerplant—Fuel system—Fuel tank filler connection (Compliance with § 23.973(f) requirements):

In place of compliance with § 23.973(e) and (f), the applicant must comply with the following:

For airplanes that operate on turbine or diesel type fuels, the inside diameter of the fuel filler opening must be no smaller than 2.95 inches.

8. Powerplant—Fuel system—Fuel tank outlet (Compliance with § 23.977 requirements):

In place of compliance with § 23.977(a)(1) and (a)(2), the applicant will comply with the following:

There must be a fuel strainer for the fuel tank outlet or for the booster pump. This strainer must, for diesel engine powered airplanes, prevent the passage of any object that could restrict fuel flow or damage any fuel system component.

9. Equipment—General—Powerplant Instruments (Compliance with § 23.1305):

In addition to compliance with § 23.1305, the applicant will comply with the following:

The following are required in addition to the powerplant instruments required in § 23.1305:

(a) A fuel temperature indictor.

(b) An outside air temperature (OAT) indicator.

(c) An indicating means for the fuel strainer or filter required by § 23.997 to indicate the occurrence of contamination of the strainer or filter before it reaches the capacity established in accordance with § 23.997(d).

Alternately, no indicator is required if certain requirements are met. First, the engine can operate normally for a specified period with the fuel strainer exposed to the maximum fuel contamination as specified in MIL–5007D. Second, provisions for replacing the fuel filter at this specified period (or a shorter period) are included in the maintenance schedule for the engine installation.

10. Operating Limitations and Information—Powerplant limitations—Fuel grade or designation (Compliance with § 23.1521 requirements):

All engine parameters that have limits specified by the engine manufacturer for takeoff or continuous operation must be investigated to ensure they remain within those limits throughout the expected flight and ground envelopes (*e.g.* maximum and minimum fuel temperatures, ambient temperatures, as applicable, etc.). This is in addition to the existing requirements specified by 14 CFR 23.1521 (b) and (c). If any of those limits can be exceeded, there must be continuous indication to the flight crew of the status of that parameter with appropriate limitation markings.

Instead of compliance with § 23.1521(d), the applicant must comply with the following:

The minimum fuel designation (for diesel engines) must be established so that it is not less than that required for the operation of the engines within the limitations in paragraphs (b) and (c) of § 23.1521.

11. Markings and Placards—Miscellaneous markings and placards—Fuel, oil, and coolant filler openings (Compliance with § 23.1557(c)(1) requirements):

Instead of compliance with § 23.1557(c)(1), the applicant must comply with the following:

Fuel filler openings must be marked at or near the filler cover with-For diesel engine-powered airplanes—

(a) The words ''Jet Fuel''; and

(b) The permissible fuel designations, or references to the Airplane Flight Manual (AFM) for permissible fuel designations.

(c) A warning placard or note that states the following or similar:

''Warning—this airplane equipped with an aircraft diesel engine, service with approved fuels only.''

The colors of this warning placard should be black and white.

12. Powerplant—Fuel system—Fuel-Freezing:

If the fuel in the tanks cannot be shown to flow suitably under all possible temperature conditions, then fuel temperature limitations are required. These will be considered as part of the essential operating parameters for the aircraft and must be limitations.

A minimum takeoff temperature limitation will be determined by testing to establish the minimum cold-soaked temperature at which the airplane can operate. The minimum operating temperature will be determined by testing to establish the minimum operating temperature acceptable after takeoff from the minimum takeoff temperature. If low temperature limits are not established by testing, then a minimum takeoff and operating fuel temperature limit of 5 °F above the gelling temperature of Jet A will be imposed along with a display in the cockpit of the fuel temperature. Fuel temperature sensors will be located in the coldest part of the tank if applicable.

13. Powerplant Installation—Vibration levels:

Vibration levels throughout the engine operating range must be evaluated and:

(1) Vibration levels *imposed on the airframe* must be less than or equivalent to those of the gasoline engine; or

(2) Any vibration level that is higher than that imposed on the airframe by the replaced gasoline engine must be considered in the modification and the effects on the technical areas covered by the following paragraphs must be investigated:

14 CFR part 23, §§ 23.251; 23.613; 23.627; 23.629 (or CAR 3.159, as applicable to various models); 23.572; 23.573; 23.574 and 23.901.

Vibration levels imposed on the airframe can be mitigated to an acceptable level by utilization of isolators, dampers clutches and similar provisions, so that unacceptable vibration levels are not imposed on the previously certificated structure.

14. Powerplant Installation—One cylinder inoperative:

It must be shown by test or analysis, or by a combination of methods, that the airframe can withstand the shaking or vibratory forces imposed by the engine if a cylinder becomes inoperative. Diesel engines of conventional design typically have extremely high levels of vibration when a cylinder becomes inoperative.

No unsafe condition will exist in the case of an inoperative cylinder before the engine can be shut down. The resistance of the airframe structure, propeller, and engine mount to shaking moment and vibration damage must be investigated. It must be shown by test or analysis, or by a combination of methods, that shaking and vibration damage from the engine with an inoperative cylinder will not cause a catastrophic airframe, propeller, or engine mount failure.

15. Powerplant Installation—High Energy Engine Fragments:

It may be possible for diesel engine cylinders (or portions thereof) to fail and physically separate from the engine at high velocity (due to the high internal pressures). This failure mode will be considered possible in engine designs with removable cylinders or other non-integral block designs. The following is required:

(1) It must be shown by the design of the engine, that engine cylinders, other engine components or portions thereof (fragments) cannot be shed or blown off of the engine in the event of a catastrophic engine failure; or

(2) It must be shown that all possible liberated engine parts or components do not have adequate energy to penetrate engine cowlings; or

(3) Assuming infinite fragment energy, and analyzing the trajectory of the probable fragments and components, any hazard due to liberated engine parts or components will be minimized and the possibility of crew injury is eliminated. Minimization must be considered during initial design and not presented as an analysis after design completion.

Issued in Kansas City, Missouri, on June 7, 2006.

**David R. Showers,**

*Acting Manager, Small Airplane Directorate, Aircraft Certification Service.*

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