DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 23

[Docket No. 26344; Notice No. 90-23]

RIN 2120-AD30

Small Airplane Airworthiness Review Program Notice No. 3

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Notice of Proposed Rulemaking (NPRM).

SUMMARY: This notice proposes changes to the powerplant and equipment airworthiness standards for normal, utility, acrobatic and commuter category airplanes that are based on certain proposals and recommendations discussed at the Small Airplane Airworthiness Review Conference held on October 22-26, 1984, in St. Louis, Missouri. These proposals arise from the recognition, by both government and industry, that updated safety standards are needed to maintain an acceptable level of safety in the design requirements for small airplanes that are used in both private and commercial operations. The proposed changes, if adopted, would provide design requirements applicable to advancements in technology being incorporated in current designs and reduce the regulatory burden in showing compliance with some requirements while maintaining an acceptable level of safety.

DATES: Comments must be received on or before April 1, 1991.

ADDRESSES: Comments on this notice may be mailed in triplicate to: Federal Aviation Administration, Office of the Chief Counsel, Attn: Rules Docket (AGC-10), Docket No. 26344, 800 Independence Avenue, SW., Washington, DC 20591, or delivered in triplicate to: Room 915-G, 800 Independence Avenue, SW, Washington, DC 20591. Comments delivered must be marked Docket No. 26344. Comments may be inspected in room 915-G between 8:30 a.m. and 5:00 p.m. on weekdays, except Federal holidays.

In addition, the FAA is maintaining an information docket of comments in the Office of Assistant Chief Counsel, room 1556, ACE-7, Federal Aviation Administration, Central Region, 601 East 12th Street, Kansas City, Missouri 64106. Comments in the information docket may be inspected in the Office of Assistant Chief Counsel weekdays, except Federal holidays, between the hours of 7:30 a.m. and 4 p.m.

FOR FURTHER INFORMATION CONTACT: Ervin E. Dvorak, Standards Office (ACE-110), Small Airplane Directorate, Aircraft Certification Service, Federal Aviation Administration, 601 East 12th Street, Kansas City, Missouri 64106; telephone (816) 426-5688.

SUPPLEMENTARY INFORMATION:

Comments Invited

Interested persons are invited to participate in the making of each proposed rule by submitting such written data, views, or arguments as they may desire. Comments relating to the environmental, energy, or economic impact that might result from adopting the proposals in this notice are invited. Public comments are specifically solicited by this notice on the following subjects:

Proposal 58, Section 23.1143, Engine Controls

Proposal 60, Section 23.1147, Mixture Controls

Athough these two proposals, as evaluated with the data currently available to the FAA, do not show a positive quantitative economic benefit, the FAA has included these proposals in this notice and is soliciting public comments that may provide additional information as to cost and safety benefits that may result from the adoption of these proposals.

Communications should identify the regulatory docket or notice number and be submitted in triplicate to the address specified above. All communications received on or before the closing date for comments specified above will be considered by the Administrator before taking further rulemaking action. Commenters wishing the FAA to acknowledge receipt of comments submitted in response to this notice must include a self-addressed, stamped postcard on which the following statement is made: "Comments to Docket No. 26344." The postard will be date stamped and returned to the commenter. All comments received will be available, both before and after the closing date for comments, in the Rules Docket for examination by interested persons. A report summarizing each substantive public contact with FAA personnel concerned with this rulemaking will be filed in the docket.

Availability of NPRM

Any person may obtain a copy of this NPRM by submitting a request to the Federal Aviation Administration, Office of Public Affairs, Attn: Public Inquiry Center, (APA-200), 800 Independence Avenue, SW., Washington, DC 20591, or by calling (202) 267-3484. Communications must identify the notice number of this NPRM. Persons interested in being placed on the mailing list for future NPRMs should also request a copy of Advisory Circular No. 11-2A, Notice of Proposed Rulemaking Distribution System, which describes the application procedure.

Background

The FAA announced the Small Airplane Airworthiness Review Program and invited all interested persons to submit proposals for changes to part 23 of the FAR (48 FR 4290, January 31, 1983; Notice No. CE-83-1). The Review Program objective was to encourage public participation in improving and updating the airworthiness standards applicable to small airplanes.

In response to requests from interested persons, the FAA issued Notice No. CE-83-1A, which reopened the period for submission of proposals. This action (48 FR 26623, June 9, 1983) was based upon an FAA determination that it would be in the public interest to allow more time for the public and the aviation industry to submit their proposals.

By the close of the reopened proposal period on May 3, 1984, the FAA had received approximately 560 proposals in response to Notice Nos. CE-83-1 and CE-83-1A. On July 25, 1984, the FAA issued Notice No. CE-84-1 (49 FR 30053), Availability of Agenda, Compilation of Proposals, and Announcement of the Small Airplane Airworthiness Review Program Conference. The conference to discuss these proposals was held October 22-26, 1984, in St. Louis, Missouri. A copy of the transcript of all discussions held during the conference is filed in the docket, Docket No. 23494.

Notice No. 1 of the Small Airplane Airworthiness Review Program was directed toward improvement of crashworthiness and the final rule was published, as amendment 23-36 (53 FR 30802, August 15, 1988). Notices numbered 2 and 5 address issues of specific concern in past and current certification programs and they were published in the **Federal Register** (54 FR 9276 and 54 FR 9338, March 6, 1989). Notice No. 4 addresses flight and structures issues not addressed in previous notices. This notice addresses systems and powerplant issues.

A number of proposals were submitted to the conference that did not result in proposed changes to part 23. The FAA's decision to take no further regulatory action on those proposals is based on information gained at the conference or during post-conference review. The regulatory sections are included below along with the explanation of why no action was taken to amend the rule.

No action is being taken to amend § 23.939.

Explanation: Conference proposal 323 recommended adding a new § 23.939(b) to require turborcharged engine installations meet certain detailed operation, test, and mechanical requirements. Comments at the conference did not support this proposal; therefore, proposal 323 will receive no further consideration.

Reference: Conference proposal 323.

No action is being taken to amend § 23.954.

Explanation: Conference proposal 328 recommended deleting the fuel system lightning protection requirements for conventional light airplanes of less than 3000 pounds because lightning protection is not needed for this class of airplane. Conference commenters did not support such a change in part 23. It cannot be ensured that any aircraft will not be exposed to lightning; therefore, proposal 328 will received no further consideration.

Reference: Conference proposal 328.

No action is being taken to amend § 23.1105.

Explanation: Conference proposal 394 recommended revising § 23.105(b) to limit the current rule to airplanes over 1500 pounds maximum weight. The proposal was withdrawn without conference discussion; therefore, the FAA plans no further action on this proposal.

Reference: Conference proposal 394.

No action is being taken to amend § 23.1182.

Explanation: Conference proposal 408 recommended adding interpretive material to § 23.1182 for airplanes of not more than 3000 lbs. maximum weight. The proposal was withdrawn at the conference without discussion; therefore, the FAA plans no further action on this proposal.

Reference: Conference proposal 408.

No action is being taken to amend § 23.1301.

Explanation: Conference proposal 417 recommended that the applicability of § 23.1301 for airplanes with a maximum weight of 3,000 pounds or less be limited to that equipment required by the operating regulations and those that are essential for safe operations. Since amendment 23–20, section 23.1301 has required that all installed equipment, whether optional or required, meet the functional and installation requirements applicable to essential equipment. Most airplanes certificated to Part 23 requirements have installed optional equipment, such as cigarette lighters, unrequired instrumentation, instrumentation that is redundant to required instrumentation, and so forth. Frequently, operations are predicated on use of optional equipment. In such operations, it is essential to safety for the affected optional equipment to perform its intended function. Therefore, the FAA considers it necessary to retain the requirements of this section. Since the conference, FAA has issued amendment 91–206 (53 FR 239, December 13, 1988), with an effective date of December 13, 1988. This amendment revises part 91 to permit rotorcraft nonturbine-powered airplanes, gliders, and lighter-than-air aircraft, for which an approved Master Minimum Equipment List has not been developed, to be operated with certain inoperative instruments and equipment that are not essential for the safe operation of the aircraft. These rules permit operation of an aircraft with inoperative instruments and equipment within the framework of a controlled program of maintenence inspections, repairs, and parts replacements. Basically, the only instruments and equipment that are permitted to be inoperative, and only for certain situation, would be unneeded communications and navigation radios, convenience equipment, optional installed instruments and equipment and those instruments and equipment not required by § 91.33 for the kind of flight operation being conducted. Since this final rule addresses the concerns of this conference proposal, no further action is being taken on conference proposal 417.

Reference: Conference proposal 417.

No action is being taken to amend § 23.1353.

Explanation: Conference proposal 458 recommended revising § 23.1353(g) by adding the word "or" between paragraphs (g)(1) and (g)(2) so there would be an alternative design permitted. The regulations now provide for three alternatives since there is an "or" between paragraphs (g)(2) and (g)(3). Therefore, the "or" between paragraphs (g)(1) and (g)(2) is understood. Conference proposal 457 recommended revising § 23.1353(g) so that a low energy charging power source would be acceptable, but it was withdrawn after the discussion of conference proposal 458.

Reference: Conference proposals 457 and 458.

No action is being taken to amend § 23.1413.

Explanation: Conference proposal 466 recommended replacing the specific requirement for the latching device, that is, the metal to metal latching device in § 23.1413, with objective words. This proposal was opposed at the conference since other acceptable methods have not been shown. Metal to fabric latching devices or buckles have been shown to wear, deteriorate and fail in survivable crashes.

Amendment 23–32 (50 FR 46872, November 13, 1985) amended the shoulder harness requirements but it did not amend § 23.1413 to extend the metal to metal latching device requirement to harnesses. The FAA does not believe any lesser quality latching device should be used for harnesses than is allowed for safety belts. Since the conference, § 23.1413 was revised by amendment 23–36 (53 FR 30802, August 15, 1988), effective September 14, 1988, to require that each safety belt and shoulder harness be equipped with a metal to metal latching device.

Reference: Conference proposal 466.

No action is being taken in this notice for conference proposal 517a.

Explanation: Conference proposal 517a recommended amending several sections of part 23, primarily in the fuel system area, to require improved post-crash fire protection. The proposal was based on National Transportation Safety Board (NTSB) Recommendations A–80–90, –91, and –92. The extensive discussion at the conference only addressed the concept of improved crash resistance of fuel systems as presented by the sponsor. No details of proposed rule changes were discussed. These NTSB recommendations were addressed in a separate notice of proposed rulemaking on crash resistant fuel systems for part 23 airplanes and will not be considered further in this notice.

Reference: Conference proposal 517a.

Regulatory Evaluation Summary

Benefit-Cost Analysis

The FAA is required to examine the potential benefits and costs of each proposed rulemaking action to ensure that the public is not burdened with rules where costs outweigh their benefits. This section contains an evaluation that quantifies, to the maximum possible extent, the potential costs and benefits expected to accrue from updating the airworthiness standards for part 23 airplanes.

This NPRM addresses the powerplants and equipment requirements of part 23 airplanes. The various powerplant sections include general provisions for installation, certification, and protection of engines and propellers; and specific provisions for fuel systems and their components, oil systems, cooling systems, induction systems, exhaust systems, powerplant controls, accessories, and fire protection. The sections on equipment include general standards for installation and performance, and specific standards for instrument installation, electrical systems and equipment, lights, safety equipment, and miscellaneous equipment.

The FAA estimates that the cost of compliance that is expected to accrue from implementation of the proposed rule would be $51,000 (discounted, in 1989 dollars) between 1990 and 1999. This assessment is based on the belief that only proposed §§ 23.1143 (Engine Controls) and 23.1147 (Mixture Controls) would impose greater than negligible but less than significant costs on aircraft manufacturers.

Although the proposed rule would incorporate minor to major changes to powerplant and equipment requirements of part 23, most of such changes are expected to impose negligible costs on manufacturers. Many of the proposed changes are simply a formalization of requirements that the small airplane industry is already satisfying, some proposed changes clarify or simplify the rules, and others are intended to have greater impact on enhancing safety.

Some of the proposed rule changes would require manufacturers to either redesign their components or equipment, to install additional equipment, or to conduct additional tests for certification. Most of these requirements would have negligible impacts on manufacturers because almost none of the requirements would be retroactive. Manufacturers would not be required to change their airplanes to comply with the proposed requirements. Because of the depressed state of the general aviation industry, which is likely to continue in the near future, considerably fewer airplane designs are expected to appear on the market than in the past. This would reduce the extent of costs that the industry would have to bear.

Cost-Benefit Effect of Proposed Sections 23.1143 (Engine Controls) and 23.1147 (Mixture Controls)

Section 23.1143 would require an adequate backup in the event of failure of the pilot's control installation to the fuel metering device. Section 23.1147 would require that, in the event of failure to the pilot's control installation, the mixture control device be automatically positioned at the full-rich setting.

Costs

Proposed § 23.1143 would not have significant cost impacts on airplane piston engine manufacturers. The proposal would not present a major design problem for manufacturers of reciprocating engines. This assessment is based on the informed judgment of FAA personnel and information received from industry. The total cost of designing a newly type certificated piston engine is estimated to be as high as $21 million (in 1989 dollars). The design cost for this proposal (engine controls) cannot be separated from the proposal for mixture controls (§ 23.1147). The combined design cost associated with these two proposals is estimated to range from $52,000 to $104,000 per newly type certificated engine. This estimate is based on discussions with airplane engine manufacturers and the General Aviation Manufacturers Association (GAMA). This evaluation assumes that only one engine (piston) design will be newly type certificated over the next 10 years (1990–1999), based primarily on the informed judgment of FAA personnel. Thus, the proposal's impact (including proposed § 23.1147) on total design costs is very small and would probably not affect the decision to produce a newly type certificated engine design. Hardware costs would be minimal, probably no more than $5.00 per individual engine, which consists of springs and fasteners.

The $52,000–$104,000 design costs would be distributed over each engine expected to be sold. If the proposal's design costs are distributed over 1,000 engines in the 10 year period, design costs per engine would range between $52–$104. Using the midpoint of this range, design costs are estimated to be $78 per engine. Adding the $5 per engine hardware cost to the newly type certificated engine design costs yields a $83 cost of the proposal per individual engine. Total cost of the proposal over the 10 year period is estimated to be $83 times 1,000 engines or $83,000 ($51,000 discounted, 10 percent, 10 years). All cost estimates are expressed in 1989 dollars.

Benefits

The potential benefits of proposed § 23.1143 (including proposed § 23.1147) would be enhanced safety. Such safety would take the form of a reduced likelihood of aviation accidents resulting in fatalities, injuries (serious and minor), and, to a lesser extent, property damage. According to accident data compiled by the National Transportation Safety Board, which include years 1982 through 1987, there were 71 accidents in part 23 airplanes that resulted in 1 fatality, 10 serious injuries, and 31 minor injuries. There is a high likelihood that these accidents would have been prevented had proposed § 23.1143 (including proposed § 23.1147) been in effect. Adding in the aircraft damage, which is expected to occur from a typical accident in the future involving these airplane engines, and applying monetary values to each category of casualties and damage, the average baseline annual risk exposure amounts to $11,034,000 (1989 dollars). This benefit estimate embodies global parameters in regard to the number of occupants per accident, injury distributions, etc., rather than reliance on those associated with the 71 baseline accidents. This approach is employed because there is a greater probability that future accidents would be characterized by the global parameters rather than the historic 71 accidents. Global in this evaluation refers to potential benefit estimates that take into account typical passenger (including pilot) load factors of future accidents that would involve single and multiengine (reciprocating) airplanes rather than reliance on what actually took place in the historic 71 accidents. This approach also makes the same considerations for aircraft damage, though this does employ a higher degree of uncertainty. This approach is considered to be more realistic of what we can reasonably expect in the future in the event of a typical accident related to these engines in the absence of these two proposed amendments.

The potential benefits of proposed § 23.1143 are estimated for the 10 year period 1990–1999. The benefit estimate is based on the premise that 1,000 newly type certificated reciprocating engines, which are assumed to be installed primarily in airplanes produced under amended type certificates, will be produced over the 10 year period. After taking into account the proportion of newly type certificated piston engines expected to come into U.S. service relative to the number of engines in the existing airplane fleet, the potential reduction in risk exposure is estimated to be $301,000 ($158,000 discounted, 10 percent, 10 years) over the next 10 years. This potential benefit estimate of $301,000 is based on a recent revision by the FAA in accordance with guidelines issued by The Office of the Secretary of Transportation, dated June 22, 1990. This revision was done in order to better provide the public and government officials with a benchmark comparison of expected safety benefits of rulemaking actions over an extended period of time with estimated costs in dollars. Therefore, as the result of this revision, the FAA currently uses a minimum value of $1.5 million to statistically represent a human fatality avoided. In addition, the FAA uses $640,000 and $2,300 for serious and minor injury values. Other critical values have also been revised.

The cost-benefit analysis of these proposed amendments, taken together, shows that the total potential benefits ($158,000) outweigh the total estimated costs ($51,000) by a factor of 3.1. As noted above, this benefit estimate of $158,000 is based on data in addition to that for these two proposed amendments. Such data have supplemented what was found in the accidents database by adjusting for typical passenger load factors and aircraft damages. These additional data adjustments reflect a more realistic approach as to the outcome of a typical accident involving single and multiengine (reciprocating) airplanes. Since the estimated implementation cost of $83.00 per newly installed engine sold is viewed as minor, coupled with the belief that potential safety benefits would at least be equal to the per engine cost, these two proposed amendments are considered to be cost-beneficial.

On balance, the FAA believes that all of the proposed amendments are cost-beneficial.

The Regulatory Evaluation that has been placed in the docket contains additional information related to the costs and benefits that are expected to accrue from implementation of the proposed rule.

Regulatory Flexibility Determination

The Regulatory Flexibility Act of 1980 (RFA) was enacted to ensure that small entities are not unnecessarily and disproportionately burdened by Government regulations. The RFA requires agencies to review rules that may have a "significant economic impact on a substantial number of small entities."

This NPRM would amend part 23 of the Federal Aviation Regulations. Part 23 prescribes airworthiness standards for the issue of type certificates for normal, utility, acrobatic, and commuter category airplanes. Under the criteria of the RFA, the FAA has determined that the proposed rule would not have a significant economic impact on a substantial number of small entities. The FAA size threshold for a determination of a small entity for aircraft manufacturers is 75 or fewer employees. A substantial number of small entities is defined as a number that is not fewer than eleven and that is more than one-third of the small entities subject to a proposed or existing rule. A review of domestic general aviation manufacturers indicates that only six companies have 75 or fewer employees. Therefore, this NPRM would not have a significant economic impact on a substantial number of small entities.

International Trade Impact Assessment

This NPRM is expected to have neither an adverse impact on the trade opportunities of U.S. manufacturers of part 23 airplanes doing business abroad nor on foreign aircraft manufacturers doing business in the United States. Since the certification rules are applicable to both foreign and domestic manufacturers, which sell in the United States, there would be no competitive trade advantage to either.

Federalism Implications

The regulations proposed herein would not have substantial direct effects on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government. Therefore, in accordance with Executive Order 12612, it is determined that this proposal would not have sufficient federalism implications to warrant the preparation of a Federalism Assessment.

Conclusion

For reasons discussed earlier in the preamble, the FAA has determined that this document (1) involves a proposed regulation that is not major under the provisions of Executive Order 12291, (2) is not significant under DOT Regulatory Policies and Procedures (44 FR 11034, February 26, 1979), and (3) in addition, I certify that under the criteria of the Regulatory Flexibility Act, this proposed rule, if promulgated, will not have a significant economic impact on a substantial number of small entities. In addition, this proposal, if adopted, would have little or no impact on trade opportunities for U.S. firms doing business overseas or for foreign firms doing business in the United States.

List of Subjects in 14 CFR Part 23

Aircraft, Air transportation, Aviation safety, Safety.

The Proposed Amendment

Accordingly, the Federal Aviation Administration proposes to amend part 23 of the Federal Aviation Regulations (14 CFR part 23), as follows:

PART 23—AIRWORTHINESS STANDARDS: NORMAL, UTILITY, ACROBATIC, AND COMMUTER CATEGORY AIRPLANES

1. The authority citation for part 23 continues to read as follows:

Authority: 49 U.S.C. 1344, 1354(a), 1355, 1421, 1423, 1425, 1428, 1429, and 1430; 49 U.S.C. 106(g).

2. Section 23.901 is amended by revising paragraphs (b), (d), and (e), and adding a new paragraph (f) to read as follows:

§ 23.901 Installation.

* * * * *

(b) Each powerplant installation must be constructed and arranged to—

(1) Ensure safe operation to the maximum altitude for which approval is requested.

(2) Be accessible for necessary inspections and maintenance.

(3) Result in vibration characteristics that do not exceed those established during the type certification of the engine.

* * * * *

(d) Each turbine engine installation must be constructed and arranged to provide continued safe operation without a hazardous loss of power or thrust while being operated in rain for at least 3 minutes with the rate of water ingestion being not less than 4 percent, by weight, of the engine induction airflow rate at the maximum installed power or thrust approved for takeoff and at flight idle. The engine must accelerate and decelerate safely following stabilized operation under these rain conditions.

(e) The powerplant installation must comply with—

(1) The installation and operating instructions provided under the engine and propeller type certificates; and

(2) The applicable provisions of this subpart.

(f) Each auxiliary power unit installation must meet the applicable portions of this part.

Explanation: This proposal will clarify the intent of this section by adding the words "powerplant" and "installation" in paragraphs (b) and (e); by adding vibration characteristic requirements for any airplanes; by correcting the reference for installation instructions from § 33.5 to the affected engine and propeller type certificate; by revising the water ingestion requirement to show that the engine installation does not degrade the water ingestion capability of the engine; and by adding an auxiliary power unit installation requirement.

Conference proposal 305 recommended the insertion of the words "or control" into paragraph (a)(2) after the word "safety" because the definition of what constitutes a powerplant installation should include the "control" of major propulsion units. At the conference, one commenter agreed with the additional words; however, three commenters disagreed. These commenters contended that without a definition of the word "control", the addition would cause more confusion than clarification about what is included in a powerplant installation.

The FAA has further considered this issue and concluded that the purpose of § 23.901(a) is to define an airplane powerplant installation for part 23 so that the requirements that follow would apply to all components of the installation that are necessary for propulsion and that affect the safety of the major propulsive units. It follows that each component that affects safety includes all components needed for control of the major propulsive units. Therefore, the adoption of the additional words "or control" would neither add a substantive requirement not already in the rule, nor clarify the requirement.

Conference proposal 306 recommended that the word "installation" be inserted into § 23.901(b) after the word "powerplant" to clarify the requirement that the following rules apply to those components of the installation that are not already certificated or otherwise approved. During discussion at the conference, one commenter supported the change. The FAA considers it clarifying and has incorporated it into this proposal.

Conference proposal 307 recommended deletion of the word "turbine" from § 23.901(d). Such change would require reciprocating engines to show water ingestion capability at the same level as turbine engines. The consensus of the conference was that this suggested revision was not justified. The FAA agrees with this consensus.

Conference proposal 307 also recommended revising the requirement for rain ingestion capability from "at rated takeoff power or thrust" to "at the maximum power or thrust approved for takeoff." This was not discussed in detail at the conference. The FAA has further considered this issue. Part 33 requires a showing of ingestion capability at rated takeoff power or thrust. In most installations, the rated takeoff power or thrust is approximately equivalent to the maximum power or thrust approved for takeoff on the particular airplane, but there are a number of installations where the maximum approved engine power is substantially derated. Operating the engine at its derated power may place engine operation in a regime where the rain ingestion capability was not demonstrated adequately during type certification of the engine. Substantiation to the proposed requirement will show that the installation of the engine in the airframe, even with derated power, has not impaired the engine's rain-ingestion capability. To remove redundancy and to foster consistency within the FAR, the first four words of § 23.901(d) are revised to read "Each turbine engine installation . . .".

Conference proposal 309 recommended that a new paragraph (f) be added to specify auxiliary power unit installation requirements. At the conference, the commenters agreed that the rule is needed.

Conference proposal 310 recommended that § 23.901(e)(1) be revised by replacing the words "under § 33.5 of this chapter" with the words "under the engine and propeller type certificates" because not all engines installed on new airplanes are certificated under part 33. Some engines in current production were certificated under Civil Air Regulations, part 13, and imported engines are certificated through part 21 and the applicable bilateral agreements. Since the powerplant installation also includes propellers, the FAA has determined that it is appropriate to insert a similar requirement for propeller installation instructions into this section.

Conference proposal 311 recommended a change similar to proposal 310.

The FAA has determined that the turbopropeller vibration requirements should apply to all part 23 airplanes and has deleted the words "commuter category" from paragraph (b)(3) in this proposal.

Reference: Conference proposals 305, 306, 307, 309, 310, and 311.

3. Section 23.903 is amended by revising paragraphs (d)(1) and (e)(2) to read as follows:

§ 23.903 Engines.

* * * * *

(d) * * *

(1) The design of the installation must be such that risk of fire or mechanical damage to the engine or airplane, as a result of starting the engine in any conditions in which starting is to be permitted, is reduced to a minimum. Any techniques and associated limitations for engine starting must be established and included in the Airplane Flight Manual (AFM), approved manual material, or applicable operating placards. Means must be provided for—

(i) Restarting any engine in flight, and

(ii) Stopping any engine in flight, after engine failure, if continued engine rotation would cause a hazard to the airplane.

* * * * *

(e) * * *

(2) There must be means for stopping combustion of any engine and for stopping the rotation of any engine if continued rotation would cause a hazard to the airplane. Each component of the engine stopping system located in any fire zone must be fire resistant. In addition, each component of the engine restarting system located in any fire zone must be fire resistant. If hydraulic propeller feathering systems are used for stopping the engine, the hydraulic feathering lines or hoses must be fire resistant.

* * * * *

Explanation: This proposal will require a means for restarting any engine in flight and will allow continued rotation of any engine after failure if continued rotation will not create a hazard to the airplane, and will clarify the stopping and restarting system fire resistance requirements.

Conference proposal 308 recommended the deletion of the last sentence of current § 23.903(d)(1) because the requirements of § 23.33 are adequate to limit windmilling speeds to reasonable levels, under recommended glide airspeed, after engine failure. After further examination of the cited requirements and the conference discussion, the FAA has concluded that deletion of the last sentence of paragraph (d)(1) is not justified. The requirement of § 23.33 speaks to overspeeding of operating engines while the last sentence of § 23.903(d)(1) refers to overspeeding (windmilling) of a failed engine. Windmilling of a piston engine on a single-engine or multiengine-powered airplane usually is not a hazard. Therefore, the FAA has determined that § 23.903(d) should be revised to allow continued rotation of a piston engine on single-engine and multiengine-powered airplanes after engine failure if continued rotation of the failed engine does not create a hazard. In the third sentence of current § 23.903(d)(1), the words "for multiengine airplanes" are deleted to require the means for restarting engines applicable to any engine for both single and multiengine airplanes.

Conference proposal 312 recommended revising § 23.903(e)(2) to allow windmilling of a shutdown turbine engine where no hazard to the airplane is involved, to require the components of both the stopping and restarting systems on the engine side of the firewall to be at least fire resistant, and to require any propeller feathering hoses involved in the stopping and restarting systems to be at least fire resistant.

Conference proposal 313 recommended revising § 23.903(e)(2) in a similar manner. The justification given for both of these proposals is that turbine engines can windmill safely.

Conference discussion resulted in a consensus that supported these conference proposals. The two proposals contend that most turbine engines can windmill without hazard to the airplane and should not be required to be stopped when no hazard results from continued rotation. Allowing non-hazardous windmilling of an engine removes a burden from the aviation public and is considered relieving in nature. Therefore, the FAA proposes to amend § 23.903(e)(2) to allow non-hazardous windmilling of the engines. Since all requirements relative to stopping and starting engines are appropriate to all categories of part 23 turbine-engine-powered airplanes, the phrase "for commuter category airplanes" is deleted from paragraph (e)(2).

Conference proposal 314 recommended simplified engine requirements for airplanes of not more than 1500 pounds. The consensus of commenters at the conference was that Joint Airworthiness Regulations E and 22 should not be incorporated into part 23. The FAA agrees and will not consider this proposal.

The FAA is proposing the establishment of fire zones in part 23 airplanes in new § 23.1181. Therefore, fire zone terminology has been incorporated in this and several other proposals throughout this notice.

Reference: Conference proposals 308, 312, 313, and 314.

4. Part 23 is amended by adding a new § 23.904 to read as follows:

§ 23.904 Automatic power reserve system.

If installed, an automatic power reserve (APR) system that automatically advances the power or thrust on the operating engine(s), when any engine fails during takeoff, must comply with appendix H of this part.

Explanation: See proposal 96.

5. Section 23.905 is amended by adding paragraphs (e), (f), (g), and (h) to read as follows:

§ 23.905 Propellers.

* * * * *

(e) All areas of the airplane forward of the pusher propeller that are likely to accumulate and shed ice into the propeller disc during any operating condition for which the airplane is certificated must be suitably protected to prevent ice formation, or it must be shown that any ice shed into the propeller disc will not create a hazardous condition.

(f) Each pusher propeller must be marked so that the disc is conspicuous under normal daylight ground conditions.

(g) If the engine exhaust gases are discharged into the pusher propeller disc, it must be shown by tests, or analysis supported by tests, that the propeller is capable of continuous safe operation.

(h) All engine cowling, access doors, and other removable items must be designed to ensure that they will not separate from the airplane and contact the pusher propeller.

Explanation: This proposal adds four requirements for pusher propeller configurations: (1) Ice shedding will not create a hazard; (2) the propeller disc is conspicuously marked; (3) the propeller can withstand engine exhaust gases; (4) and items from the airplane will not separate and contact the propeller. The FAA has received several applications for pusher propeller configurations. The FAA has found these configurations to be novel and unusual design features relative to the applicable requirements. Special conditions were necessary to provide the level of safety intended by the applicable requirements. The FAA has further considered the issues of propeller disc conspicuity, ice likely to be shed into the propeller disc, and engine exhaust gases that are discharged into the propeller disc.

Propeller disc conspicuity is of concern during ground operations. Ground personnel and boarding and deplaning passengers are accustomed to tractor propellers. With pusher propellers, there is a significantly higher probability of inadvertent contact with a turning propeller. Therefore, the FAA is proposing additional requirements for pusher propeller conspicuity. Additional conspicuity of tractor propellers could enhance ground operations safety, but the FAA is concerned that any additional visual attention-getters in the pilot's normal viewing area could adversely affect collision avoidance.

Most propeller installations are subject to ice being shed into them, if only from the propeller spinner. Typically, for tractor propellers, no significant damage results. However, for pusher propellers that are very close to the fuselage and well back from the front of the airplane's nose, ice shed from the forward fuselage, and from the wings may cause significant propeller damage. Therefore, the FAA is proposing requirements to ensure such damage does not cause a hazardous condition.

In most pusher propeller installations, the engine exhaust gases pass through the propeller disc. Many factors affect the temperature of these gases when they contact the propellers and propeller tolerance to these gases varies with propeller design and materials. Therefore, the FAA is proposing requirements to ensure damage to the propellers does not occur as a result of exhaust gas impingement.

In pusher propeller installations, design factors need to be incorporated to ensure that removable items do not separate from the airplane and contact the propeller.

Reference: Conference proposals 315, 316, and special conditions recently promulgated that apply to pusher propellers.

6. Section 23.909 is amended by revising the heading; by removing the workd "turbosupercharger" and replacing it with the word "turbocharger" each time it appears in paragraphs (b) and (c); by revising paragraph (a); and by adding new paragraphs (d) and (e) to read as follows:

§ 23.909 Turbocharger systems.

(a) Each turbocharger must be approved under the engine type certificate or it must be shown that the turbocharger system, while in its normal engine installation and operating in the engine environment—

* * * * *

(d) Each intercooler installation, where provided, must comply with the following—

(1) The mounting provisions of the intercooler must be designed to withstand the loads imposed on the system;

(2) It must be shown that, under the installed vibration environment, the intercooler will not fail in a manner allowing portions of the intercooler to be ingested by the engine; and

(3) Airflow through the intercooler must not discharge directly on any airplane component (e.g., windshield) unless such discharge is shown to cause no hazard to the airplane under all operating conditions.

(e) Engine power, cooling characteristics, operating limits, and procedures affected by the turbocharger system installations must be evaluated. Turbocharger operating procedures and limitations must be included in the Airplane Flight Manual in accordance with § 23.1581 of this part.

Explanation: This proposal expands and clarifies the intent of the requirements for turbocharger system standards by adding an engine/turbocharger operating environment requirement and intercooler installation requirements.

Conference proposal 317 recommended revising § 23.909(a) to require that turbochargers be compatible with the engine environment in which turbochargers will be expected to operate. The justification given was that the current rule has been interpreted as allowing turbochargers to be approved as part of the airplane type design rather than as part of the engine type design. Current § 23.909(a)(1) allows a bench test of the turbocharger system by itself; it need not be installed on an engine. This test does not subject the turbocharger system to the engine environment, nor the engine to the turbocharger environment. The FAA concludes that it is necessary to test the turbocharger and the engine as a unit, and incorporates the proposal as recommended.

Conference proposal 318 recommended revising § 23.909(a)(1) to require that the turbocharger undergo an additional 500 hours of flight testing, including at least 400 hours of operation at 75 percent cruise power or normal cruise power for the engine with which it is installed. The objective is the same as the previously cited conference proposal 317. The justification cited mismatches in turbocharger/engine combinations; however, consensus of the conference discussion was opposed to this proposal because such prolonged testing is not needed. The FAA agrees and conference proposal 318 will not receive further consideration.

Although it was not discussed at the conference, the FAA is aware of the trend toward adding intercoolers into turbocharger systems and has determined that there is a need for airworthiness standards for such installations. Therefore, the FAA has developed proposed standards for intercoolers covering mounting loads, vibration environment, and the cooling airflow exhaust. The standards are incorporated into new paragraph (d) of this proposal.

The FAA has determined that engine power, cooling characteristics, operating limits, and procedures attributable to the turbocharger system must be evaluated and documented in the Airplane Flight Manual. These requirements are incorporated into new paragraph (e) of this proposal. Since this proposal addresses the total turbocharger system installation, the section heading is revised by adding the word "systems".

Reference: Conference proposals 317 and 318.

7. Part 23 is amended by adding a new § 23.911 to read as follows:

§ 23.911 Propulsion drive system design.

Propulsion drive systems as defined in paragraph (a) of this section must meet the requirements as set forth in §§ 23.911 through 23.921 of this part.

(a) The propulsion drive system includes all parts necessary to transmit power from the engine(s) to the propeller(s) that have not been approved as part of the engine(s) or propeller(s). This includes couplings, universal joints, drive shafts, supporting bearings for shafts, brake assemblies, clutches, gear boxes, transmissions, any attached accessory pads or drives, and any cooling fans that are attached to, or mounted on, the propulsion drive system.

(b) Each propulsion drive system powered by more than one engine must be arranged so that the propeller and its control will continue to be operated by the remaining engine(s) if any engine fails.

(c) Each multiengine propulsion drive system must incorporate a device to automatically disengage any engine from the propeller if that engine fails.

(d) If a transmission is torque limited, a means to prevent exceeding the torque limit must be provided unless it can be shown by design and tests that the torque limit cannot be exceeded.

(e) The oil for components of the propulsion drive system that require continuous lubrication must be sufficiently independent of the lubrication systems of the engine(s) to ensure operation with any engine inoperative.

(f) There must be cooling provisions to maintain the fluid temperatures in any propulsion drive transmission within design values under any critical ground and flight operating condition. Compliance must be shown by ground and flight tests.

(g) Torque limiting means must be provided on all accessory drives that are located on the propulsion drive system in order to prevent the torque limits established for those drives from being exceeded.

(h) There must be provisions to minimize the hazards resulting from failure of an engine to transmission drive shaft such that the airplane can continue flight to a safe landing.

(i) A positive means must be provided to indicate that an engine is inoperative, or it must be determined that required instruments will readily alert the pilot when an engine is inoperative.

(j) In addition to the propulsion drive system complying with the requirements in § 23.903(c), the installed propulsion drive system powered by more than one engine must be—

(1) Designed so that torque to the propeller is not interrupted after failure of any engine or element in the propeller drive system; and

(2) Examined in detail to determine all components and their failure modes that would be critical to the continued safe flight and landing of the airplane. For each component and its failure modes identified by this examination, it must be shown—

(i) By appropriate test that such a failure is not likely to occur in the system component's service life established by these tests; or

(ii) That the system is designed so continued safe flight and landing can be accomplished after occurrence of the failure.

(k) The following applies to the propeller pitch control—

(1) No loss of normal propeller pitch control may cause hazardous overspeed of the propeller under all intended operations.

(2) Each propeller pitch control and pitch locking (safety) device must be subjected in tests to cyclic loading that simulates the frequency and amplitude to which the components would be subjected during 1,000 hours of propeller operations.

(3) Compliance with paragraph (k)(2) of this section may be shown by a rational analysis based on the results of tests on similar components.

Explanation: This proposal, and several related proposals, presents requirements for propulsion drive systems that are designed to connect the engine(s) with the propeller(s) when they are not joined directly and are not approved as part of the engine type design. The FAA has received applications for approval of this type system, which is novel and unusual relative to the applicable requirements. In response to these applications, it is required by § 21.16 that special conditions be established. To preclude the need for further special conditions, the FAA is introducing the requirements into part 23.

Reference: Cited special conditions.

8. Part 23 is amended by adding a new § 23.913 to read as follows:

§ 23.913 Propulsion drive system limitations.

(a) The propulsion drive system limitations must be established so that they do not exceed the corresponding limits approved for the engine, propeller, and drive system components.

(b) For all engines, takeoff operation must be limited by—

(1) The powerplant maximum rotational speed for takeoff operation and the maximum rotational propeller speed may not be greater than the values determined by the drive system type design or the maximum value shown during type tests.

(2) The maximum allowable temperature for the transmission oil.

(3) The time limit for the use of power, gas temperature, and speed corresponding to the limitations established in paragraphs (b) and (c) of this section.

(c) For turbine engines, takeoff operation must also be limited by—

(1) The powerplant maximum allowable gas temperature at maximum allowable power or torque for each engine considering the power input limitations of the transmission with all engines operating; and

(2) The powerplant maximum allowable gas temperature at maximum allowable power or torque for each engine considering the power input limitations of the transmission with one engine inoperative.

(d) For all engines, continuous operation must be limited by—

(1) The powerplant maximum rotational speed for continuous operation. The maximum rotational propeller speed may not be greater than the values determined by the drive system type design maximum value shown during type tests;

(2) The maximum allowable temperature for the transmission oil;

(3) A low oil quantity warning; and

(4) A low oil pressure warning.

(e) For turbine engines, continuous operation must also be limited by—

(1) The powerplant maximum allowable gas temperature for continuous operation and the maximum allowable power or torque for each engine considering the power input limitations of the transmission with all engines operating; and

(2) The powerplant maximum allowable gas temperature at maximum allowable power or torque for each engine considering the power input limitations of the transmission with one engine inoperative.

(f) Ambient temperature limitations (including limitations for winterization installations if applicable) must be established as the maximum ambient atmosphere temperature at which compliance with the cooling provisions of §§ 23.1041 through 23.1045 is shown.

Explanation: See proposal 7.

9. Part 23 is amended by adding a new § 23.915 to read as follows:

§ 23.915 Propulsion drive system instruments.

In addition to the requirements of § 23.1305 of this part, the following instruments must be provided for any gear box or transmission:

(a) An oil pressure warning device for each pressure-lubricated gear box to indicate when the oil pressure falls below a safe value;

(b) A low oil quantity warning indicator for each gear box, if lubricant is self-contained;

(c) An oil temperature warning device to indicate unsafe oil temperatures in each gear box;

(d) A tachometer for each propeller;

(e) A torquemeter for each transmission driving a propeller; and

(f) A chip detecting and indicating system for each gear box.

Explanation: See proposal 7.

10. Part 23 is amended by adding a new § 23.917 to read as follows:

§ 23.917 Propulsion drive system and control mechanism tests.

(a) *Endurance tests; general.* The propulsion drive system, as defined in § 23.911, and the propeller(s) control mechanism must be tested as prescribed in paragraphs (b) through (k) of this section for at least 200 hours plus the time required to meet paragraphs (i) and (j) of this section. For the 200-hour portion, these tests must be conducted as follows:

(1) Twenty each, ten-hour test cycles consisting of the test times and procedures in paragraphs (b) through (h) of this section;

(2) The tests must be conducted on the airplane or on a representative portion of the fuselage or nacelle for all or a portion of these tests if determined appropriate;

(3) The test torque must be determined by actual powerplant limitations; and

(4) The test torque must be absorbed by the actual propellers to be installed or an FAA approved alternate.

(b) *Endurance tests; takeoff torque run.* The takeoff torque run endurance test must be conducted as follows:

(1) The takeoff torque run must consist of a one-hour run on the engine(s) at the torque corresponding to takeoff power, but with the engine power setting alternately cycled every five minutes to as low an engine idle speed as practicable. For multiengine installations, differential power is applied such that one engine is at takeoff setting and the other engine(s) is at idle setting.

(2) Deceleration and acceleration of the engines and/or of individual engines and drive systems must be performed at the maximum rate. (This corresponds to a one-second movement of the power lever from idle to takeoff setting and one second from takeoff setting to idle in accordance with § 33.73 of this chapter.)

(3) The time duration of all engines at takeoff power setting must total one hour and does not include the time required to go from takeoff to idle and back to takeoff speed.

(c) *Endurance tests; maximum continuous run.* Three hours of continuous operation at the torque corresponding to maximum continuous power and speed must be conducted as follows:

(1) The propeller(s) must be operated at a minimum of 15 times each hour between test configuration maximum and minimum pitch positions of the propeller(s) except that the change in pitch position movements need not produce loads exceeding the maximum loads encountered in flight.

(2) The minimum and maximum pitch position must be held for at least 10 seconds and the rate of change of pitch position must be at least as rapid as that for normal operation.

(d) *Endurance tests; 90 percent of maximum continuous run.* One hour of continuous operation at the torque corresponding to 90 percent of maximum continuous power must be conducted at maximum continuous rotational propeller speed.

(e) *Endurance tests; 80 percent of maximum continuous run.* One hour of continuous operation at the torque corresponding to 80 percent of maximum continuous power must be conducted at the minimum rotational propeller speed intended for this power.

(f) *Endurance tests; 60 percent of maximum continuous run.* Two hours of continuous operation at the torque corresponding to 60 percent of maximum continuous power must be conducted at the minimum rotational propeller speed intended for this power.

(g) *Endurance tests; engine malfunctioning run.* It must be determined whether malfunctioning of components, such as the engine fuel or ignition systems, or unequal engine power can cause dynamic conditions detrimental to the drive system. If so, a suitable number of hours of operation must be acccomplished under those conditions, 1 hour of which must be included in each cycle and the remaining hours of which must be accomplished at the end of 20 cycles. If no detrimental condition results, an additional hour of operation in compliance with paragraph (b) of this section must be conducted.

(h) *Endurance tests; overspeed run.* One hour of continuous operation must be conducted at the torque corresponding to maximum continuous power and at the maximum rotational propeller speed expected in service, assuming that speed and torque limiting devices, if any, function properly.

(i) *Endurance tests; one-engine-out application.* A total of at least 400 full differential power applications, including those specified in paragraphs (b) and (g) of this section (120 engine power setting cycles in each of paragraphs (b) and (g) of this section totaling 240 cycles) must be made at takeoff torque and RPM. If during these tests it is found that a critical dynamic condition exists, an investigative assessment to determine the cause shall be performed throughout the torque speed range. In each of the remaining 160 engine power setting cycles (160 per engine drive branch) a full differential power application must be performed and the drive shaft of the engine-out must be at rest.

(j) Any components affected directly and/or indirectly by any existing flight loads must be investigated for the same flight conditions as the propeller(s) and their service lives must be determined by fatigue tests or by other acceptable methods. In addition, an acceptable level of safety must be provided for—

(1) Each component in the propeller drive system whose failure would preclude further flight; and

(2) Each component common to all engines of a multiengine airplane.

(k) Each part tested, as prescribed in this section, must be in a serviceable condition at the end of the tests. No intervening disassembly that might affect these results may be conducted.

Explanation: See proposal 7.

11. Part 23 is amended by adding a new § 23.919 to read as follows:

§ 23.919 Additional propulsion drive system tests.

Additional dynamic, endurance, and operational tests and vibratory investigations must be performed to determine that the drive mechanism is safe. The following additional tests and conditions apply:

(a) If the torque output of all engines to the transmission can exceed the highest engine or transmission torque limit, and that output is not directly controlled by the pilot under normal operating conditions (such as where the primary engine power control is accomplished through the propeller(s) control), the following test must be conducted. Under conditions associated with all engines operating, apply 200 cycles to the drive system for 10 seconds each, of a torque that is at least equal to the lesser of—

(1) The maximum torque used in complying with paragraph (b) of § 23.917 plus 10 percent; or

(2) The maximum torque attainable under normal operating conditions, assuming that any torque limiting devices function properly.

(b) For a multiengine propulsion drive system with each engine alternately inoperative, apply to the remaining transmission inputs the maximum transient torque attainable under normal operating conditions, assuming that any torque limiting devices function properly. Each transmission input must be tested at this maximum torque for at least 15 minutes.

(c) The drive system must be subjected to 50 overspeed runs, each 30±3 seconds in duration at a speed of at least 120 percent of maximum continuous speed or other maximum overspeed that is likely to occur in service, plus a margin of speed approved by the Administrator for that overspeed condition. These runs must be conducted as follows:

(1) Overspeed runs must be alternated with stabilizing runs from 1 to 5 minutes duration each 60 to 80 percent of maximum continuous speed.

(2) Acceleration and deceleration must be accomplished in a period no longer than 10 seconds and the time for changing speeds may not be deducted from the specified time for the overspeed runs.

(3) Overspeed runs must be made with the propellers in the flattest pitch for smooth operation.

(d) The test prescribed in paragraphs (a) and (c) of this section must be conducted on the airplane and the torque must be absorbed by the propeller to be installed, except other ground or flight test facilities with other appropriate methods of torque absorption may be used if the conditions of support and vibration are no less severe than the conditions that would exist during a test on the airplane.

(e) Each part tested, as prescribed in this section, must be in serviceable condition at the end of the tests. No intervening disassembly that might affect test results may be conducted.

(f) If drive shaft couplings are used and shaft misalignment or deflections are probable, loads must be measured in flight for the installation limits affecting misalignment. These loads must be combined to show adequate fatigue life.

Explanation: See proposal 7.

12. Part 23 is amended by adding a new § 23.921 to read as follows:

§ 23.921 Propulsion drive system shafting critical speed.

(a) The critical speeds of any shafting must be determined by test except that analytical methods may be used if reliable methods of analysis are available for the particular design.

(b) If any critical speed lies within, or close to, the operating ranges for idling and power-on conditions, the stresses occurring at that speed must be within design limits. This must be shown by tests.

(c) If analytical methods are used and show that no critical speed lies within the permissible operating ranges, the margins between the calculated critical speeds and the limits of the allowable operating ranges must be adequate to allow for possible variations between the computed and actual values.

Explanation: See proposal 7.

13. Section 23.925 is amended by redesignating paragraphs (b) and (c) as (c) and (d), respectively, and by adding a new paragraph (b) to read as follows:

§ 23.925 Propeller clearance.

* * * * *

(b) *Aft-mounted propellers.* The airplane must be designed such that the propeller will not contact the runway surface when the airplane is in the maximum pitch attitude attainable during normal takeoff and landings. If a tail wheel, bumper, or an energy absorption device is provided to show compliance with this paragraph, the following apply:

(1) Suitable design loads must be established for the tail wheel, bumper, or energy absorption device; and

(2) The supporting structure of the tail wheel, bumper, or energy absorption device must be designed to withstand the loads established in paragraph (b)(1) of this section and inspection/replacement criteria must be established for the tail wheel, bumper, or energy absorption device and provided as part of the information required by § 23.1529.

* * * * *

Explanation: Typical small airplanes have been of the tractor propeller configuration. Recently, the FAA has received several applications for pusher propeller configurations. The FAA found for those configurations, which it considered unique relative to the applicable requirements, that special conditions were necessary to provide the level of safety intended by the applicable requirements. This proposal would eliminate the need for further special conditions relative to ground clearance for pusher propeller installations.

Reference: Special conditions mentioned above.

14. Section 23.933 is revised to read as follows:

§ 23.933 Reversing systems.

(a) For propeller reversing systems—

(1) Each system must be designed so that no single failure, likely combination of failures or malfunction of the system will result in unwanted reverse thrust under any operating condition. Failure of structural elements need not be considered if the probability of this type of failure is extremely improbable.

(2) Compliance with paragraph (a)(1) of this section must be shown by failure analysis, or testing, or both, for propeller systems that allow the propeller blades to move from the flight low-pitch position to a position that is substantially less than the normal flight, low-pitch stop position. The analysis may include or be supported by the analysis made to show compliance with § 35.21 for the type certification of the propeller and associated installation components. Credit will be given for pertinent analysis and testing completed by the engine and propeller manufacturers.

(b) For turbojet and turbofan reversing systems—

(1) Each system intended for ground operation only must be designed so that no single failure or malfunction of the system will result in unwanted reverse thrust under any expected operating condition. Failure of structural elements need not be considered if the probability of this type of failure is extremely improbable.

(2) Each system intended for inflight use must be designed so that no unsafe condition will result during normal operation of the system, or from any failure, or likely combination of failures of the reversing system under any operating condition including ground operation. Failure of structural elements need not be considered if the probability of this type of failure is extremely improbable.

(3) Each system must have means to prevent the engine from producing more than idle forward thrust when the reversing system malfunctions; except that it may produce any greater forward thrust that is shown to allow directional control to be maintained, with aerodynamic means alone, under the most critical reversing condition expected in operation.

Explanation: This proposal clarifies the reversing system requirements by separating the propeller reversing systems from the turbojet/turbofan reversing systems, and by amending the requirements for propeller reversing systems to allow incorporating a "beta range" of propeller blade pitch angles.

Conference proposal 320 recommended the addition of the world "propeller" as the first word in paragraph (a) and the addition of the words "and turbofan" as the second and third words in paragraphs (b) and (c) to clarify the type of reversing system each paragraph is to apply. This would ensure that the rules also apply to turbofan engine fan duct reversers.

Conference discussion indicated that current requirements are unclear. Since the conference, the FAA has reviewed the background of these requirements, along with state-of-the-art reversing systems, including special conditions applicable to reversing systems, and has concluded that clarification of the rule is necessary. This proposal separates the propeller reversing system requirements from the turbojet/turbofan reverser system requirements.

Since all requirements of this section are appropriate for all categories of part 23 airplanes, paragraph (d) applicable to turbopropeller-powered commuter category airplanes is deleted.

Reference: Conference proposal 320.

15. Part 23 is amended by adding a new § 23.934 to read as follows:

§ 23.934 Turbojet and turbofan engine thrust reverser systems tests.

Thrust reverser systems of turbojet or turbofan engines must meet the requirements of § 33.97 of this chapter or it must be demonstrated by tests that engine operation and vibratory levels are not affected.

Explanation: This proposal would incorporate a rule similar to § 25.934 to establish the engine/reverser compatibility testing requirements for thrust reversing systems on turbojet and turbofan engines.

Conference proposal 321 recommended the adoption of the testing requirements of § 33.97 of this chapter because § 23.933 contains installation design requirements for thrust reverser systems but no engine/reverser test compatibility requirements. This proposal would not require any additional testing for those systems type certificated as part of the engine.

At the conference, one commenter opposed requiring a 150-hour block test with a thrust reverser installed on an engine because it is expensive and serves no technical purpose. This commenter agreed that it is important to investigate any asymmetric effects the reverser may have on the engine and to ensure the compatibility of the reverse/engine combination. The commenter opposed any reference to thrust reverse testing requirements.

Another commenter stated that until the conference proposal appeared, it was assumed that § 33.97 was applicable to part 23 airplanes since there is nothing limiting the requirement to part 25 airplanes. This commenter stated that if § 33.97 is not applicable to part 23 airplanes, the FAA should clarify the applicability. Another commenter stated that endurance testing of a thrust reverser on its intended provided valuable answers. Since most fan thrust reversers are asymmetric, the effect on the engine should be investigated. In addition to inlet distortion, there is also an exhaust distortion so it is important to retain the test for the lessons learned from the thrust reverser and from the engine.

The FAA has further studied this issue and does not agree that there is an additional expense to the public imposed by this proposal because these same requirements have been imposed for add-on and retrofit reverser systems for many years. FAA policy is to forego the extra 150-hour test. When a thrust reverser is added or retrofitted, the reverser installation must demonstrate that the engine operation and vibratory levels are not affected. Sufficient test instrumentation is required to provide substantiating data that the operation and vibratory characteristics of the engine are not adversely affected.

The reverser test requirements of § 33.97 have been part of the FAR for twenty years, whereas this proposal is directed primarily at retrofit systems. The FAA has determined that the test requirements proposed are approriate for those engine/reverser combinations not yet tested.

Reference: Conference proposal 321.

16. Section 23.937 is amended by designating the current text as paragraph (a) and adding a new paragraph (b) to read as follows:

§ 23.937 Turbopropeller-drag limiting systems.

* * * * *

(b) As used in this section, drag limiting systems include manual or automatic devices that, when actuated after engine power loss, can move the propeller blades toward the feather position to reduce windmilling drag to a safe level.

Explanation. This proposal adds a definition of drag limiting systems, as recommended by conference proposal 322, to clarify their function. The consensus of the conference discussion supported clarification of the requirements.

Reference: Conference proposal 322.

§ 23.943 [Amended]

17. Section 23.943 is amended by removing the words "expected for the acceleration" and replacing them with "of acceleration expected in service".

Explanation: This change would clarify the requirement. Conference proposal 325 recommended adding interpretive material. Conference consensus was that the recommendation is not regulatory in nature and should not be included in the rules.

Conference proposal 326 recommended the insertion of the phrase "in service" to avoid a rule interpretation requiring negative acceleration tests for extended durations on those airplanes not expected to experience long term negative accelerations in service. Conference discussion supported this recommendation. In all cases, it has been FAA practice to ensure, during type certification, that no hazardous malfunction occurs at the negative acceleration levels and for the durations expected in service. Therefore, the FAA concludes that adding the clarifying words "in service" are appropriate.

Reference: Conference proposals 325 and 326.

18. Section 23.951 is amended by revising paragraph (a) to read as follows:

§ 23.951 General.

(a) Each fuel system must be constructed and arranged to ensure fuel flow at a rate and pressure established for proper engine and auxiliary power unit functioning under each likely operating condition, including any maneuver for which certification is requested and during which the engine or auxiliary power unit is permitted to be in operation.

* * * * *

Explanation: This proposal would amend the general fuel system rules to make them applicable to auxiliary power unit fuel systems.

Conference proposal 327, and several other conference proposals to be addressed later, recommend identifying the specific requirements applicable to the installation of auxiliary power units in small airplanes.

Conference discussion concentrated on APUs intended for inflight use, ground use only, and unattended ground use. Conferees discussed the merits of having different levels of requirements based on the various uses. The FAA has further reviewed these issues and concludes the new APU requirements should be stated objectively; thereby allowing the applicant to select the phases of operation for which approval is desired.

Reference: Conference proposal 327.

§ 23.953 [Amended]

19. Section 23.953 is amended by removing the word "drain" and inserting in its place the word "escape", and by adding the phrase "after valve shutoff" at the end of the last sentence of paragraph (b)(1).

Explanation: This proposal clarifies the intent of paragraph (b)(1). The purpose of this rule is to limit fuel loss into the engine compartment due to failure or damage of any fuel system component downstream from the firewall shutoff valve or other valve providing that function. The word "drain" used in other sections of this part denotes a discharge of fluids under controlled conditions, even through that control may be limited to draining overboard. This rule addresses an uncontrolled release of fuel into an area of possible ignition source and the word "escape" more appropriately defines the objective.

Reference: This proposal resulted from recent questions regarding the interpretation of this rule.

20. Section 23.955 is amended by removing the word "carburetor" and inserting in its place the word "engine" in paragraph (a); by inserting the words "or its" before the word "bypass" in paragraph (a)(2); by adding new paragraphs (a)(3), (a)(4) and (f)(3); and by revising paragraphs (c) introductory

text, (c)(1), (c)(3), (d)(2), (e), and (f)(2) to read as follows:

§ 23.955 Fuel flow.

(a) * * *

(3) If there is a flowmeter without a bypass, it must not have any failure mode that would restrict fuel flow below the level required in this fuel flow demonstration; and

(4) The fuel flow must include that flow needed for vapor return flow, jet pump drive flow, and for all other purposes for which fuel is used.

* * * * *

(c) *Pump systems.* The fuel flow rate for each pump system (main and reserve supply) for each reciprocating engine must be 125 percent of the fuel flow required by the engine at the maximum takeoff power approved under this part.

(1) This flow rate is required for each main pump and each emergency pump, and must be available when the pump is operating as it would during takeoff;

* * * * *

(3) The fuel pressure, with main and emergency pumps operating simultaneously, must not exceed the fuel inlet pressure limits of the engine.

(d) * * *

(2) If there is a placard providing operating instructions, a lesser flow rate may be used for transferring fuel from any auxiliary tank into a larger main tank. This lesser flow rate must be adequate to maintain engine cruise power but the flow rate must not overfill the main tank at lower engine powers.

(e) *Multiple fuel tanks.* For reciprocating engines that are supplied fuel from more than one tank, if engine power loss becomes apparent due to fuel depletion from the tank selected, it must be possible after switching to any full tank, in level flight, to obtain 75 percent maximum continuous power on that engine in not more than—

(1) 10 seconds for naturally aspirated single-engine airplanes;

(2) 20 seconds for turbocharged single-engine airplanes, provided that 75 percent maximum continuous naturally aspirated power is regained within 10 seconds; or

(3) 20 seconds for multiengine airplanes.

(f) * * *

(2) For multiengine airplanes, notwithstanding the lower flow rate allowed by paragraph (d) of this section, be automatically uninterrupted with respect to any engine until all the fuel scheduled for use by that engine has been consumed. In addition—

(i) For the purposes of this section, "fuel scheduled for use by that engine" means all fuel in any tank intended for use by a specific engine.

(ii) The fuel system design must clearly indicate the engine for which fuel in any tank is scheduled.

(iii) Compliance with this paragraph must require no pilot action after completion of the engine starting phase of operations.

(3) For single-engine airplanes, compliance with this paragraph must require no pilot action after completion of the engine starting phase of operations unless means are provided that unmistakenly alert the pilot to take any needed action at least five minutes prior to the needed action; such pilot action must not cause any change in engine operation; and such pilot action must not distract pilot attention from essential flight duties during any phase of operations for which the airplane is approved.

Explanation: This proposal clarifies the requirements and incorporates changes relative to single-engine, turbine-powered fuel systems that will allow inflight fuel management, will ensure uniterrupted fuel to the engine until all useable fuel has been consumed, and will provide for cross-flow prevention between interconnected tanks when the airplane is not being operated.

Conference proposal 329 recommends revising paragraph (a) to simplify fuel system testing for airplanes of less than 1500 pounds maximum weight. A conference commenter objected to compromising fuel system validation for any size airplane. The FAA agrees and proposes no further consideration of proposal 329.

Conference proposal 330 recommended revising paragraph (a) by replacing the word "carburetor" with the word "engine" to expand the applicability of this paragraph to all types of powerplant installations as intended under the "general" heading. At the conference, no comments were offered. The FAA concurs with this recommendation and proposes amending paragraph (a) accordingly.

Conference proposal 331 recommended revising paragraph (a)(2) by adding the following, explanatory sentence to the existing rule concerning fuel flow through the flowmeter bypass during the flow test: "If the flowmeter does not have a bypass, it should be modified to simulate a probable malfunction that would restrict fuel flow." The justification was that § 23.1337(c) allows the option of a flowmeter that does not incorporate a bypass, if malfunctions do not severely limit fuel flow. At the conference, no comments were offered. The FAA has further reviewed this issue and has concluded that clarification is necessary. Many flowmeters without a separate bypass are capable of allowing the required fuel flow through the fuel flow sensing element even when the element is blocked. Therefore, the FAA is proposing clarifying wording in paragraph (a)(2).

Conference proposal 332 recommended revising paragraph (b) by replacing the phrase "consumption of the engine" with the phrase "flow required by the engine". The justification given was that fuel injected reciprocating engines may return a substantial amount of fuel to the tanks under normal operating conditions. A system based merely on the fuel "consumed" by the engine would be inadequate to meet the combined consumption and return flow demands. At the conference, no comments were offered. The FAA has considered this issue and concluded that the fuel flow requirements should include all flow passing through the system to the engine compartment. Therefore, the FAA is proposing clarifying wording in paragraph (b).

Conference proposal 333 recommended revising paragraph (c) by removing that portion of the paragraph stating "* * * takeoff fuel flow of the engine at the maximum power approved for takeoff under Part 33 of this chapter or lesser power selected and approved for takeoff under this part" and inserting a new portion stating, "* * * fuel flow required by the engine at the maximum takeoff power selected and approved for takeoff under this part." The justification given was that reciprocating engine maximum fuel flows under installed conditions may be higher than those approved for takeoff under part 33 due to engine cooling requirements. The justification also considered this recommended revision to incorporate the intent of SFAR 23.46(b). At the conference, the proponent of conference proposal 333 was asked to clarify how the proposal would account for the fuel flow that is returned to the tanks and is not consumed by the engine. The proponent stated that the intent of the conference proposal was to address the limitation in the current rule; i.e., the proposal addresses fuel flow in terms of takeoff fuel flow for the engine. The proponent further stated that the purpose was to expand the rule to cover systems that have off-takes for jet pumps and to assure that the fuel pump flow requirement would be 125 percent of the fuel flow needed by the engine installation.

Conference proposal 334 recommended revising paragraph (c) by inserting between the second use of the word "engine" and the word "at", the phrase "plus any fuel returned to the tanks as vapor return flow"; by replacing the phrase "under part 33 of this chapter" with the phrase "during type certification of the engine"; and by adding a new paragraph (3) to read, "The fuel pressure with main and emergency pumps operating simultaneously may not exceed the engine limits for fuel inlet pressure." The justification given was that this rule needs to be expanded to include the vapor return flow in the fuel flow tests for fuel metering devices having return flow systems. The justification further recommended the rule require an investigation to assure maximum fuel pressures are not exceeded when the main and emergency pumps are operated at the same time.

When conference proposal 334 was presented at the conference, one commenter opposed the change to paragraph (c) in preference to conference proposal 333. The commenter considered that the term "fuel flow required" in conference proposal 333 covered all the requirments; e.g., the fuel flow required into the engine compartment for all the purposes associated with operating the engine.

The FAA has further reviewed the issues raised by conference proposals 333 and 334 and is proposing paragraph (a)(4) to define the term "fuel flow required" in order to clarify the intent of all paragraphs of this section.

Conference proposal 335 recommended revising paragraph (d)(2) by deleting the words "small" and "large" and revising the last part to read, "* * * if there is a suitable placard that provides fuel transfer procedures to prevent fuel starvation and overfilling the main tank(s)." The justification was that there are always questions as to the relative size of the "small" auxiliary tank and the "large" main tank. Also, the placard requirement should consider not opening the valve to the auxiliary inadvertently. At the conference, the only commenter agreed with the proposed change.

Conference proposal 336 recommended revising paragraph (d)(2) to read: "If there is a suitable placard providing appropriate operating instructions, a lesser flow rate may be used for a small auxiliary tank feeding into a large main tank." The justification given was that the currently required placard (operating limitation) would prohibit the pilot from opening the auxiliary tank to main tank ports if the main tank was below a predetermined amount. At the conference, the proponent requested the proposal be modified by deleting the word "small".

The FAA has further reviewed the issues raised by conference proposals 335 and 336 and has concluded that the use of the terms "small" and "large" was originally intended to establish the relative sizes of the affected auxiliary and main tanks where a reduced flow rate is allowed. The FAA is proposing to revise the rule to clarify and simplify it while retaining the relationship of tank sizes and functions.

Conference proposal 337 recommended revising paragraph (e) by replacing the term "engine malfunctioning" with the term "engine power loss". At the conference, one commenter questioned requiring the return to full fuel pressure when full power possibly could be obtained without full fuel pressure. Another commenter asked the definition of "power loss".

Conference proposal 338 recommended revising paragraph (e) to allow more time to regain full power for turbocharged engines, as follows: "10 seconds for naturally aspirated engines; 20 seconds for turbocharged, single-engine airplanes, provided naturally aspirated power is regained in 10 seconds; and * * *." The justification given was that during testing of a turbocharged, single-engine-powered airplane, it was found that an engine power recovery of over 10 seconds was experienced due to the time required for the turbocharger to regain normal speed. Therefore, § 23.955(e) should be revised to account for turbocharger boost recovery lag and to introduce a requirement that full nonsupercharged power be regained in 10 seconds for such engines. At the conference, one commenter stated that the additional 10 seconds requested came from the experience that more time is needed to get the turbocharger up to speed. This is a characteristic of the turbocharged engine.

Another commenter wanted to confirm that 10-second allowances were not cumulative; i.e., 10 seconds allowed for a naturally aspirated engine plus 10 seconds for the turbocharger plus 10 seconds for multiple engines. Further, this commenter stated that the rule should apply when engine power is actually lost, airplane yaw is felt, or the decay of power is heard rather than when a gauge indicates a power loss.

Another commenter recommended that the rule should say 10 seconds for the restoration of normal operation rather than restoration to "full" power. This commenter also stated the real concern is that the engine is smoothly regaining power.

The FAA has reviewed these issues and the applicable rules. Since "full" power depends on a number of variables, the FAA proposes to require ability to regain 75 percent maximum continuous power on the affected engine in 10 to 20 seconds, as appropriate. This value of power is used for many certification requirements in part 23. Although it may appear to relax the requirements, the intended level of safety will be maintained. The intent of this rule is to impose a maximum limit on the time needed to regain power after a power loss due to fuel starvation brought on by inadvertently running the selected tank dry.

This proposed revision of paragraph (e) will also allow additional time for turbocharged engines to regain power and will clarify when the 10-second allowances are cumulative for single-engine, turbocharged engines and when the allowances are not cumulative for multiengine airplanes.

There was no conference proposal to revise paragraph (f)(2); however, since the conference, compliance with the current requirements in turbine-powered, single-engine airplanes has resulted in unacceptable operational characteristics. The current requirement that flow of all fuel scheduled for use by an engine be automatically uninterrupted mandates that on single-engine airplanes all fuel must be available to the engine without any pilot action to manage fuel after engine start. This precludes using the normally installed tank valves to prevent cross-flow of gasoline between sides of the airplane while parked and to balance fuel between wings during flight. The intent of paragraph (f)(2) is to assure that all the usable turbine fuel aboard the airplane will find its way to the engine(s) without further attention from the pilot once the fuel is turned on and the engine(s) is started. This intent must be matched by a reasonable balance between the need to transfer fuel among wing tanks during flight and the need to prevent fuel in partially filled tanks from transferring to one side of the airplane while parked, which could result in subsequent unsafe flight. A new paragraph (f)(3) is proposed to define single-engine and tubine-powered airplane fuel flow requirements.

Reference: Conference proposals 329, 330, 331, 332, 333, 334, 335, 336, 337, and 338.

21. Section 23.957 is amended by designating the current paragraph as "(a)"; and by adding a new paragraph (b) to read as follows:

§ 23.957 Flow between interconnected tanks.

* * * * *

(b) If fuel can be pumped from one tank to another in flight, the fuel tank vents and the fuel transfer system must be designed so that no structural damage to any airplane component can occur because of overfilling of any tank.

Explanation: This proposal incorporates a limitation on fuel transfer to prevent damage to the airplane due to overpressurizing any fuel tank.

Conference proposal 339 addresses this issue. The justification given was that the rules do not include provisions to prevent structural or fuel tank damage that could occur when transferring fuel between tanks. At the conference, no comments were submitted. The FAA is proposing to require that fuel transfer systems that can pump fuel from one tank to another be designed so that they cannot cause damage to tanks or other airplane components.

Reference: Conference proposal 339.

22. Section 23.961 is revised to read as follows:

§ 23.961 Fuel system hot weather operation.

Each fuel system must be free from vapor lock when using fuel heated to 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, the initial temperature must be 100 °F, −0°, +5 °F or the maximum outside air temperature for which approval is requested, whichever is more critical.

Explanation: This proposal clarifies the intent of this rule and expands the rule to include fuels of different volatility levels.

Conference proposal 340 recommended replacing the existing § 23.961 rule with the language of § 25.961. The justification given was that the existing rule is totally deficient concerning what is required to show compliance. Also, there is always a question regarding the definition of a fuel system conducive to vapor formation. At the conference, a commenter recommended that these tests be conducted with the highest volatility fuel in the airplane.

Another commenter recommended that if the proposal is going to require "the fuel temperature must be at least 110°F", after the climb to altitude, the fuel temperature will be lower; therefore, the work "initially" should be inserted.

Another commenter requested that the record show what is deficient with the present rule. The present rule does not specify the fuel octane, the vapor pressure, the actual climb conditions, or fuel temperature degradation allowed during climb.

Conference proposal 341 recommended revising § 23.961 by removing the article "a" and replacing it with the words "an initial". The justification given was that this change will provide a realistic condition for initiation of the hot fuel test and reflects the language developed for (nonadopted) § 24.961(a)(5). At the conference, a commenter stated that the fuel should be at an initial temperature of 110°F, and this conference proposal reflects what has been a successful certification practice. Another commenter stated a preference for the previous conference proposal with the provision that the "initial temperature" is inserted into paragraph (a)(5).

Conference proposal 342 recommended revising § 23.961 to read:

"(a) No fuel system shall be conducive to vapor formation. Where fuel lines pass in close proximity to heated areas, adequate shielding or insulation shall be used to prevent unnecessary transfer of heat energy to the fuel while the airplane is in operation.

"(b) Each fuel system shall be capable of sustained vapor-free operation at the maximum altitude for which certification is sought, using fuel with a Reid Vapor Pressure of 15.0 psi, under standard day conditions, with the auxiliary fuel pump (if any) on."

The justification given was that the present regulation is weak in that it does not specify Reid vapor pressure of the fuel, it allows fuel systems to be conducive to vapor formation, and makes no demands that fuel lines be minimally protected from heat. Further, the present requirement for a vapor test using fuel heated to 110°F is poor in that preheated fuel has a lower vapor potential than cold fuel that is fed to a heated engine compartment. Present test requirements are thus ambiguous and even self-defeating.

At the conference, the consensus objected to this conference proposal because the proposed language would be very difficult to administer.

Post conference review of these comments and other technical data led the FAA to develop the present proposal. The current rule has been in use for many years and the intent is understood by the affected aviation community, but only aviation gasoline was used. The main question on current systems concerns the higher volatility (lower initial boiling point) of other fuels such as automobile fuel (autogas) and turbine fuels. Heating autogas to 110°F may change the composition of the fuel considerably. This proposal requires that the fuel be heated to its critical temperature with respect to vapor formation.

The recommendation that the rule be changed to allow an initial temperature of 110°F, and then accepting a temperature degradation during the climb test, was incorporated.

Reference: Conference proposals 340, 341, and 342.

§ 23.963 [Amended]

23. Section 23.963 is amended by removing paragraph (f).

Explanation: This proposal deletes paragraph (f) from § 23.963 since this requirement, which is applicable to only commuter airplanes, is very similar to the requirements in paragraph (e) of § 23.967, which are applicable to all part 23 airplanes. Paragraph (f) was added to part 23 by amendment 23–34 with the other commuter category requirements incorporated into part 23. These commuter category requirements were developed from Special Federal Aviation Regulation (SFAR) No. 23, 41 and appendix A of part 135, which contained interim airworthiness standards for propeller-driven, multiengine airplanes. These interim airworthiness standards were integrated into part 23 without proposed substantive changes to the existing part 23 airworthiness standards.

24. Section 23.965 is amended by revising paragraph (b) to read as follows:

§ 23.965 Fuel tank tests.

* * * * *

(b) Each fuel tank with large, unsupported, or unstiffened flat surfaces, whose failure or deformation could cause fuel leakage, must be able to withstand the following test without leakage, failure, or excessive deformation of the tank walls:

(1) Each complete tank assembly and its support must be vibration tested while mounted to simulate the actual installation.

(2) Except as specified in paragraph (b)(4) of this section, the tank assembly must be vibrated for 25 hours at a total displacement of not less than 1/32 of an inch (unless another displacement is substantiated) while 2/3 filled with water or other suitable test fluid.

(3) The test frequency of vibration must be as follows:

(i) If no frequency of vibration resulting from any rpm within the normal operating range of engine or propeller speeds is critical, the test frequency of vibration in the number of cycles per minute is obtained by multiplying the maximum continuous propeller speed in rpm by 0.9 for propeller-driven airplanes, and for non-propeller driven airplanes, 2,000 cycles per minute.

(ii) If only one frequency of vibration resulting from any rpm within the normal operating range of engine or propeller speeds is critical, that frequency of vibration must be the test frequency.

(iii) If more than one frequency of vibration resulting from any rpm within the normal operating range of engine or propeller speeds is critical, the most critical of these frequencies must be the test frequency.

* * * * *

Explanation: This proposal clarifies that the amplitude of vibration means total displacement and amends the rule to better relate the vibration test frequency to the propulsion means. Further, the paragraph (b) lead-in is clarified.

Conference proposal 342 recommended revising paragraph (b) to clarify the intent of the phrase "large unsupported or unstiffened areas".

At the conference, there was not a clear consensus in the comments of the participants that indicated a problem with the current rule. A commenter observed that all tanks are tested during certification regardless of the lack of clarity relative to what is meant by "large, unsupported, or unstiffened areas." Another commenter observed that "total displacement" was not clear due to the rule specifying "an amplitude."

Conference proposal 344 recommended revising paragraph (b)(3)(i) to better relate the vibration frequency to the propulsion means. The justification given was that the frequency required by paragraph (b)(3)(i) is dependent upon engine speed. This restricts fuel tank certification to a particular engine. Further, the required 90 percent of maximum continuous rpm is unrealistic for turbine engines. At the conference, the intent of the proposal was supported but it was recommended that the proposal be clarified due to differences in turbojet and turboprop means of propulsion. The current rules originated with reciprocating engines and have not been amended to reflect installations of turboprop or turbojet engines in small airplanes. During the discussion, it was suggested that the rule be amended to have separate requirements for propeller-driven and nonpropeller-driven airplanes. The FAA agrees and paragraph (b)(3)(i) is proposed accordingly.

Conference proposal 345 recommended revising paragraph (d) for clarity. The conference discussion did not support the recommended rewording.

The FAA has further reviewed the issues raised in proposal 345 and has concluded that the term "amplitude" for vibration tests needs to be clarified; that the term "flat areas" in paragraph (b) should be changed to "flat surfaces"; and that paragraph (b)(3) should be amended to better relate vibration test frequencies to the airplane's propulsion means. In this regard, the FAA is proposing that the critical test frequency survey include the normal operating range of engine and propeller speeds as appropriate. Where no such critical speed is found for propeller-driven airplanes, the vibration test frequency is proposed to be the maximum continuous propeller speed (rpm) multiplied by 0.9; and for non-propeller-driven airplanes, a fixed test frequency of 2,000 cycles per minute is proposed. This fixed test frequencey for non-propeller-driven airplanes is selected because that frequency has been used successfully for the transport category airplanes certificated to part 25. The use of the propeller speed rather than engine speed for propeller-driven airplanes is proposed because the propeller speeds are considered to be more representative of the airplane vibration environment.

Conference proposal 346 recommended deleting certain paragraphs of § 23.965 for airplanes of not more than 1500 pounds. Conference commenters objected to revising this rule based on airplane weight. The FAA plans no further action on this proposal.

Reference: Conference proposals 343, 344, 345, and 346.

25. Section 23.967 is amended by revising paragraph (d) to read as follows:

§ 23.967 Fuel tank installation.

* * * * *

(d) Each fuel tank must be isolated from personnel compartments by a fume-proof and fuel-proof enclosure that is vented and drained to the exterior of the airplane. The required enclosure must sustain any personnel compartment pressurization loads without permanent deformation or failure under the conditions of §§ 23.365 and 23.843 of this part. A bladder-type fuel cell, if used, must have a retaining shell at least equivalent to a metal fuel tank in structural integrity.

* * * * *

Explanation: This proposal permits the installation of fuel tanks in the fuselage of airplanes within certain limitations and it deletes the restriction against fuel tanks in the personnel compartments of multiengine airplanes.

Conference proposal 347 recommended revising paragraph (d) essentially as proposed. The justification given was that the current rule prohibits the installation of a fuel tank in the personnel compartment of multiengine airplanes and that there should be no distinction whether the installation is in a single or multiengine airplane. When the fuel tank is installed in pressurized personnel compartments, the pressurization loads must be considered for the enclosure.

The conference consensus supported the change. The FAA concludes that this change would not adversely affect safety and would relieve a regulatory burden on the public.

Reference: Conference proposal 347.

26. Section 23.971 is revised to read as follows:

§ 23.971 Fuel tank sump.

(a) Each fuel tank must have a drainable sump with an effective capacity, in the normal ground and flight attitudes, of 0.25 percent of the tank capacity, or 1/16 gallon, whichever is greater.

(b) Each fuel tank must allow drainage of any hazardous quantity of water from any part of the tank to its sump with the airplane in the normal ground attitude.

(c) Each reciprocating engine fuel system must have a sediment bowl or chamber that is accessible for drainage; has a capacity of 1 ounce for every 20 gallons of fuel tank capacity; and each fuel tank outlet is located so that, in the normal flight attitude, water will drain from all parts of the tank except the sump to the sediment bowl or chamber.

(d) Each sump, sediment bowl, and sediment chamber drain required by paragraphs (a), (b), and (c) of this section must comply with the drain provisions of § 23.999(b)(1) and (b)(2).

Explanation: The proposal would require both fuel tank sumps and sediment bowl/chambers for reciprocating engine fuel systems. The proposal also requires that hazardous quantities of water must be allowed to drain to a sump with the airplane in the normal ground attitude. Service experience has shown that reciprocating engine airplane fuel systems are susceptible to water collecting in the fuel tanks. Existing rules allow either tank sumps or a sediment bowl/chamber arrangement that does not always prevent this water from reaching the engine, especially in tanks with flexible liners. Otherwise, there are no changes proposed for turbine engine fuel systems.

Reference: None.

27. Section 23.973 is amended in paragraph (c) by adding to the end of the second sentence the phrase "provided such openings comply with the requirements of § 23.975(a) of this part"; and by adding new paragraphs (e) and (f) to read as follows:

§ 23.973 Fuel tank filler connection.

* * * * *

(e) For airplanes with engines requiring gasoline as the only permissible fuel, the inside diameter of the fuel filler opening must be no larger than 2.36 inches.

(f) For airplanes with turbine engines, and not equipped with pressure fueling provisions, the inside diameter of the fuel filler opening must be no smaller than 2.95 inches.

Explanation: This proposal clarifies the requirements for vented fuel filler caps and establishes fuel filler opening dimensions as an aid in preventing misfueling; i.e., the refueling of a reciprocating-engine airplane with turbine-engine fuel.

Conference proposal 348 recommended revising § 23.973(c) by adding the phrase essentially as proposed. The justification was that more detailed requirements for vented tank filler caps are needed and that those details are contained in § 23.975(a). At the conference, the only commenter agreed with the proposal.

Conference proposal 349 recommended deleting the requirements of § 23.973(d) for airplanes of less than 1500 pounds. After some discussion at the conference, the sponsor withdrew the proposal; therefore, the FAA plans no further action on this proposal.

Conference proposal 350 recommended revising § 23.973 by adding new paragraphs (e) and (f) essentially as proposed. The justification given was that providing fuel filler opening dimensional restrictions will be useful in preventing turbine fuel from being put into tanks of airplanes with engines that operate only on gasoline. At the conference, the consensus supported the proposal.

The airplane fuel filler kits currently being supplied by the airplane manufacturers are in accordance with proposed paragraph (e) and (f). Considerable effort has gone into establishing these dimensions and obtaining the cooperation of the airplane manufacturers, the fuel suppliers, and the cognizant industry associations. Current production airplanes of the major manufacturers already comply with these proposed dimensions. The FAA believes that specifying these opening sizes will help reduce the number of misfueling occurrences and, therefore, has included them in this proposal.

Reference: Conference proposals 348, 349, and 350.

§ 23.975 [Amended]

28. Section 23.975 is amended in paragraph (a) introductory text by removing the phrase "of the expansion space" and inserting in its place the phrase "of the fuel tank"; and in paragraph (a)(5) by replacing the semicolon with a period and adding a new sentence "Any drain valves installed in the vent lines must meet the applicable requirements of § 23.999 "; at the end of the paragraph.

Explanation: This proposal clarifies the rules on fuel tank vent line termination points and specifies the requirements applicable to vent line drains.

Conference proposal 351 recommended revising paragraph (a) essentially as presented in this proposal. The justification given was that § 23.969, Fuel tank expansion space, does not always require an expansion space. Current paragraph (a) states that the fuel tank must be vented from the top of the expansion space. At the conference, a commenter supported the proposal.

Conference proposal 352 recommended a revision to § 23.975(b), which essentially was incorporated by amendment 23-29. The FAA plans no further action on this proposal.

Conference proposal 353 recommended revising paragraph (a)(5) by adding a vent drain valve provision essentially as proposed. The justification was that § 23.975(a)(5) states "* * * there may be no undrainable points in any vent line * * *" and is not clear as to its intent; it could mean the vent line must slope downward all the way from the top of the tank to the vent outlet. During the conference, one commenter objected to the part of the proposal that adds the drain valve requirements of § 23.999 to vent line drains because parts of § 23.999 are inappropriate. The commenter further contended that vent drains did not need to "discharge clear of all parts of the airplane," just to get a little water out, and that because there are distinct differences between fuel system drains and vent line drains, that should be considered in administering the rules. Another commenter stated that if there is a problem with the wording "applicable requirements of § 23.999", it should be clarified. The proposal is intended to prevent drains from discharging inside the airplane.

The FAA has further considered these issues and has concluded that fuel tank vent drains operate in much the same environment as fuel tank drains in that vent lines frequently contain fuel in addition to the water that may condense in them. The vent drains permit the drainage of whatever fluids that have collected at any low points. The fuel tank drains permit the drainage of whatever fluids that have collected at their locations. The FAA, therefore, finds no reason to allow a lower quality drain system for vent line drains than for fuel tank drains.

Conference proposal 354 recommended adding some interpretive material to § 23.975(a)(6). After a short discussion at the conference, the sponsor withdrew the proposal.

Conference proposal 355 recommended a revision to § 23.975(b), which essentially was incorporated by amendment 23–29. After a short discussion, the sponsor withdrew the proposal.

Reference: Conference proposals 351, 352, 353, 354, and 355.

§ 23.977 [Amended]

29. Section 23.977 is amended in paragraph (d) by removing the word "finger".

Explanation: This proposal would require all strainers, not only "finger" strainers, to be accessible for inspection and cleaning.

Conference proposal 356 recommended the removal of the word "finger" from § 23.997(d). The rule currently specifies only fuel tank finger strainers are to be accessible for inspection and cleaning; however, all fuel strainers are subject to contamination and should be accessible for inspection and cleaning. At the conference, only one comment was offered, which agreed with the proposal.

Reference: Conference proposal 356.

§ 23.991 [Amended]

30. Section 23.991 is amended in paragraph (c) by removing the word "normal" and inserting in its place the word "main".

Explanation: This proposal would standardize fuel pump terminology, as defined in § 23.991(a).

Conference proposal 357 recommended adding interpretive material to § 23.991(a)(1), after a short discussion at the conference, the sponsor withdrew the proposal.

Conference proposals 358 and 359 recommended rearranging § 23.991(a) to match § 25.991(a). After a short discussion at the conference, the proposal was withdrawn as inappropriate to Part 23 airplanes.

Reference: Conference proposals 357, 358, and 359.

§ 23.993 [Amended]

31. Section 23.993 is amended in paragraph (d) by removing the words "must be approved or".

Explanation: This proposal deletes inappropriate terminology; all components that are acceptable for installation on a certificated airplane must be approved. In this case, the fuel hoses could be "approved" through the Technical Standard Order system but still not be suitable to the environment of a particular installation; therefore, the subject phase should be deleted.

Reference: None.

§ 23.995 [Amended]

32. Section 23.995 is amended in paragraph (f) by removing the word "check".

Explanation: This proposal would require all valves, not only check valves, to incorporate provisions to preclude incorrect assembly or connection and a resultant unsafe condition.

Conference proposal 363 recommended deleting the word "check" from § 23.995(f). The justification given was that incorrect assembly and connection of fuel selector valves and other fuel valves result in unsafe conditions. The current rule applies only to check valves. One commenter at the conference disagreed with the proposal stating that the current rule addressing check valves is appropriate but is not necessary for all valves. The commenter further stated that a large quantity of fuel valves that have been in production for 25 years do not have such a provision and have not caused any problem because if it is installed improperly, the engine cannot start and an engine that won't start cannot injure anyone.

The FAA further considered these issues and concluded that improper assembly or connection of fuel valves would not necessarily preclude an engine from starting. Improper assembly or connection could cause engine stoppage in flight. Therefore, the FAA concludes that all fuel valves should comply with the proposed requirements of paragraph (f).

Conference proposal 360 recommended relaxing the requirement of § 23.995(d) for airplanes of not more than 1500 pounds to allow gravity or vibration to cause fuel valves to move toward the open position. The consensus of conference commenters was opposed to the proposal. The FAA agrees with the commenters and plans no further action on this proposal.

Conference proposal 361 recommended adding interpretive material to § 23.995 (e) and (f) for airplanes of not more than 1500 pounds. Prior to any discussion, the sponsor withdrew this proposal as inappropriate material.

Conference proposal 362 recommended revising § 23.995 to prevent the inadvertent movement of fuel control valves to the "off" position. The proposal was withdrawn without discussion after the FAA pointed out that the requirement had been incorporated in amendment 23–29.

Reference: Conference proposal 360, 361, 362, and 363.

§ 23.997 [Amended]

33. Section 23.997 is amended in paragraph (d) by removing the phrase "in part 33 of this chapter" and inserting in its place the phrase "during its type certification".

Explanation: This proposal clarifies the intent of the rule.

Conference proposals 364 and 365 recommended revising § 23.997(d) essentially as proposed. The justification given was that engines are also certificated under CAR part 13. The current rule references only part 33 of the FAR. When presented for comment at the conference, the only commenter supported the proposal. Engines certificated to the provisions of CAR part 13 continue to be manufactured and may be incorporated into new airplane designs. Therefore, the FAA concludes this change to be clarifying and necessary.

Reference: Conference proposal 364 and 365.

34. Section 23.999 is amended by removing paragraph (b)(3) in its entirety and by revising paragraph (b)(2) to read as follows:

§ 23.999 Fuel system drains.

* * * * *

(b) * * *

(2) Have a drain valve—

(i) That has manual or automatic means for positive locking in the closed position;

(ii) That is readily accessible;

(iii) That can be easily opened and closed;

(iv) That allows the fuel to be caught for examination;

(v) That can be observed for proper closing; and

(vi) That is either located or protected to prevent fuel spillage in the event of a landing with landing gear retracted.

Explanation: This proposal clarifies that fuel system's drains must have drain valves and adds the requirements that the valve operator must be able to catch the fuel and must be able to observe the valve for proper closing without excessive effort.

Conference proposal 366 recommended revising § 23.999(b)(2) essentially as proposed. The justification given was that many airplane manufacturers have installed remotely operated fuel drains; however, these installations do not permit ready examination of the drained fuel, or a determination that the valve was closed after draining.

In the past few years, the trend has been to install the fuel drain operating provisions in the cockpit. When that is done, it is difficult for the pilot to observe that the drain has indeed drained properly, that it has stopped when the pilot places the control in the closed position, and that no fuel continues to drip from the drain valve. To ensure there is positive closure of the drain valve, the pilot must get out of the airplane to make that observation. Fuel that falls freely to the ground without being caught cannot be adequately examined by the pilot for water or other contaminants. Therefore, a requirement has been added to ensure the pilot can catch the draining fuel to examine it for impurities.

Reference: Conference proposal 366.

§ 23.1001 [Amended]

35. Section 23.1001 is amended in paragraph (f) by removing the word "personnel" and inserting in its place the word "crewmembers".

Explanation: This proposal will standardize the terminology used. In all other instances in part 23 (11 places) the term "crewmembers" is used.

Reference: A question has been raised if "flight personnel" and "flight crewmembers" mean the same. The FAA stated that the terms mean the same people are involved.

36. Section 23.1011 is amended by redesignating paragraphs (a), (b), (c), and (d) as (b), (c), (d), and (e), respectively; and by adding a new paragraph (a) to read as follows:

§ 23.1011 General.

(a) For oil systems and components that have been approved under the engine airworthiness requirements and where those requirements are equal to or more severe than the corresponding requirements of subpart E of this part, that approval need not be duplicated. Where the requirements of subpart E are more severe, substantiation must be shown to the requirements of subpart E.

* * * * *

Explanation: This proposal adds a new paragraph to allow oil systems and components properly approved during engine type certification to be accepted without further substantiation when the standards previously met were equal or more severe than those in this subpart. This proposal is needed to clarify that those oil systems approved through other means, to equal or more severe requirements, need not be reapproved under the oil system requirements of this part. This proposal evolved from the conference discussion of three different proposals and post conference investigations.

Conference proposal 367 recommended adding a new phrase, "if an oil system is needed" at the beginning of current paragraph (a). The justification was that this addition would allow the installation of two-stroke-cycle reciprocating engines for which an airframe-installed oil system is not necessary. The FAA has further reviewed the cited paragraph (redesignated as paragraph (b)) and has concluded that this rule includes two-stroke-cycle engine oil systems and any other configuration of engine oil systems. The oil may be injected into the engine or mixed with the fuel. These systems have been approved as meeting these requirements so a two-cycle engine would not be excluded based on the current § 23.1011.

Conference proposal 368 recommended adding the wording "which is not part of a type certificated engine" after the opening words "each oil tank" of § 23.1013(a) Installation. The justification given was that this addition would clarify that the rule only applied to engine oil tanks installed by the airframe manufacturer. During the discussion at the conference, one proponent stated that this recommendation is intended to permit the airframe manufacturer and the FAA to accept the engine type certification in those cases where the oil tank was indeed included as part of the engine. Proposed paragraph (a) will allow the relief recommended when the affected engine's type certification basis contains requirements equal to or more severe than the requirements of this part applicable to engine oil systems.

Conference proposal 370 recommended inserting the phrase "not approved as part of the engine" after the opening words "each oil tank" of § 23.1015, Oil Tank Tests. The justification given was that part 33 now includes requirements for certification of oil tanks included with the engine and a tank so approved should not require redundant certification in part 23. Conference commenters' main concerns were that the rule be revised to ensure that oil systems are properly substantiated but not require a duplicate substantiation.

The proposed paragraph (a) is formulated to avoid requiring redundant showing of compliance to equivalent criteria, to ensure adequate requirements related to the installation environment, and to ensure that certificated engines are adequately substantiated when installed in part 23 airplanes.

Reference: Conference proposals 367, 368, and 370.

§ 23.1013 [Amended]

37. Section 23.1013 is amended in paragraph (g) by removing the words "a turbine" and inserting in their place the word "an".

Explanation: Conference proposal 369 recommended removing the words "a turbine" from the oil tank filler cap oiltight seal requirement and inserting the word "an" because the current rule requires the oil filler cap to have an oiltight seal only on turbine engines. The conference consensus was that the rule should apply to all types of engines. The FAA concludes the requirement should apply to all airplanes certificated to part 23.

Reference: Conference proposal 369.

38. Section 23.1017 is amended by adding a new paragraph (b)(6) to read as follows:

§ 23.1017 Oil lines and fittings.

* * * * *

(b) * * *

(6) For reciprocating-engine airplanes, breather line blockage due to ice or foreign matter is prevented or pressure relief is provided in the event of such blockage. This pressure relief, if used, must be in a sheltered location to avoid malfunction caused by ice or foreign material.

Explanation: Conference proposal 371 recommended adding a requirement for means of pressure relief in case of breather line blockage. The justification given was that experience has shown that water vapor can progressively accumulate, freeze, and obstruct breather lines in service conditions. Conference commenters objected to a new requirement that looks like an alternative to paragraph (b)(5), especially for turbine engines. Even though the airplane originally complied with paragraph (b)(5), as the engine wears, increased piston blowby sends more and more oil and water vapor through the breather and makes it more likely that the breather will be blocked by ice. Though blockage is not ordinarily a problem, it does occur at the least expected time with the subsequent failure of oil seals and the loss of engine oil.

The FAA has further studied these issues and has concluded that the proposal should be limited to reciprocating engine airplanes.

Reference: Conference proposal 371.

§ 23.1019 [Amended]

39. Section 23.1019 is amended in paragraph (a)(2) by removing the words "under part 33 of this chapter" and inserting in their place the words "for its type certification"; in paragraph (a)(3) by removing the words "an indicator that will" and inserting in their place the words "a means to"; and in paragraph (a)(5) by removing "§ 23.1305(u)" and inserting in its place "§ 23.1305(c)(9)".

Explanation: This proposal revises incorrect references and clarifies paragraph (a)(3).

Conference proposal 372 recommended revising paragraph (a)(2) by replacing the last two prepositional phrases "under part 33 of this chapter" with the phrase "during its type certification". Justification given was that engines are also certificated under CAR part 13. There was no objection to the revision at the conference.

Conference proposal 373 recommended revising paragraph (a)(3) by replacing the words "an indicator" with "a mechanical device on its container". The justification given was clarification as to whether the contamination indicator must be on the filter or on the instrument panel. At the conference, four commenters objected to this wording as being too design restrictive. It was suggested that the rule should be revised to allow any means that gives adequate warning whether the indicator is on the body of the filter, on a remotely located maintenance panel, or on the flight deck instrument panel.

After further review, the FAA has concluded that paragraph (a)(3) should be revised to allow the suggested design flexibility and is proposing to revise paragraph (a)(3) accordingly.

Conference proposal 374 recommended revising paragraph (b) to require all reciprocating-engine powerplant installations to have provisions for installing a spin-on type oil filter capable of removing particulates in the 30-micron range. No justification was given for the recommendation. At the conference, a commenter objected to the recommendation as being too specific and restrictive. The FAA agrees that the current rule covers the provisions intended and allows a spin-on filter of the proper design as long as it meets the mesh and strainer requirements of the engine. The FAA plans no further action on this recommendation.

Paragraph (a)(5) has been revised to reference the proper paragraph in § 23.1305 of this notice.

Reference: Conference proposals 372, 373, and 374.

40. Section 23.1021 is amended by revising paragraphs (a) and (b) and adding a new paragraph (c) to read as follows:

§ 23.1021 Oil system drains.

* * * * *

(a) Be accessible;

(b) Have drain valves, or other closures, employing manual or automatic shut-off means for positive locking in the closed position; and

(c) Be located or protected to prevent inadvertent operation.

Explanation: This proposal clarifies the intent and adds a requirement for protection against inadvertent operation. Conference proposal 375 recommended clarifying paragraph (b) by adding "drain valves or other closures". The conference proposal also recommended adding the new requirement to locate or protect oil drains to prevent inadvertent operation. The justification given was that service experience shows that valves with automatic means for locking closed have been unintentionally opened by interference from a retracting landing gear. Also, drain hoses have opened valves when the hose is not properly installed or moves out of proper position.

At the conference, two commenters agreed with adding paragraph (c) but would not support the addition to paragraph (b) because they did not believe it was necessary and were not sure what the implications would be if it were adopted.

The FAA has further reviewed this issue and has concluded that this revision will clarify the requirement.

Reference: Conference proposal 375.

41. Part 23 is amended by adding a new § 23.1024 to read as follows:

§ 23.1024 Oil-air separators.

For reciprocating-engine installations only, each oil-air separator, if installed, must provide means for separating and disposing of any water entrained in the oil.

Explanation: This proposal would add a new requirement defining the function of the oil-air separator.

Conference proposal 376 recommended requiring a means for separating and disposing of any water entrained in the oil vapor in the engine oil system. The justification given was based on service experience that demonstrated oil recovered from oil vapor may contain water. This water can then be introduced into the engine oil system. Discussion at the conference revealed that the proposal was intended for only reciprocating-engine installations.

Reference: Conference proposal 376.

42. Section 23.1027 is amended in paragraphs (b) and (c) by removing the word "trapped" and inserting in its place the word "reserved", and by revising paragraph (a) to read as follows:

§ 23.1027 Propeller feathering system.

(a) If the propeller feathering system uses engine oil and that oil supply can become depleted due to failure of any part of the oil system, a means must be incorporated to reserve enough oil to operate the feathering system.

* * * * *

Explanation: This proposal will allow that amount of engine oil dedicated to the propeller feathering system to be stored in a reservoir other than the oil tank and replaces the word "trapped" with the word "reserved". By definition, the word "reserve" is more appropriate than the word "trap" in this application.

Conference proposal 377 recommended changing the word "tank" to the words "storage container" because engine oil dedicated to the propeller feathering system may be stored in containers other than the oil tank.

At the conference, three commenters objected to the term "storage container" because it makes the rule sound like the pan-type tank crankcase is no longer acceptable and that other rules on container location and possible fire resistance requirements were being brought into question.

One commenter agreed the rule should allow storage means other than the oil tank, and it should simply state the objective that the feathering system has available an adequate supply of oil.

The FAA has further reviewed this issue and has concluded that the proposal is appropriate to those feathering systems that require engine oil to accomplish feathering. Many designs require engine oil for propeller pitch control while feathering is accomplished through springs and/or weights after oil pressure is released or the oil is lost from the system. In such designs, where oil is required for the unfeathering operation, but where engine stoppage involves loss of oil with the propeller automatically moving into feather, unfeathering the propeller is probably not a viable option.

Reference: Conference proposal 377.

43. Section 23.1041 is revised to read as follows:

§ 23.1041 General.

The powerplant and auxiliary power unit cooling provisions must maintain the temperatures of powerplant components and engine fluids, and auxiliary power unit components and fluids within the limits established for those components and fluids under ground and water operating conditions, and flight operation to the maximum altitude for which approval is requested, and after normal engine and auxiliary power unit shutdown.

Explanation: This proposal incorporates cooling provisions for auxiliary power units (APU) and for temperature control of components and fluids on both the propulsion powerplant and the auxiliary power unit after normal shutdown. APUs have been approved in small airplanes and more installations are anticipated in the future. Cooling provisions for both engines and APUs should ensure that the components and fluids do not overheat after the flow of forced cooling air ceases.

Conference proposal 378 recommended revising § 23.1041 by replacing it with the wording of § 25.1041. The justification for this change was that applicants for approval of APU installations should be informed of the applicable requirements.

At the conference, four commenters agreed that adding the APU cooling requirements into the rule was acceptable, but they objected to the new requirement for temperature control (cooling) after normal engine or APU shutdown. The commenters stated that this is the first time the rule would cover "soak-back" after shutdown and there may be a burden to the applicant involved; although soak-back is usually considered during the normal cooling evaluation, the addition of the requirements into the rule may bring up other areas of consideration not well defined.

The FAA has further considered these issues and does not agree that the after-shutdown cooling requirement is new, but is actually a clarification of existing requirements. It is evident that excessive temperatures cannot be allowed to exist in the powerplant or APU installation at any time, including after the engine or APU shutdown when the forced flow of cooling air is usually discontinued. Any damage to the powerplant or APU during soak-back would not be readily detectable by routine inspection before further flight and could cause an unsafe condition.

Conference proposal 379 recommended revising § 23.1041 by replacing the phrase "within the temperature limited established" with the phrase "within the green or normal operating ranges established by the engine manufacturer" and recommended adding to the end of the section, "assuming standard day conditions". No justification was given for the proposed changes to the conference proposal.

At the conference, two commenters objected to the proposed change of proposal 379 because (1) the current rule is stated more objectively than the recommendation; (2) not all temperature limits are established by engine manufacturers; they may be established by the manufacturers of other equipment located in the engine or APU compartment; (3) the "green range" is not the only normal range for temperature; yellow or red arcs or shapes may indicate normal, time-limited temperature ranges; and (4) the revision to standard day conditions is inappropriate since the installation must be tested or corrected to 100 °F hot day criteria. The FAA agrees and is considering no further action on conference proposal 379.

The FAA reviewed the special conditions programs concerning the installation of APUs in Part 23 airplanes and concluded that it is appropriate to propose APU requirements for part 23 at this time.

Reference: Conference proposals 378 and 379.

§ 23.1047 [Amended]

44. Section 23.1047 is amended in paragraph (b)(2) by removing the phrase

"in § 23.1337(e)" and inserting in its place the phrase "in § 23.1305(b)(3)".

Explanation: Conference proposal 380 recommended revising the current incorrect reference. At the conference the consensus agreed with the recommendation.

Reference: Conference proposal 380.

45. Section 23.1061 is amended by redesignating paragraph (a)(3) as (a)(4); in newly redesignated paragraph (a)(4) by removing the words "expansion tank" and inserting in their place the words "coolant tank expansion space"; by removing the concluding text of paragraph (a); by revising paragraph (a)(2); and by adding a new paragraph (a)(3) to read as follows:

§ 23.1061 Installation

(a) * * *

(2) There are pads or other isolation means between the tank and its supports to prevent chafing.

(3) Pads or any other isolation means that is used must be nonabsorbent or must be treated to prevent absorption of flammable fluids; and

* * * * *

Explanation: This proposal allows means other than pads to prevent chafing between coolant tanks and their supports and clarifies the reference to the coolant tank expansion space. This change will encourage the use of improved vibration isolation provisions that have been developed.

Conference proposal 381 recommended the addition of the phrase "or other isolation means" after the word "pads" in paragraph (a)(2). The justification given was that consideration should be given to the use of improved isolation provisions that have been developed to reduce vibration, accommodate relative displacement of components and prevent chafing.

At the conference, there was no objection to the recommended addition. However, it was further recommended that the unnumbered sentence at the end of paragraph (a) restricting the padding absorption qualities, be made a part of paragraph (a)(2) so that all rule references to coolant tank padding are together. The FAA has further considered these issues and has found that the padding absorption qualities should be a separate paragraph that follows paragraph (a)(2). Also, in the current paragraph (a)(3), the term "expansion tank" may be interpreted as another tank separate from the coolant tank when in actual practice the expansion space in the coolant tank is accepted as the expansion tank. Therefore, the term "expansion tank" has been replaced by the term "coolant tank expansion space".

Reference: Conference proposal 381.

46. Section 23.1091 is amended by revising the section heading in paragraph (a) by inserting the phrase "and auxiliary power unit and their accessories" after the word "engine" in two places; in paragraph (c)(1) by inserting the phrase "or auxiliary power unit and their accessories" after the word "engine"; by adding two new paragraphs (b)(4) and (b)(5); and by revising paragraph (c)(2) to read as follows:

§ 23.1091 Air induction system.

* * * * *

(b) * * *

(4) Each automatic alternate air door must have an override means accessible to the flight crew.

(5) Each alternate air door must have a position indicator in the cockpit to show the flight crew the position of the alternate air door.

(c) * * *

(2) The airplane must be designed to prevent water, slush or other foreign material on the runway, taxiway, or other airport operating surface from being directed into the engine or auxiliary power unit air inlet ducts in hazardous quantities during takeoff, landing, and taxiing.

Explanation: This proposal incorporates air induction system requirements for auxiliary power units, a flight crew accessible override means for automatic alternate air door systems, a cockpit located position indicator for each alternate air door, and a clarification of the water ingestion and foreign material ingestion requirements. The FAA has determined that these changes are needed to update the rules with current design practices.

Conference proposal 382 recommended revising the air induction system requirements to include the inlet for the auxiliary power unit (APU). The justification given was that a number of applications for approval of APUs have been processed by the FAA and with more expected in the future, it is appropriate to establish suitable requirements in the FAR. At the conference, the consensus agreed with the recommendation.

Conference proposal 383 recommended § 23.1091(a) be amended to prevent intake air being taken from a hot part of the engine compartment, or from any cooling air that has passed over the engine or turbocharger. It also recommended that the pressure drop across the induction air filter in normal cruise flight not exceed one inch of mercury for normally aspirated airplanes. The justification was that some airframe installations seriously compromise the horsepower output and/or detonation limits of the engine as originally certified, due to peculiarities of the induction system that may have a marked deleterious effect on the volumetric efficiency and/or heat burden. At the conference, the consensus was that the recommendations addressed poor design practices, not flight safety issues. The FAA agrees and plans no further action on this recommendation.

Conference proposal 385 recommended that a new paragraph (b)(4) be added that stated: "Each alternate air door must have a manual override accessible to the flight crew and a position indicator to show the flight crew the position of the alternate air door." The justification was that certain airplanes have been certificated with alternate air doors that open automatically. Service history has shown that these doors can stick or freeze closed making alternate air unavailable. Also, the door can stop midway between outside and heated air so that the required heat rise is diluted and unfiltered air enters the engine. At the conference, the commenters basically supported the need for a rule in this area, but requested clarification and generalization of the rule so that the word "manual" would not necessarily mean "mechanical". The FAA has further considered these issues and is proposing paragraphs (b)(4) and (b)(5). The words "manual override" have been replaced by the words "override means", thus, allowing design latitude. The word "automatic" was inserted to clarify that the rule applies only to automatic alternate air doors. Proposed new paragraph (b)(5) separates the position indicator requirement from the override requirement to clarify that these are indeed separate requirements. In this case, a position indicator can be a light, a dial indicator or, for mechanically actuated doors, the position of the actuator knob or handle in the cockpit.

Conference proposal 386 recommended adding into paragraph (c)(2) the requirement that the airplane must be designed to prevent water or slush on the runway, taxiway, or other airport operating surfaces from being directed into the engine or auxiliary power unit air inlet ducts in hazardous quantities. The justification given was that there has been a controversy regarding classifying water and slush on airport surfaces as foreign matter that may be hazardous if taken into the air induction system. At the conference, two commenters suggested that the language of the rule be minimized as much as possible. The FAA has further reviewed these issues and has simplified the proposal.

Conference proposal 384 recommended revising § 23.1091(b) to delete the requirement for two separate air intakes for airplanes of not more than 1500 pounds maximum weight. The proposal was withdrawn without discussion. The FAA plans no further action on this proposal.

Reference: Conference proposals 382, 383, 384, 385, and 386.

47. Section 23.1093 is amended in paragraphs (a)(3) and (c) by removing the word "carburetors" and inserting in its place the words "fuel metering device"; by revising paragraphs (a)(4), (a)(5), and (b)(1); and by adding new paragraph (a)(6) to read as follows:

§ 23.1093 Induction system icing protection.

(a) * * *

(4) Each airplane with sea level engine(s) using a fuel metering device tending to prevent icing has a sheltered alternate source of air with a preheat of not less than 60 °F with the engines at 75 percent of maximum continuous power;

(5) Each airplane with sea level or altitude engine(s) using fuel injection systems having metering components on

which impact ice may accumulate has a preheater capable of providing a heat rise of 75 °F when the engine is operating at 75 percent of its maximum continuous power; and

(6) Each airplane with sea level or altitude engine(s) using fuel injection systems not having fuel metering components projecting into the airstream on which ice may form, and introducing fuel into the air induction system downstream of any components or other obstruction on which ice produced by fuel evaporation may form, has a sheltered alternate source of air with a preheat of not less than 60 °F with the engines at 75 percent of maximum continuous power.

(b) Turbine engines.

(1) Each turbine engine and its air inlet system must operate throughout the flight power range of the engine (including idling), without the accumulation of ice on engine or inlet system components that would adversely affect engine operation or cause a serious loss of power or thrust—

(i) Under the icing conditions specified in appendix C of part 25 of this chapter; and

(ii) In snow, both falling and blowing, within the limitations established for the airplane for such operation.

* * * * *

Explanation: This proposal adds specific ice protection requirements for fuel injection system designs with and without metering components on which impact ice may accumulate and clarifies the section by replacing the term "carburetors" with the term "fuel metering device" where appropriate. In addition, the proposal eliminates the differences in requirements that are based solely on the number of engines on the airplane or on the method of cooling; i.e., air cooled or liquid-cooled.

Conference proposal 387 recommended replacing the term "carburetor" with the term "fuel metering device" in those places where the device may be other than a conventional venturi carburetor. The reason for the recommendation was that the term "carburetor tending to prevent icing" has been a great source of confusion and has caused difficulty in applying the rules. "Fuel metering device" would be a better term to use than carburetor because fuel injection systems, as well as conventional carburetors, are involved. At the conference, one commenter questioned why there is a difference in heat rise requirements based on the number of engines on the airplane as in the current paragraphs (a)(4), single engine, and (a)(5), multiengine. Almost 30 years ago, a multiengine airplane with no alternate air provision had an accident. A rule change resulted, but only for multiengine airplanes. This anomaly has persisted since.

The FAA has further considered these issues and has concluded that the requirements need to be clarified and aligned with past equivalent safety findings. The current requirement for a heat rise equal to the heat rise in the cooling air downstream of the cylinders was changed to 60 °F at 75 percent maximum continuous power. This heat rise proposal is based on previously approved equivalency to the heat rise downstream of air-cooled cylinders.

Conference proposal 388 recommended the addition of two new paragraphs defining the heat rise requirements for fuel injection system designs based upon whether the systems incorporated components in the induction air stream that could accumulate ice. The justification for the recommendation was that the regulation does not now include specific requirements for various types of fuel injection systems. The proposed additions have been used by the FAA as guidelines for these systems, as covered in an FAA policy letter dated May 21, 1970. At the conference, a commenter suggested that this recommendation be combined with the previous recommendation into an overall section revision.

Based on post conference review of the rule and the policy involved in years of its administration, the FAA concluded that the prime objective has been consistently pursued. The objective of the section is stated explicitly in the first sentence: "Each reciprocating engine air induction system must have means to prevent and eliminate icing." The remainder of paragraph (a) specifies temperature rise requirements to accomplish this objective for certain induction system designs. Experience has shown that for the designs addressed, the heat rise required is adequate to provide the necessary icing protection. However, since there can be an infinite number of induction system designs, the proposed rule sets forth the objective to preclude icing.

Even after the heat rise required for a particular design has been demonstrated, it must be shown that the prime objective of the first sentence is met. When an applicant submits an air induction system design for icing protection evaluation, it is incumbent upon the applicant to demonstrate that not only the appropriate heat rise is met but also that the air induction system prevents icing. In the event icing does occur, the system must have the ability to eliminate icing without hazard to the airplane.

Conference proposal 389 recommended deleting the paragraph (b)(1)(ii) reference to snow, both falling and blowing because insufficient definition of this requirement exists to allow the application of specific analytical or test verification procedures. Experience has shown that normal compliance with the icing certification requirement covers this item. At the conference, one commenter stated that the way the rule is phrased there is no yardstick to reasonably determine compliance; further, this commenter would like to see the requirement deleted.

The FAA has further reviewed this issue and has concluded that the requirement is needed. This requirement is identified in parts 23, 25, 27, and 29, and has been administered adequately for all categories of aircraft.

As a result of an FAA review of the background and policy on § 23.1093(b), it was discovered that the phrase "within the limitations established for the airplane" was mistakenly placed in the middle of paragraph (b)(1). It should be at the end of (b)(1)(ii). The proposal has been revised to align part 23 with part 25, as proposed in Notice 84-21 (49 FR 47358, December 3, 1984).

Reference: Conference proposals 387, 388 and 389.

48. Section 23.1101 is amended by revising the section heading, the introductory text of the section, and paragraph (a) to read as follows:

§ 23.1101 Induction air preheater design.

Each exhaust-heated, induction air preheater must be designed and constructed to—

(a) Ensure ventilation of the preheater when the induction air preheater is not being used during engine operation;

* * * * *

Explanation: This proposal clarifies the cooling requirement for the induction air preheater during those times the preheater is not otherwise being ventilated and cooled through the use of the induction air preheat system and correctly identifies the preheater as an "induction" air preheater rather than only a "carburetor" air preheater.

Conference proposal 390 recommended revising the current wording "when the engine is operated in cold air" to the phrasing "when the engine is in operation." The justification given was that the ventilation requirements of this paragraph should ensure continuous ventilation any time the engine is operating.

Conference proposal 391 recommended revising the current wording to the phrasing "when the carburetor heat control is in the off position." The justification given was that § 23.1101(a) is not very comprehensive and as written, "cold air" could mean cold ambient air and not cold induction air, as intended.

At the conference, the discussion focused on ensuring that the induction air preheat device taking heat from the exhaust will be ventilated and cooled whenever the engine is operating.

When induction air preheat is in use, the preheat device is ventilated and cooled by the induction air flow. The intent is to ensure that the preheat device is ventilated and cooled at all other times the engine is operating. The FAA has further considered these issues and agrees that the requirements need clarification.

Reference: Conference proposals 390 and 391.

49. Section 23.1103 is amended by adding new paragraphs (c), (d), (e), and (f) to read as follows:

§ 23.1103 Induction system ducts.

* * * * *

(c) Each flexible induction system duct must be capable of withstanding the effects of temperature extremes, fuel, oil, water, and solvents to which it is expected to be exposed in service and maintenance without hazardous deterioration or delamination.

(d) For reciprocating engine installations, each induction system duct must be—

(1) Strong enough to prevent induction system failures resulting from normal backfire conditions; and

(2) Fire resistant in any compartment for which a fire extinguishing system is required.

(e) Each inlet system duct for an auxiliary power unit must be—

(1) Fireproof within the auxiliary power unit compartment;

(2) Fireproof for a sufficient distance upstream of the auxiliary power unit compartment to prevent hot gas reverse flow from burning through the duct and entering any other compartment of the airplane in which a hazard would be created by the entry of the hot gases;

(3) Constructed of materials suitable to the environmental conditions expected in service, except in those areas requiring fireproof or fire resistant materials; and

(4) Constructed of materials that will not absorb or trap hazardous quantities of flammable fluids that could be ignited by a surge or reverse-flow condition.

(f) Any induction system duct supplying air to a cabin pressurization system must be constructed of materials that will not produce hazardous quantities of toxic gases during a powerplant fire.

Explanation: This proposal adds standards for flexible inlet ducts, backfire strength and fire resistance requirements for reciprocating engine inlet ducts, requirements for auxiliary power unit inlet ducts, and requirements for cabin pressurization supply ducts in conjunction with induction system ducts.

Conference proposal 392 recommended the adoption of a new paragraph (c) to read the same as the paragraph proposed here except without the word "hazardous". The justification was that service experience has shown that certain flexible ducting, of the type most commonly used, is susceptible to deterioration and delamination when exposed to heat, fuel, and oil. At the conference, one commenter agreed with the intent of the recommendation but suggested inserting the word "excessive" before the word "deterioration". The FAA further considered this suggestion and concluded that the word "hazardous" is more appropriate to the objective of the proposal.

Conference proposal 393 recommended adding four new paragraphs stating many of the new requirements proposed in paragraphs (d) and (e) of this proposal. The justification given was that applications for approval of auxiliary power unit installations have been received by the FAA and applicants should be informed of the applicable requirements for such approvals.

At the conference, two commenters stated that putting bleed air duct requirements in the induction system section could be inappropriate. The FAA agrees and has not included the recommended paragraph addressing the bleed air duct in § 23.1103(a). Another commenter questioned whether it is intended that the applicant induce a backfire or series of backfires as a means of showing compliance with proposed paragraph (d)(1). The FAA has determined that the applicant is allowed the option of using any method that shows compliance to the rule; in this case, analysis may be more appropriate than actual testing.

Another commenter recommended backfires be limited to reciprocating engines and not be associated with turbine engines. The FAA agrees and has formatted the proposal accordingly.

Another commenter questioned if the phrase "the maximum heat conditions likely to occur" in the conference proposal is to be interpreted as fire resistant. Upon further consideration of these issues, the FAA replaced the questioned phrase with the phrase, "the environmental conditions expected in service."

Subsequent to the conference, the FAA determined as part of its crashworthiness improvements that any duct furnishing air to the cabin must not produce toxic fumes in case of a powerplant fire. A new § 23.1103(f) is proposed to add this requirement.

Reference: Conference proposals 392 and 393.

50. Part 23 is amended by adding a new §23.1107 to read as follows:

§23.1107 Induction system filters.

On reciprocating-engine installations, if an air filter is used to protect the engine against foreign material particles in the induction air supply—

(a) Each air filter must be capable of withstanding the effects of temperature extremes, rain, fuel, oil, and solvents to which it is expected to be exposed in service and maintenance; and

(b) Each air filter subject to failure that will release material large enough to interfere with fuel metering components must be provided with a screen downstream of the filter.

Explanation: This proposal would add design requirements for reciprocating-engine induction air filters not currently addressed in the rules.

Conference proposal 395 recommended a new induction system filter rule that, in addition to the requirements of this proposal, would require that each filter be simple to remove, inspect, and install without special tools and that each filter include instructions for servicing and replacement on the filter itself. The justification for the recommendation was that practically all part 23 airplanes incorporate induction system filters in the primary air ducts. Service experience has shown these filters to be the source of numerous problems: (1) deterioration due to water, heat, age, etc.; (2) incorrect installation sequence; and (3) loose parts clogging the carburetor or injector, etc.

At the conference, a majority of commenters agreed that requirements for induction air filters are appropriate; however, some commenters objected to including specific maintenance procedures in part 23. The FAA has further considered these issues and has concluded that the recommended maintenane procedures should not be included in this proposal.

Reference: Conference proposal 395.

51. Section 23.1121 is amended by adding introductory text to the section; by revising paragraph (c); and by adding a new paragraph (i) to read as follows:

§ 23.1121 General.

For powerplant and auxiliary power unit installations, the following apply—

* * * * *

(c) Each exhaust system must be separated by fireproof shields from adjacent flammable parts of the airplane that are outside of the engine and auxiliary power unit compartments.

* * * * *

(i) All exhaust system materials must meet the requirements of § 23.603 of this part.

Explanation: This proposal incorporates requirements for auxiliary power unit exhaust systems and a requirement for exhaust system materials and workmanship.

Conference proposal 397 recommended inserting the term "and auxiliary power unit" after the word "engine" in paragraph (c). The justification given was that applicants should be informed, through the rules, of the requirements for APU installations.

At the conference, a commenter questioned whether this should be defined as an "auxiliary power unit fire zone compartment". At this time, part 23 does not recognize fire zones as such.

The FAA has further considered these issues and has concluded that the words "fire zone" are not needed in this section. If a designated fire zone rule is adopted for part 23, then the auxiliary power unit compartment will be designated a fire zone by that section. If a fire zone designation proposal is not adopted, then the words "fire zone" would be inappropriate anywhere in part 23.

Two commenters suggested deleting the word "component" in current paragraph (c) because of the possible interpretation that each individual nut, bolt, washer, and clamp may have to be examined rather than taking the exhaust system as a whole. The FAA concurs that the word "component" is unnecessary; however, the term "system" does include each individual part of that system. All pieces of any system must be appropriate to the usage involved, including the environment in which they work. The word "component" has been deleted from the proposal.

Conference proposal 399 recommended the addition of a new pragraph to § 23.1123 establishing exhaust system material requirements and changing the word "manifold" to the word "system" throughout that section. The justification given was that there should be more stringent requirements on exhaust system materials that should apply to all exhaust system components, not just the manifold.

A commenter stated that the real change recommended is the addition of the paragraph requiring exhaust system materials to meet the requirements of § 23.603 and recommended that such a material requirement belongs in §23.1121. The FAA agrees and has incorporated new paragraph (i) in this proposal.

Reference: Conference proposals 397, 398, and 399.

§ 23.1123 [Amended]

52. Section 23.1123 is amended in the section heading and paragraphs (a), (b), and (c) by removing the word "manifold" and inserting in its place the word "system".

Explanation. This proposal makes this section applicable to the total exhaust system rather than to the manifold only.

Conference proposal 398 recommended adding a lead-in sentence to § 23.1123, as follows: "For powerplant and auxiliary power unit installations the following apply:" The justification given was to set forth the exhaust manifold requirements for auxiliary power units when installed in an airplane. At the conference, the consensus agreed with the addition. The FAA concluded from the conference discussion that changing "exhaust manifold" to "exhaust system" in § 23.1123 clarifies the requirement and accomplishes the intent of conference proposal 398 because the requirements are applicable to the exhaust system rather than just the manifold assembly.

Conference proposal 399 recommended changing the word "manifold" to the word "systems" throughout this section because these requirements should apply to all the exhaust system parts that are required to experience the exhaust environment.

Conference proposal 400 recommended adding a sentence to read: "Materials used in exhaust manifolds must retain at least 25 percent of their room-temperature tensile strength when subjected to the highest exhaust gas temperature development in normal continuous high-cruise operation of the powerplant." The justification given was that 321 stainless steel used in exhaust systems loses over 80 percent of its tensile strength at 1650° F.

Conference commenters opposed this type of subjective requirement. The FAA agrees and is considering no further action on this recommendation; however, material requirements are being proposed in new § 23.1121(i).

Reference: Conference proposals 398, 399, and 400.

§ 23.1141 [Amended]

53. Section 23.1141 is amended in paragraph (e) by removing the phrase "For turbine engine powered airplanes".

Explanation. This proposal will make the more stringent powerplant control system requirements of this paragraph applicable to all part 23 airplanes, rather than only turbine-powered airplanes.

Conference proposal 401 recommended the deletion of the first phrase of current paragraph (e). The justification given was that: each flexible control must be of an acceptable kind (paragraph (b)); powerplant control failures in small airplanes are common and cause many accidents and incidents; single-strand controls wear rapidly and break at the fastener ends; plastic lined or covered controls melt under fire conditions and jam the control; and the current rules are inadequate to ensure against these types of failures.

Because of the problems with controls over the years, the FAA is proposing a requirement that no single failure of a control, such as a pushpull control separation, will cause the failure of any powerplant function necessary for safety.

Experience indicates that when the mixture control breaks, the mixture goes to idle cut-off, the engine stops and that is a failure. In the case of throttle control breakage, the throttle goes to idle, and the airplane cannot maintain flight. These are examples of failures that lead to the loss of function necessary for safety.

A commenter pointed out that there are engine systems where a failure that leads to an engine shutdown is not normally, in itself, considered to be a safety hazard. A shutdown is deemed a hazard only in single-engine airplanes and, if a failure that leads to a benign engine shutdown is not acceptable, something else must be done. There have been supplemental type certificates issued for emergency fuel systems that provide a separate fuel supply and insert it directly into the intake manifold through metering valves controlled by the pilot. Once back to the landing field, the fuel is cut off and the pilot makes a dead-stick landing. These fuel systems are for flying over the jungle and ensuring a return home. Such fuel systems are costly, but accomplish the mission.

The FAA has further considered these issues and concludes that paragraph (e) should be applicable to all part 23 airplanes.

Reference: Conference proposal 401.

54. Part 23 is amended by adding a new § 23.1142 to read as follows:

§ 23.1142 Auxiliary power unit controls.

Means must be provided on the flight deck for the starting, stopping, monitoring, and emergency shutdown of each installed auxiliary power unit.

Explanation: This proposal adds a requirement that the controls for any auxiliary power unit and monitoring be installed on the flight deck. Part 23 does not currently address requirements for auxiliary power unit installations; applications for such installations have, therefore, been subject to special conditions.

Conference proposal 403 recommended adding a new section on auxiliary power unit controls similar to § 25.1142. The justification given was that applicants for approval of the auxiliary power units should be informed of the requirements for these installations.

At the conference, a number of commenters spoke on several aspects of the recommendation. A majority of commenters agreed that the auxiliary power unit controls should be on the flight deck; however, clarification was desired. The FAA has further considered these issues and concludes that (1) the primary controls for starting, stopping, and monitoring the auxiliary power unit should be on the flight deck because the status of the systems that may be powered by the APU can be readily determined prior to start-up; (2) other "emergency shutdown" controls may be located elsewhere on the airplane for the convenience of maintenance personnel; (3) where the "emergency shutdown" system is essentially the same as the regular stopping system, there is no justification for addressing both; and (4) the flight crew should not be able to override an APU automatic shutdown.

Reference: Conference proposal 403.

55. Section 23.1143 is amended by adding a new paragraph (g) to read as follows:

§ 23.1143 Engine controls.

* * * * *

(g) For reciprocating single-engine airplanes, each power or thrust control must be designed so that if the control separates from the engine fuel metering device, the airplane is capable of continued safe flight and landing. In the event of such separation, the control must incorporate an adequate back-up system, or the fuel metering device must be automatically positioned at a setting that permits continued safe flight and landing from any point in the flight envelope of the airplane.

Explanation: This proposal requires a back-up system or automatic positioning of the fuel metering device to ensure that the engine continues to furnish adequate power if the pilot's control installation fails. Service experience shows that the primary mode of failure of the engine control is breakage/separation from the fuel metering device. Loss of engine power follows.

Conference proposal 402 recommended adding a new paragraph to § 23.1141 to require that, for small, single-engine airplanes, when throttle linkage separation occurs, the fuel control must go to a setting that will allow the pilot to maintain level flight in the cruise configuration. The justification given was that NTSB Recommendation A-81-6 requested this rule change and the FAA committed to the NTSB to include this recommendation in this review by letter dated October 21, 1983. This conference proposal is more appropriate to § 23.1143 because it addresses the throttle, power, and thrust controls specifically.

At the conference, one commenter had no objection to meeting the objective on single-reciprocating-engine airplanes; however, that commenter did object to the requirement that the fuel control must go to a specific setting. On turbine engines, there are safety back-up systems built into the fuel control. Powerplant control requirements for turbine engine powered airplanes for addressing failures are in § 23.1141(e). No changes are being proposed for these engines. In other cases, it may be possible to provide some supplementary system that will enable a modicum of control, but that would not necessarily result in the fuel control going to a setting. There is one arrangement where there is an extra control run that acts on a different part of the fuel control unit and is, in effect, a crude power setting device.

Another commenter was concerned about a means of compliance and did not think that there is a single value (setting) that would serve for a given engine installation considering all the parameters of ambient conditions, temperature, altitude, loading, etc.

Conference proposal 404 recommended revising § 23.1143 by adding a new paragraph requiring that a means be provided to ensure that if throttle linkage separation occurs in a single-engine airplane, the fuel control will be automatically positioned at the full throttle position for agricultural airplanes, and an intermediate throttle position for other airplanes that will allow the pilot to maintain level flight in the cruise configuration. The justification was the same as conference proposal 402 (NTSB Recommendation A–81–6), except for the final sentence, which states, "However, in consideration of the typical low level operating environment of agricultural airplanes, the Safety Board believes that automatic positioning at the full throttle setting would be most appropriate under similar circumstances involving these type airplanes."

A commenter, citing an investigation done 3 or 4 years prior to the conference, questioned whether throttle control failure was a maintenance problem, as several of the failures occurred when the controls were fitted to the airplane by the manufacturer at least 15 years prior to the accident.

Another commenter stated that this recommendation addresses agricultural single-engine airplanes separately and the classification of the airplanes that have had the problem should be examined more closely. The commenter further stated that there might be differences among the small, single-reciprocating-engine airplanes, turboprop airplanes and turbofan airplanes. Because there is a substantial quality difference in the control mechanisms of these airplanes and the commenter would hate to see a high quality system that has no difficulty in service being burdened with a requirement for unwarranted redundancy.

Another commenter stated that, as an engine manufacturer, it has been offering an additional control capability on turboprop engines for single-engine installations, but has not been able to convince the airplane manufacturers to connect it up.

The FAA, upon further consideration of these issues, has concluded that the proposal should include the power or thrust control terms to make it applicable to reciprocating single-engine airplanes, allow an adequate back-up system as an alternative to a power position setting device, allow a range of power position setting with level flight cruise as a minimum and add the requirement for the capability of safe flight and landing.

Reference: Conference proposals 402 and 404.

§ 23.1145 [Amended]

56. Section 23.1145 is amended in paragraph (a) by removing the word "engine" and inserting in its place the phrase "reciprocating and turbine engine and must be located and arranged to allow operation by the flight crew."

Explanation: This proposal clarifies the requirement for ignition system control by the flight crew on all types of airplane engines regardless of principle of operation. This will avoid the misinterpretation that § 23.1145 (a) and (b) apply only to reciprocating engines.

A manufacturer has recently developed an automatic ignition system for its turboprop engine to correct an engine flameout problem that developed in service. The automatic ignition system proposed would provide the pilot with a choice of an "automatic" position, or a "continuous" position but with no "off" position as required by paragraph (b). The FAA concludes that clarification of § 23.1145 is necessary.

Reference: Questions from the public requesting interpretation and clarification.

57. Section 23.1147 is amended by redesignating the introductory text of paragraph (a) and paragraphs (a)(1) and (a)(2) as paragraphs (a)(1) introductory text, (a)(1)(i), and (a)(1)(ii) respectively; by redesignating the introductory text to the section as the introductory text of paragraph (a); by redesignating paragraph (b) as paragraph (a)(2); and by adding a new paragraph (b) to read as follows:

§ 23.1147 Mixture controls.

* * * * *

(b) A means must be provided to assure that each engine mixture control device will move automatically to the full-rich position in the event it becomes disconnected from the mixture control linkage.

Explanation: This proposal would add a rule to require mixture control go to a full-rich setting if the pilot control system linkage becomes separated for any reason. This requirement would prevent the mixture control from inadvertently moving into idle-cut-off setting when the disconnect occurs. While the full-rich setting is not considered ideal for most circumstances, it is judged to be the best of the alternatives.

Conference proposal 405 recommended adding a new requirement into § 23.1147 to require the mixture control lever to move automatically to the full-rich position in the event the linkage becomes disconnected. A commenter at the conference supported the proposal.

The FAA has concluded that § 23.1147 should be amended to require full-rich fuel mixtures when a mixture control linkage fails, regardless of whether part 33 is subsequently amended to require such features. This amendment to § 23.1147 will ensure currently approved engines that continue to be produced will have this safety feature when installed in part 23 airplanes.

Reference: Conference proposal 405.

58. Part 23 is amended by adding a new § 23.1181 to read as follows:

§ 23.1181 Designated fire zones; regions included.

(a) Designated fire zones are—

(1) The power section of reciprocating engines;

(2) The accessory section of reciprocating engines;

(3) Any complete powerplant compartment in which there is no isolation between the power section and the accessory section, for reciprocating engines;

(4) Any auxiliary power unit compartment;

(5) Any fuel-burning heater and other combustion equipment installation described in § 23.859;

(6) The compressor and accessory sections of turbine engines; and

(7) The combustor, turbine, and tailpipe sections of turbine engine installations that contain liens or components carrying flammable fluids or gases.

(b) For commuter category airplanes, each designated fire zone must meet the requirements of § 23.1195 through § 23.1203.

Explanation: This proposal would add a new section identifying designated fire zones. Previously, fire zones have not been identified as such in part 23, although, functionally, there are a number of fire zones in small airplanes.

Conference proposal 407 recommended a new section be adopted for commuter category airplanes that designated fire zones and was patterned after § 25.1181. The justification given was that a comment in response to Notice No. 83–17 recommended that fire zones be designated for commuter category airplanes.

At the conference, the commenters objected to discussing commuter rules at the part 23 Review. After the FAA requested comments on the conference proposal only in relation to part 23 airplanes, a number of comments were forthcoming. Conference consensus agreed that a new § 23.1181 to designate fire zones would be appropriate but some commenters expressed concerns about proposal details; i.e., the proposal should more clearly define the fire zones for reciprocating engines, turbine engines, auxiliary power units, and combustion heaters and clarify the term "compartment".

The FAA has further considered these issues and, in response to the comments, proposes to define each designated zone with respect to a reciprocating engine, turbine engine, auxiliary power unit, or other combustion device. The commuter requirement was moved to new paragraph (b). The FAA has determined the word "compartment" is the most appropriate of the words available. A compartment can be any size, shape, or configuration. For the purpose of this proposal, compartment means a relatively close-fitting, total enclosure; the word does not inhibit design flexibility.

The FAA concluded that fire zones should be identified and designated, although that designation does not, in itself, impose any new requirements on them. Adequate fire resistance and fireproofing requirements are already incorporated in several other sections of the rules.

Reference: Conference proposal 407.

59. Section 23.1189 is amended in paragraph (a) introductory text by removing the words "subject to § 23.67(a) and § 23.67(b)(1)" and by revising paragraph (a)(5) to read as follows:

§ 23.1189 Shutoff means.

(a) * * *

(5) Not more than one quart of flammable fluid may escape into the engine compartment after engine shutoff. For those installations where the flammable fluid that escapes after shutdown cannot be limited to one quart, it must be demonstrated that this greater amount can be safely contained or drained overboard.

* * * * *

Explanation: The proposal changes this section's applicability to all multiengine airplanes and quantifies the hazardous amount of flammable fluid. For fuel, the hazardous quantity was established as one quart by FAA policy and practiced many years ago. It was incorporated into § 23.953(b)(1) in 1979 and is proposed for this section to clarify the intent for all flammable fluids.

Conference proposal 409 recommended revising § 23.1189(a)(5) by replacing the words "no hazardous amount of flammable fluid" with the words "no more than one quart of flammable fluid (or any greater amount shown to be safe)". The justification given was that a definition for "hazardous quantity" of flammable fluid is needed.

At the conference, the majority of commenters agreed that such a definition is necessary. One commenter expressed confusion by the term "drain into the engine compartment" because the term could imply draining into a container. This commenter suggested clarification that this is free fluid in the engine compartment.

The FAA has further considered these issues and has concluded that the word "drain" in the current rule should be changed to "escape".

In other sections of the rules, the word "drain" connotes a capability of controlling the flow of fluid, sometimes catching it in a container. "Control" may be limited to ensuring that the fluid drains overboard at predetermined locations in predictable patterns. In this case, the intent is to limit the uncontrolled release or "escape" of flammable fluids to a predictable quantity. It is understood that fluid escaping from a broken component may or may not depart the airframe through existing cowling drain provisions. Therefore, the word "drain" has been changed to the word "escape" in this context.

FAA is proposing another Notice of Proposed Rulemaking on crash-resistant fuel systems for part 23 airplanes. This notice proposes changes to improve crash resistance of fuel systems. A proposed design change is included to limit fuel spillage in survivable accidents to reduce fire-related fatalities. The proposal requires the fuel system to be designed so that no more than 8.0 ounces of fuel will be liberated by any rupture that will occur in specific junctures of lines and connections, as a result of a survivable accident.

The reference to § 23.67 in § 23.1189 is being deleted so § 23.1189 will be applicable to all multiengine airplanes, as originally intended. The reference to § 23.67 in § 23.1189 did not keep current with the changes in § 23.67.

Section 23.67, climb: one engine inoperative, was amended by amendment 23–21, effective March 1, 1978. This amendment changed paragraphs (a) and (b) to be applicable for reciprocating engine-powered multiengine airplanes and added paragraph (c) to be applicable for turbine-powered multiengine airplanes. Paragraphs (a) and (b) are further restricted to airplanes of more than 6,000 pounds and 6,000 pounds or less maximum weight, respectively. Amendment 23–34, effective date February 17, 1987, further amended § 23.67. This amendment added airworthiness standards for commuter category airplanes to part 23 of the FAR. With amendment 23–34, § 23.67, paragraphs (a), (b), and (c) were changed to further limit their application to normal, utility, and acrobatic airplanes and a new paragraph (e) was added for one engine inoperative climb for the commuter category airplanes. During this time, the reference to §§ 23.67(a) and 23.67(b)(1), in § 23.1189, did not change. The original application of § 23.1189 was for all reciprocating engine-powered multiengine airplanes only. Since turbine-powered multiengine airplanes should also be included, the reference to § 23.67 is being deleted.

Reference: Conference proposal 409.

60. Section 23.1191 is amended in paragraph (a) by removing the words "intended for operation in flight,"; in paragraph (b) by removing the word "engine" and inserting in its place the word "isolated"; by removing and reserving paragraph (d) in paragraph (f)(1) by removing the term "2000±50 °F" and inserting in its place the term "2000±150 °F"; and by adding a new paragraph (h)(6) to read as follows:

§ 23.1191 Firewalls.

* * * * *

(h) * * *

(6) Titanium sheet, 0.016 inch thick.

Explanation: This proposal removes a rule that allows, under certain circumstances, fire resistant seals in fireproof firewalls, adds a new firewall material, and clarifies the intent that all heat producing devices must be separated from the airframe by firewalls or shrouds.

Conference proposal 410 recommended the deletion of § 23.1191(d). The justification was that fire resistant seals do not provide an adequate level of safety. Openings in firewalls on single-engine airplanes and multiengine airplanes not subject to § 23.67(a) or (b)(1) should meet the more stringent requirements of § 23.1191(c).

At the conference, a commenter pointed out that § 23.1191(a) requires firewalls, shrouds, etc., only for those heat-producing devices "intended for operation in flight". Such devices, when only operated on the ground, do not require firewall protection.

Another commenter objected to conference proposal 410 because it contained no cost/benefit analysis in the justification and because the group that the commenter represented needed to study and better understand the benefits of the proposal. At the conference, the FAA assured the commenter that such analysis would be accomplished before a proposal is presented for public comment.

The FAA has further considered these issues and has concluded that the intent of this section is to protect the airframe from high temperature producing equipment whether operated in flight or on the ground. Except for the engine, most of this equipment, when or where it is operated, requires little attention from the operator. Even those auxiliary power units only operated on the ground that demand minimum attention, have been and should be required to be installed in fireproof containers or compartments. This proposal would amend paragraph (a) by removing that part referring to operation in flight. In paragraph (b) the word "engine" is changed to the word "isolated" to parallel the requirement with paragraph (a) for all compartments.

The intent of the firewall requirement is to meet the fireproof requirements (withstand 2000° F flame for 15 minutes) for the total firewall installation. Allowing the seals on small openings to burn away after 5 minutes has been permitted; however, these openings have been limited to 1/32 inch radial clearance around components passing through the firewall. Even these openings are required to show by test that a hazardous amount of flame will not pass through. The FAA has concluded that, with the advent of modern, fireproof seals, this rule is obsolete for new designs.

Conference proposal 411 recommended adding a new paragraph (h)(6) to allow the use of 0.016 inch thick titanium sheet for firewall material without further testing. The justification given was that one aircraft manufacturer has qualified and used 0.016 inch thick titanium on its aircraft. This change would allow future use without costly development testing and increases the choice of previously qualified materials. When presented for discussion at the conference, a commenter stated that Joint Airworthiness Requirements (JAR) 25 allows 0.018 inch thick titanium as equivalent to the other materials specified in paragraph (h).

A post conference search discovered CAA Technical Development Report No. 317, dated September 1957, that shows test results for 0.016 inch titanium.

In paragraph (f)(1), the temperature tolerance of ±50 °F is raised to ±150 °F. The readily available test equipment has difficulty maintaining the required tolerance over a five-by-five inch area for five minutes.

The FAA has accepted the industry practice of ±150 °F on past certification programs.

Reference: Conference proposals 410 and 411.

61. Section 23.1193 is amended by revising paragraph (b) to read as follows:

§ 23.1193 Cowling and nacelle.

* * * * *

(b) There must be means for rapid and complete drainage of each part of the cowling in the normal ground and flight attitudes. Drain operation may be shown by test, analysis, or both, to ensure that under the most adverse aerodynamic pressure distribution expected in service each drain will operate as designed. No drain may discharge where it will cause a fire hazard.

* * * * *

Explanation: This proposal clarifies the intent of the rule; i.e., the drains must assure that all free fluids depart the airframe under any operating condition, whether in flight or on the ground.

Conference proposal 412 recommended revising paragraph (b) by replacing the words "flight attitudes" with the phrase "during all intended flight conditions" because this rule only requires an evaluation of the drain provision on the ground. Experience has shown that drains that work on the ground may not drain in flight when aerodynamic pressures are acting across the drains.

At the conference, a commenter suggested that the rule should require a flight test evaluation of the drain system. Another commenter objected to the proposed words "all intended flight conditions" because the FAA could require a flight test program that would go on forever and suggested perhaps the language could be improved by allowing analysis as an acceptable means of compliance. The FAA agrees that a test is needed to ensure that the drains work under all flight conditions. Certain evaluations and analyses can be done on the ground, but the ultimate proof is in the flight evaluation. The FAA, upon further consideration, concludes that the better approach to this problem would be to leave the current wording as is and add a new explanatory sentence to clarify the intent of the rule; i.e., that the drains enable any free fluids to escape the airframe under any expected operating condition.

Conference proposal 413 recommended adding a new paragraph (g), "Each cowling must be easily removable, without special tools or techniques, for routine maintenance. No more than 24 fasteners may be used to secure the cowling unless it can be shown that a single unaided technician can remove and install the cowling in less than five minutes using ordinary hand tools, or unless individual access covers sufficient in number and placement to accomplish all required between-100-hour checks have been provided in the cowl exterior". No justification was given for the recommendation. When presented for comment at the conference, the first commenter objected to the proposal as too detailed. The second commenter observed that ordinary hand tools could include can openers, hack saws, and axes; etc., and is not regulatory language. The FAA agrees that while such a requirement could aid in maintenance, it is not an airworthiness standard and plans no further consideration of this conference proposal.

Reference: Conference proposals 412 and 413.

62. Section 23.1195 is amended by redesignating paragraphs (a), (b), and (c) as paragraphs (a)(1), (a)(2), and (a)(3), respectively; by designating the introductory text of the section as paragraph (a) introductory text; and by adding a new paragraph (b) to read as follows:

§ 23.1195 Fire extinguishing systems.

* * * * *

(b) If an auxiliary power unit is installed in any airplane certificated to this part, that auxiliary power unit compartment must be served by a fire extinguishing system meeting the requirements of paragraph (a)(2) of this section.

Explanation: This proposal adopts requirements for auxiliary power unit compartment fire extinguishing systems. Currently, there are no requirements for such systems.

Conference proposal 414 recommended revising the § 23.1195, proposed in Notice No. 83-17, by inserting the words "and auxiliary power units" into the lead sentence after the word "airplane" and into paragraph (c) after the word "nacelle", two places. The justification given was that applicants for approval of auxiliary power unit installations should be informed of the requirements for such installations.

The proposal for a new § 23.1195 in Notice 83-17 was issued as a final rule (52 FR 1806, January 15, 1987). At the conference, three commenters objected to the word "simultaneously" because it could mean that the fire extinguishing system could be discharged into both an engine nacelle and the auxiliary power unit compartment at the same time. They did not think that was the intent of the proposed rule. The word "simultaneously" in the conference proposal was intended to indicate the capacity of the fire extinguishing system rather than to literally flood both areas instantaneously. One commenter recommended the adoption of the proposal for all part 23 airplanes, not just the commuter category. Another commenter objected to requiring all part 23 airplanes to have engine compartment fire extinguishing systems. The FAA agrees that there is no need for a fire extinguishing system in many engine installations. However, in some instances, for example where the engine is installed within the fuselage, extinguishing systems have been required.

The FAA has further considered these issues and is proposing a fire extinguishing system for all auxiliary power unit compartments, as such compartments are usually in the fuselage where the consequences of a fire are more varied and adverse than the typical engine fire.

Reference: Conference proposal 414.

63. Section 23.1203 is amended in paragraph (e) by removing the words "an engine compartment" and inserting in their place the words "a fire zone"; by removing the introductory text to the section; and by revising paragraph (a) to read as follows:

§ 23.1203 Fire detection system

(a) There must be means that ensures the prompt detection of a fire in—

(1) An engine compartment of—

(i) Multiengine turbine power airplanes;

(ii) Multiengine reciprocating engine powered airplanes incorporating turbochargers;

(iii) Airplanes with engine(s) located where they are not readily visible from the cockpit; and

(iv) All commuter category airplanes.

(2) The auxiliary power unit compartment of any airplane incorporating an auxiliary power unit.

* * * * *

Explanation: This proposal incorporates new requirements for fire detector systems in auxiliary power unit compartments and in the engine compartments on those airplanes where the engine(s) are not readily visible from the cockpit.

Conference proposal 415 recommended adding a new requirement by inserting the words "auxiliary power units" into the lead-in sentence and the words "and auxiliary power unit compartment" into paragraph (e). The justification given was that applicants for approval of auxiliary power unit installations should be informed of the requirements for such installations.

At the conference, a commenter suggested adding the words "fire zone" after the words "auxiliary power unit compartment" to further define the fire resistance capability of the area. The FAA agrees and proposes to revise paragraph (e) by removing the words "an engine and auxiliary power unit compartment" and replacing them with the words "a fire zone".

Conference proposal 416 recommended revising the lead-in sentence by adding at the end the statement "and airplanes with engine(s) located such that they are not readily visible from the cockpit". The justification given was that an engine compartment fire with an engine that was located on or near the centerline of the aircraft and aft of the pilot's station could go undetected for a significant period of time and could result in catastrophic failure of other main components. At the conference, a commenter agreed that the addition appears reasonable and the FAA agrees.

The FAA has further considered these issues and has concluded that this section lead-in would become too detailed and cumbersome. Therefore, the lead-in sentence and paragraph (a) have been combined and rearranged to clarify the intent of this section.

Reference: Conference proposals 415 and 416.

64. Section 23.1303 is amended by revising paragraph (c) to read as follows:

§ 23.1303 Flight and navigation instruments.

* * * * *

(c) A direction indicator (nonstabilized magnetic compass).

* * * * *

Explanation: This proposal would clarify the intent of the regulations for a magnetic nonstabilized direction indicator. The nonstabilized magnetic direction indicator, which does not require power from the airplane's electrical systems, provides directional information to the pilot when all other directional navigation systems have failed due to loss of power. There have been contentions that a magnetic direction indicator with a remote magnetic sensor should be acceptable because only one magnetic direction indicator is required and it is more accurate for navigation.

When the requirement for a magnetic direction indicator was promulgated, only a nonstabilized magnetic direction indicator (magnetic compass) was envisioned. Requirements in the operating rules for various kinds of operations are in addition to these basic requirements for type certification. The minimum level of safety established by these regulations was based on the reliability and failure modes of the nonstabilized magnetic compass and its ability to provide continuous heading information due to its functional independency.

Conference proposals 418 and 419 recommended listing all the instruments that are in the operational requirements. They are categorized in parts 91 and 135 by kinds of operations, such as day VFR, night VFR, IFR, and icing. At the conference, the consensus was that such requirements for part 23 airplanes should remain in the operating rules and not be redundantly stated in part 23. Instruments and equipment installed to qualify the airplane for the various kinds of operations set forth in the operating rules must be found to comply with applicable requirements of this subpart and be listed in the Airplane Flight Manual (AFM) in accordance with § 23.1583.

Conference proposal 419 further recommended dual instruments for commuter category airplanes. The minimum crew requirements for type certification may be different than the operational requirements of parts 91 and 135. If a second pilot is required for a specific operation, the instruments used by that pilot must also comply with § 23.1321. The FAA is unaware of any configuration that would comply with § 23.1321 without each pilot having an individual set of instruments.

Proposal 421 is being considered under § 23.1331, since it dealt with independent power sources for instruments.

Reference: Conference proposal 418, 419, and 421.

65. Section 23.1305 is revised to read as follows:

§ 23.1305 Powerplant instruments.

The following are required powerplant instruments:

(a) *For all airplanes.*

(1) A fuel quantity indicator for each fuel tank, or for each assembly of interconnected tanks that function as one tank.

(2) An oil pressure indicator for each engine.

(3) An oil temperature indicator for each engine.

(4) An oil quantity measuring device for each oil tank.

(5) A fire warning means for those airplanes required to comply with § 23.1203.

(b) *For reciprocating engine-powered airplanes.* In addition to the powerplant instruments required by paragraph (a) of this section, the following powerplant instruments are required:

(1) An induction system air temperature indicator for each engine equipped with a preheater and having induction air temperature limitations that can be exceeded with preheat.

(2) A tachometer indicator for each engine.

(3) A cylinder head temperature indicator for—

(i) Each air-cooled engine with cowl flaps;

(ii) Each airplane for which compliance with § 23.1041 is shown at a speed higher than V_y; and

(iii) Each commuter category airplane.

(4) A fuel pressure indicator for each pump fed engine.

(5) A manifold pressure indicator for each altitude engine and for each engine with a controllable propeller.

(6) For each turbocharger installation:

(i) If limitations are established for either carburetor (or manifold) air inlet temperature or exhaust gas or turbocharger turbine inlet temperature, indicators must be furnished for each temperature for which the limitation is established unless it is shown that the limitation will not be exceeded in all intended operations.

(ii) If its oil system is separate from the engine oil system, oil pressure and oil temperature indicators must be provided.

(7) A coolant temperature indicator for each liquid-cooled engine.

(c) *For turbine engine-powered airplanes.* In addition to the powerplant instruments required by paragraph (a) of this section, the following powerplant instruments are required:

(1) A gas temperature indicator for each engine.

(2) A fuel flowmeter indicator for each engine.

(3) A fuel low pressure warning means for each engine.

(4) A fuel low level warning means for any fuel tank that should not be depleted of fuel in normal operations.

(5) A tachometer indicator (to indicate the speed of the rotors with established limiting speeds) for each engine.

(6) An oil low pressure warning means for each engine.

(7) An indicating means to indicate the functioning of the powerplant ice protection system for each engine.

(8) For each engine, 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).

(9) For each engine, a warning means for the oil strainer or filter required by § 23.1019, if it has no bypass, to warn the pilot of the occurrence of contamination of the strainer or filter screen before it reaches the capacity established in accordance with § 23.1019(a)(5).

(10) An indicating means to indicate the functioning of any heater used to prevent ice clogging of fuel system components.

(d) *For turbojet/turbofan engine-powered airplanes.* In addition to the powerplant instruments required by paragraphs (a) and (c) of this section, the following powerplant instruments are required:

(1) For each engine, an indicator to indicate thrust or to indicate a parameter that can be related to thrust, including a free air temperature indicator if needed for this purpose.

(2) For each engine, a position indicating means to indicate to the flight crew when the thrust reverser, if installed, is in the reverse thrust position.

(e) *For turbopropeller-powered airplanes.* In addition to the powerplant instruments required by paragraphs (a) and (c) of this section, the following powerplant instruments are required:

(1) A torque indicator for each engine

(2) A position indicating means to indicate to the flight crew when the propeller blade angle is below the flight low pitch position, for each propeller, unless it can be shown that such occurrence is highly improbable.

(3) For each gearbox or transmission, a chip detector indicator light.

Explanation: This proposal clarifies the powerplant instrument requirements by separating the reciprocating engine, turbine engine, turbojet/turbofan, and turbopropeller requirements; and adding requirements for coolant temperature indicator, fuel low-level warning, manifold pressure indicator, and chip detector indicator.

Conference proposal 422 recommended revising paragraph (a) by adding the phrase "or for each unit of interconnected tanks functioning as a unique tank". The justification given was that this recommendation is consistent with § 23.953(b), which makes no distinction between a single fuel tank and series of fuel tanks interconnected to function as a single fuel tank. At the conference, the commenters agreed the change would clarify the rule; however, one commenter suggested that the word "unique" should be the word "single". The proponent agreed that the word should be "single". Post conference review led to the clarified proposal to ensure that the requirement is consistent with § 23.1337(b)(4).

Conference proposal 423 recommended revising paragraph (b) by inserting the phrase "or a low oil pressure warning" after the word "indicator". The justification given was that usually a pressure indicator comprises 3 ranges: for the proper functioning, for caution, and for warning the crew of a failure or an abnormal condition. An indication in the caution range will require more attention from the crew, which possibly takes corrective actions if the indication goes into the "failure range" (reduce the power, land as soon as possible). With a low oil pressure warning suitably adjusted, the corrective actions will be the same and safety is not impaired. At the conference, the proponent stated that this conference proposal is a cheaper way to achieve the same conclusion. The low pressure warning should be set to function as soon as there is a small loss of oil pressure. Two commenters opposed the change because a single light cannot furnish the trend information, both high and low pressure, that is required in an engine oil pressure instrument. The FAA agrees that, with few exceptions, the powerplant instruments specified under § 23.1305 are expected to provide trend information.

Another commenter pointed out there are trends toward unregulated oil systems that have extreme pressure variations. The commenter stated his belief that a single point indication would be adequate in this case and that the current rule permits such a simple readout, even though it may not meet the part 1 definition of an instrument.

The FAA reviewed the part 1 definition of the word "instrument", and other technical data and has concluded as follows: (1) where a light is sufficient, the instrument requirement should be changed to a "warning means"; (2) where trend information is needed, the word "indicator" should be retained; and (3) where point operation or steps in a sequence need to be shown, the words should be changed to "indicating means"; i.e., the functioning of an ice protection system.

Conference proposal 424 recommended revising § 23.1305(d) by adding a new requirement: "Tachometer scale error must not exceed 2 percent" and by adding to paragraph (h) the words "and for each engine with a controllable propeller". The justification given was that when excessive vibration stresses are found in portions of the normal operating range, § 23.1549(d) requires a red arc on the tachometer that means "do not operate" in this range. Experience and field surveys show tachometers are not accurate enough to prevent operation in the high stress area that ultimately results in propeller blade failures. Manifold pressure, along with engine rpm, is necessary for engines with controllable propellers to determine power settings.

At the conference, six commenters objected to adding the tachometer scale accuracy requirement because they considered it was not needed or appropriate. The conference consensus was to leave it up to the engine installation manual to state the required instrument accuracies. Most engine-propeller combinations do not need a high accuracy instrument to aid in avoiding any excessive vibration rpm ranges. Another commenter stated that the addition to paragraph (h) is acceptable as long as the requirement is restricted to reciprocating engine airplanes. Also, in paragraph (e), the rule should allow the exemption of some rotors from the speed readout requirement where those rotor speeds are not particularly significant. There are a large number of turbine engines with three rotors where one or two rotors are so dependent on the remaining rotor(s) that their speeds are not of any particular interest to the flight crew.

The FAA considered these issues and concluded that the tachometer accuracy is not needed, and no change is needed to paragraph (3) because the words "rotors with established limiting speeds" are adequate. Because of the apparent cost impact of requiring very accurate tachometers in airplanes where they are not needed, the FAA has determined that the appropriate place for specifying instrument accuracy is the engine installation manual. The same is true for the significant rotor speeds of paragraph (e). The installation manual should specify the rotor speed(s) information of use to the flight crew and for tachometer range marking.

Conference proposal 425 recommended adding a new paragraph (x) to read as follows: Each powerplant instrument required in paragraphs (d), (e), (g), (j), (k), (l), and (m) must display trend and rate of change indication. The justification given was that electronic displays, with lighted elements, required a specific, discrete update rate or time to display the information. This rate or time is critical to the readability of the display and is not presently controlled by the regulations.

At the conference, the several commenters did not reach a consensus. After further consideration, the FAA has concluded that each instrument installation must be evaluated individually; however, analog indicators are usually best at showing rates and trends. One commenter stated that paragraph (1) needed clarification and suggested the words "gas stream pressure" be replaced with the word "parameter". The FAA has considered these issues and has concluded that electronic displays should be addressed in a new § 23.1311. Notice 5 of the Small Airplane Airworthiness Review Program contains that proposal. The suggested change to paragraph (1) has been determined to be appropriate and has been incorporated in proposed § 23.1305(d)(1) of this proposal.

Conference proposal 426 recommended revising paragraph (f) by adding "and for each engine with pilot-operated mixture control" and paragraph (h) by adding "and for each engine driving a constant speed propeller" because this section does not properly define the requirements for cylinder head or manifold pressure instruments. Cylinder head limit temperatures can be exceeded by leaning the engine, and manifold pressure is needed to determine power settings and avoid over-boosting. At the conference, a commenter questioned the need for the change to (f), particularly since compliance with § 23.1041 must be shown. Another commenter stated that there are a great number of airplanes in use today that have pilot-operated mixture controls but do not have a cylinder head temperature (CHT) indicator. Another commenter objected to the paragraph (f) proposal if having automatic mixture control would allow deletion of the CHT indicator. The FAA has considered these issues and concluded that paragraph (f) needs to be clarified. As noted previously, the entire section has been rearranged to separate the requirements for the several modes of aircraft propulsion.

Conference proposal 427 recommended revising paragraph (f) by deleting the phrase "with cowl flaps". This would make CHT instrumentation mandatory on all air-cooled reciprocating engines. No further justification was offered. At the conference, five commenters agreed that a CHT indicator would be nice to have on any reciprocating engine installation, but is not always a necessity. The FAA agrees that CHT indicators are handy, but since cooling tests are normally run under critical operating conditions, with or without cowl flaps, there is no need for CHT indicators on all reciprocating engine airplanes. The FAA plans no further action on this recommendation.

Earlier airworthiness standards contained requirements for both liquid-cooled and air-cooled engine installations. The requirement for a coolant temperature indicator for liquid cooled engines was deleted from the rules, without explanation, by Civil Air Regulations, amendment 3–5, effective October 1, 1959. Since there have been few, if any, liquid-cooled engines installed in part 23 airplanes, the lack of this requirement was not noted until the Small Airplane Airworthiness Review Program. New design features are making the liquid-cooled engine attractive for installation; therefore, the requirements for coolant temperature indicator needs to be readopted into part 23.

Conference proposal 429 recommended revising paragraph (g) by inserting the words "or a low fuel pressure warning" after the word "indicator". The justification given was that a low fuel pressure warning will better alert the pilots than an indicator will if the fuel pressure falls. The corrective action taken by the pilot is the same whatever the indication means. At the conference, two commenters supported the proposal, particularly for turbine engine airplanes. Review of equivalency findings allowing fuel low pressure warning lights on some turbine powered airplanes, led the FAA to conclude a low fuel pressure warning is an acceptable alternative to an indicator for turbine engines.

Conference proposal 430 recommended revising § 23.1305 by deleting paragraph (n) entirely since a requirement to indicate to the crew when the propeller blade angle is below the flight low pitch stop is redundant. Section 23.1155 currently requires that a separate and distinct operation by the crew is necessary to displace the propeller control from the flight regime to below the flight idle position. This equates to a conscious and deliberate selection of propeller blade angles below flight idle. Deliberate crew action, when taken in combination with an undeniable and immediately discernible drag rise from propeller blade angles below flight idle stop, will achieve the necessary level of safety envisioned by part 23.

At the conference, a commenter stated that § 23.1305(n) appears to be redundant because § 23.1155 requires stops and distinct operation of the power lever to go to blade angles below flight idle. Another commenter stated that § 23.1305(n) originated with piston engines that incorporated a mechanical flight low pitch stop. If the stop failed, the flight crew should be alerted. Modern propellers on turboprop engines have different characteristics. Any failure of the system on the hydraulic (oil pressure) side will result in the propeller increasing in pitch. The hazard the current rule addresses no longer exists and there is no benefit to the required indication.

A commenter stated that since some airplanes are taxied with the propeller in the Beta range, it is a good idea to have the indication so the pilot knows when the propeller moves into the flight range. Another commenter questioned whether there is a failure mode that could cause the blade to move to low pitch angle, and, therefore, require the pilot to be warned. A commenter stated that modern propellers will move toward feather except in the case of certain structural failures. Older systems could fail in such a way that the blades would go toward flat pitch and, invariably, those propellers had backup systems to prevent that from happening. It should be pointed out that Beta range is not always consigned to ground operation. On short takeoff and landing (STOL) airplanes, it is part of the normal flight regime.

A commenter attempted to clarify the discussion in that some early model reciprocating engine propellers, when hydraulic (oil) pressure was lost, would go into low pitch through normal centrifugal twisting moment forces. Later model propellers are counterweighted so that when hydraulic pressure is removed, the natural geometry and mass of the blade will move it to high pitch position. With respect to the Beta range, modern turboprop engines provide for a Beta light to show when the engine is in the Beta mode of operation. This mode can include reverse pitch and forward blade angles up to and above the flight low pitch stop position. It is a mode of operation controlling blade angle, as opposed to governing. The rule either needs to be deleted or clarified to provide the indication of interest; i.e., the Beta range.

A commenter made the observation that there is a degree of antiquity in this rule. He asked if there was anyone who remembered the perceived hazard that initiated this rule? Also, there are some airplane types that are in compliance with this rule, after the Beta light was deleted, based on power lever position. The FAA replied that some designs could inadvertently get into Beta range due to a particular failure mode and concludes that an indication is needed. The FAA does not see a conflict between §§ 23.1155 and 23.1305; the former requires a stop and a distinct operation of the power lever while the latter requires an indication to the pilot.

The FAA has further considered these issues and concluded that the requirement for a blade position indicating means for each turboprop engine propeller should be retained. This requirement is included in the new turboprop requirement paragraph.

Conference proposal 431 recommended revising § 23.1305(p) by inserting the parenthetical wording "(or manifold)" after the word "carburetor"; and inserting the words "or turbocharger turbine inlet" after the word "gas". The justification given was that this proposal includes fuel injected and turbocharged engines, which may have limiting temperatures. At the conference, the consensus supported the recommendation. The FAA concurs and this recommendation has been included.

Subsequent to the part 23 review, the FAA became aware of safety benefits that could be offered by the installation of a warning light that would alert the pilot that the fuel in the tanks being used was at a low level. Such a low level fuel warning light would alert the pilot to take action to either make a fuel management correction or to land the airplane prior to fuel starvation and engine stoppage. To provide this additional level of safety for fuel systems, a low level warning means has been proposed in § 23.1305(c)(4).

Service experience also indicates that it may be appropriate to require chip detector indicator lights for turbine engines and gear boxes. These lights show trend information in that they indicate distress in the engine bearings and gear drives allowing corrective action before total failure. Generally, if oil filter bypass, low oil pressure, or high oil temperature is indicated, it is too late for effective corrective action; the failure is imminent. Proposed chip detector indicator lights are added in § 23.1305(e)(3).

Reference: Conference proposals 422, 423, 424, 425, 426, 427, 429, 430, and 431.

66. Section 23.1307 is amended in paragraph (a) by removing the words "an approved" and inserting in their place the word "a"; and by adding a new paragraph (c) to read as follows:

§ 23.1307 Miscellaneous equipment

* * * * *

(c) All equipment necessary for an airplane to operate in the National Airspace System (NAS) at its maximum operating altitude and in all kinds of operations and meteorological conditions for which it is certificated in accordance with § 23.1559 must be included in the type design.

Explanation: This proposal deletes the word "an approved" in § 23.1307, and adds a new requirement that all equipment items necessary for the airplane to operate in the National Airspace System (NAS) to its maximum approved altitude and in all kinds of operations for which it is approved must be included in the type design.

Conference proposal 432 recommended deleting § 23.1307(a) in its entirety, because it was redundant to § 23.785(b). Conference proposal 433 recommended deleting only the word "approved" in § 23.1307(a).

Both §§ 23.1307 and 23.785(b) contain seat requirements; however, § 23.1307(a) only requires a seat or berth for each occupant, while § 23.785(b) contains specific design requirements for each seat, berth, safety belt, and shoulder harness, but does not include requirements for a seat or berth to be provided for each occupant. The requirements of § 23.1307(a) were added by amendment 23–23 to eliminate questions as to the maximum seating capacity and compliance with the emergency exit requirements. The FAA does not consider these requirements to be redundant and plans no further action on these recommendations.

A new paragraph (c) is added because the FAA considers it necessary to clarify the type design requirements for part 23 airplanes relative to equipment items. Frequently, manufacturers have requested their airplanes be approved relative to structural, performance, and propulsion requirements for a specific altitude without also requesting approval of necessary equipment to operate at that altitude. The FAA considers it necessary for the type design to include all equipment necessary for operation in accordance with the limitations required by §§ 23.1559 and 23.1583.

Reference: Conference proposals 432 and 433.

67. Section 23.1322 is amended by adding a new paragraph (e) to read as follows:

§ 23.1322. Warning, caution, and advisory lights.

* * * * *

(e) Effective under all probable cockpit lighting conditions.

Explanation: This proposal is addressed in conference proposal 438. It requires that the specific colors be consistent with change in brightness over the full range of ambient light conditions in the cockpit and that the luminance difference and/or color difference be sufficient to preclude confusion or ambiguity under all probable cockpit lighting conditions. Light color is not controlled by a lens color cathode ray tube (CRT) displays now being incorporated into airplanes. Cockpit lighting evaluations are required in § 23.1321 and clarification is needed in this section to assure compliance with these requirements.

Reference: Conference proposal 438.

68. Section 23.1329 is amended by redesignating paragraphs (b), (c), (d), (e), (f), and (g) as (c), (d), (e), (f), (g), and (h),

respectively; and adding a new paragraph (b) to read as follows:

§ 23.1329 Automatic pilot system.

* * * * *

(b) If the provisions of paragraph (a)(1) of this section are applied, the quick release (emergency) control must be located on the control wheel (both control wheels if the airplane can be operated from either pilot seat) on the side opposite the throttles, or on the stick control, such that it can be operated without moving the hand from its normal position on the control.

* * * * *

Explanation: This proposal would standardize the location of the quick release (emergency) control for autopilot systems. Standardization permits consistency of pilot responses in preventing hazardous airplane attitudes during autopilot malfunctions.

Conference proposal 443 recommended standardizing the location, but it did not specify the location. Comments at the conference indicated that such a proposal is open to various interpretations and would cause disagreement in the certification process. It was suggested that FAA should specify the location of the quick release control in this proposal. The location specified is consistent with the requirements for part 25 airplanes, except this proposal allows the control to also be located on a stick control.

Conference proposal 444 recommended installing an indicator for determining adequacy of pneumatic or suction source pressure that would affect autopilot function in any axis. Since there is limited production of autopilots that utilize a pneumatic pressure as the autopilot power source and future autopilots are not expected to use pneumatic power, the FAA plans no further action on conference proposal 444.

Reference: Conference proposal 443 and 444.

69. Section 23.1331 is revised to read as follows:

§ 23.1331 Instruments using a power source.

For each gyroscopic instrument the following apply:

(a) Each instrument must have a visual annunciator integral with or adjacent to the instrument to indicate when power is not adequate to sustain proper instrument performance. The power must be sensed at or near the point where it enters the instrument. For electric and vacuum/pressure instruments, the power is considered to be adequate when the voltage or the vacuum/pressure, respectively, is within approved limits.

(b) The installation and power supply systems must be designed so that—

(1) The failure of one instrument will not interfere with the proper supply of energy to the remaining instrument; and

(2) The failure of the energy supply from one source will not interfere with the proper supply of energy from any other source.

(c) There must be at least two independent sources of power (not driven by the same engine on multiengine airplanes), and a manual or an automatic means to select each power source.

Explanation: This proposal requires a visual annunciation to indicate when power for gyroscopic instruments is not adequate, and two independent sources of power for all airplanes. Requirements in current paragraphs (a)(1) and (a)(2) are being deleted because the general requirements of §§ 23.1301 and 23.1309 will adequately address these issues.

Conference proposals 445, 446, and 447 recommended a visual means to indicate the adequacy of the power being supplied to the gyroscopic instruments. It was reported, in many cases, that the pilot does not have adequate warning after instrument power source failure. Section 23.1331 contained a requirement that there must be a means to indicate the adequacy of the power being supplied to the instruments, but this requirement is not specific relative to location. Most low cost gyroscopic instruments do not have a warning flag and, in many cases, this power warning indicator has been located outside the normal pilot scan. Consequently, the pilot's first clue of power failure is that the airplane is either turning, climbing, descending, and so forth, without corresponding instrument indication. If the pilot recognized the failure immediately, the pilot would more readily recognize and disregard erroneous or misleading information and transition quickly to partial panel.

Conference proposals 445, 446, and 448 also recommended requirements for redundant gyroscopic instruments power sources and at least two independent sources of power for multiengine airplanes. Conference proposal 445 would promote standardization in the application of FAA regulations since new technology permits complex systems installed in part 25 airplanes to also be installed in part 23 airplanes. One commenter stated that sophisticated and complex systems may be installed in part 23 airplanes but it is incorrect to assume all new part 23 airplanes will have complex systems. Therefore, the regulations should have a distinction between them, or the price of small simple airplanes will be too high.

The FAA has concluded that the requirements of § 25.1331 are not appropriate to part 23 airplanes. Small Airplane Airworthiness Review Program Notice No. 5 contains a proposal to amend § 23.1309, which would be applicable for complex safety-critical systems, and proposed paragraph (c) will provide adequate power supply redundancy for other airplanes.

Conference proposals 446 and 448 would require redundant power sources for gyroscopic instruments in airplanes approved for night, known icing conditions, and day VFR conditions. Conference proposal 421 recommended amending § 23.1303 by requiring that the attitude and direction indicators on single-engine airplanes have a power source independent from the power source for the pneumatic deicing equipment, autopilot, or cabin pressurization system. The justification for this proposal was that single-engine airplanes do not have adequate gyroscopic instrument redundancy and, between 1978 and 1981, there were large numbers of vacuum pump failures. At the conference, considerable confustion existed relative to what was intended by proposal 421. The FAA concludes the intent was to require redundant power sources for gyroscopic instruments. Proposed paragraph (c) would require such redundancy.

Conference proposal 446 also recommended deleting paragraph (a)(1) and (a)(2) since these requirements are applicable to venturi systems. As previously stated, the FAA is proposing to delete paragraphs (a)(1) and (a)(2).

Reference: Conference proposal 421, 445, 446, 447, and 448.

§ 23.1337 [Amended.]

70. Section 23.1337 is amended in paragraphs (a)(1) and (a)(3) by inserting the words "and auxiliary power unit" after the word "powerplant" and in paragraph (b)(5) by removing the words "a small" and inserting the word "an".

Explanation: This proposal adds APU installation requirements and clarifies fuel quantity indicator requirements.

Conference proposal 449 recommended amending this section to include APU requirements for the reason that applications have been received for approval of auxiliary power unit installations in part 23 airplanes. These installations also need protection from the escape of flammable fluids. At the conference, the only commenter suggested it might be appropriate to place all auxiliary power unit requirements in a separate section rather than scattering them throughout the many different rule sections. In response, the FAA has further considered this issue and has concluded that, in an effort to maintain parallelism among the airworthiness standards, the auxiliary power unit requirements should be addressed where possible in sections with corresponding numbers in other airworthiness parts.

The proposed revision to paragraph (b)(5) will maintain compatibility with proposed changes to § 23.955(d).

Reference: Conference proposal 449.

71. Section 23.1351 is amended by revising paragraphs (c)(1) and (c)(3) and adding a new paragraph (g) to read as follows:

§ 23.1351 General.

* * * * *

(c) * * *

(1) Each generator must be able to deliver its continuous rated power, or such power as is limited by its regulation system;

* * * * *

(3) Means must be provided to disconnect each generator from the battery and other generators when enough reverse current exists that might damage the generator, or will adversely affect the airplane electrical system.

* * * * *

(g) It must be shown by analysis, tests, or both, that the airplane can be operated safely in VFR conditions, for a period of not less than five minutes, with the normal electrical power (electrical power sources excluding the battery and any other standby electrical sources) inoperative, with critical type fuel (from the standpoint of flameout and restart capability), and with the airplane initially at the maximum certificated altitude. Parts of the electrical system may remain on if—

(1) A single malfunction, including a wire bundle or junction box fire, cannot result in loss of the part turned off and the part turned on; and

(2) The parts turned on are electrically and mechanically isolated from the parts turned off.

Explanation: This proposal would allow a generator to be installed and operate below its continuous rating when it has a rating higher than necessary, allow methods other than reverse current cutouts for protecting against reverse current, and would require the airplane to operate safely for 5 minutes without normal electrical power.

Conference proposal 453 recommended revising paragraphs (c)(1) and (c)(3) essentially as proposed herein. The justification given is that the generator-rated output may be higher than required for the electrical loads of the airplane and, in such case, the electrical system (generator output) is limited by its regulation system. The consensus at the conference supported the objective of this conference proposal. The FAA agrees with the need for changing paragraph (c)(1) to clarify its intent and to revise paragraph (c)(3) to relieve the burden to install a specific type of reverse current control where more efficient and less costly controls are now available.

Conference proposal 456 recommended adding paragraph (g), essentially as proposed herein except the requirement would only be applicable for airplanes operated above 25,000 feet. The justification was that part 23 airplanes that operate at high altitudes above 25,000 feet depend upon electrical power for safe operation. Emergencies involving loss of normal electrical power at or above this altitude typically result in the loss of other systems, such as electric fuel pumps, pressurization system, warning system, navigation, communications, and instrumentation. The FAA developed special conditions for part 25 that initiated the requirement in this proposal and it was later adopted into part 25 by amendment 25-41, in 1977. Conference proposal 456 was essentially developed from the part 25 requirements except for the 25,000 foot applicability. When offered for comment at the conference, there were no objections on conference proposal 456. After further review, FAA has concluded that the proposal should not be limited to airplanes that operate above 25,000 feet since emergencies resulting in the loss of normal electrical power are critical for all airplanes. Five minutes is considered adequate time to cope with such an emergency so that pilot can operate the airplane safely and assess the reason for the loss of normal electrical power.

Conference proposal 452 recommended changing the phrase "essential for safe operation" to "essential to flight safety" for consistency in the regulations. A word search of the regulations indicated that there were other phrases such as "essential to safety of flight," and "essential to continued safe operation." All of these phrases have been interpreted to have the same meaning. Since the affected regulations have been administered effectively without significant problems, the FAA does not consider the recommended change to be beneficial.

Conference proposal 451 recommended a dual electrical power distribution system. At the conference, there was confusion as to its applicability and what would be an acceptable means of compliance. The FAA has addressed related issues in Notice 5 of the Small Airplane Airworthiness Review Program and is taking no further action on this conference proposal.

Conference proposal 454 recommended adding a voltmeter as an additional required instrument in paragraph (d) and conference proposal 455 recommended deleting the entire second sentence of § 23.1351(d). Conference commenters considered the ammeter to be more valuable than a voltmeter because an ammeter can better indicate the performance of the generator and the magnitude of the electrical loads. Voltage variations could be small when there are large variations in power or current. The FAA agrees and plans no further action on these two proposals.

Conference proposal 455a, relating to fire resistance of electrical equipment, was considered interpretive material and no further action will be taken in this notice.

Reference: Conference proposals 451, 452, 453, 454, 455a, and 456.

72. Section 23.1357 is amended by revising paragraphs (a)(1) and (e) to read as follows:

§ 23.1357 Circuit protective devices.

(a) * * *

(1) Main circuits of starter motors used during starting only; and

* * * * *

(e) For fuses identified as replaceable in flight—

(1) There must be one spare of each rating or 50 percent spare fuses of each rating, whichever is greater; and

(2) The spare fuse(s) must be readily accessible to any required pilot.

Explanation: The intent has historically been to protect the airplane from the hazards of all electrical faults. Paragraph (a)(1) exempted starting motor circuits because they did not have power applied, except during engine starting. It is proposed to clarify the intent of paragraph (a)(1). The existing rules of paragraph (e) require spare fuses for all electric circuits. This proposal would require spare fuses for fuses identified as replaceable in flight, which would be those required by paragraph (d) and any other fuses identified as replaceable in flight. This proposal would also require the fuses be readily accessible and available.

Conference proposal 460 recommended paragraph (e) be combined with paragraph (d), so the applicability of paragraph (e) would only be for essential circuits. At the conference, there was an objection to having more than one requirement in one paragraph and it was recommended that the requirements be in separate paragraphs as in this proposal. The requirement to have spare fuses for nonessential circuits, such as cigarette lighter, map light, and refreshment bar, are not necessary for safety. However, if they are identified as replaceable in flight, the available spare fuses for essential circuits are likely to be used to replace them. If spare fuses were used for nonessential circuits and such fuses were not allocated for in establishing the required number of spares, fuses may not be available for the essential circuit replacement.

Conference proposal 459 recommended revising paragraph (a)(2) to clarify that its applicability was for short lengths of wire. At the conference, this recommendation was opposed since there could be different interpretations of what is considered a short length of wire and since the existing rule was clear on this matter.

Reference: Conference proposals 459 and 460.

73. Section 23.1361 is amended by revising paragraphs (a) and (b) to read as follows:

§ 23.1361 Master switch arrangement.

(a) There must be a master switch arrangement to allow ready disconnection of all electric power sources from power distribution systems, except as provided in paragraph (b) of this section. The point of disconnection must be adjacent to the sources controlled by the switch arrangement. A separate switch may be incorporated into the arrangement for each separate power source provided the switch arrangement can be operated by one hand with a single movement.

(b) Load circuits may be connected so that they remain energized when the master switch is open, if the circuits are isolated, or physically shielded, to prevent their igniting flammable fluids or vapors that might be liberated by the leakage or rupture of any flammable fluid system; and—

(1) The circuits are required for continued operation of the engine; or

(2) The circuits are protected by circuit protective devices with a rating of five amperes or less adjacent to the electric power source.

(3) In addition, two or more circuits installed in accordance with the requirements of paragraph (b)(2) of this section must not be used to supply a load of more than five amperes.

* * * * *

Explanation: The proposal clarifies the master switch arrangement requirement and permits new generations of engines to operate with the master switch turned off, as is necessary to isolate hazardous electrical faults.

Subsequent to the receipt of the proposals submitted for the Part 23 Review, engine designs have been developed that depend on an electrical power source for normal ignition and/or fuel pressure. An electrical fault that makes it necessary to turn off the master switches must not cause unintentional disabling of such designed engines. However, the pilot must retain the capability to isolate all sources of electrical energy that might ignite flammable fluids that are likely to escape during a survivable crash landing.

When conference proposal 461 was discussed, a commenter specifically noted that he had no objections to the multiple circuits restriction in the proposal and supported that position. The commenter did express a concern that the proposal, "Load, circuits, such as cabin entry lights whose functions are needed prior to entering the cockpit," may unnecessarily limit those circuits to those functions that are needed before entering the cockpit. It was noted that there are other continuously energized circuits that do meet the "needed prior to entering the cockpit" definition in the proposal. A circuit for an electrical clock was cited as an example.

The FAA has reviewed the proposal and this discussion and agrees that while the proposed wordage was only intended to provide an example of the type of circuit that was permitted by this section, it could be interpreted as more restrictive than intended; therefore, this example language has not been included in this proposal. This action by FAA should not be interpreted as an endorsement to install an unlimited number of circuits that bypass the master switch. This provision was added to, and retained in, the requirements because it was recognized that there are a limited number of electrical functions that are needed when the master switch is in the position. The requirements of this section provide for the safe installation of these circuits. The five ampere load restriction of a new paragraph (b)(3) was added because the FAA was made aware of an installation in which this provision was being used to circumvent the master switch arrangements by using up to four five-ampere fuses to supply a 20 ampere circuit. This restrictive provision should make it clear that such installations are not permitted.

Reference: Conference proposal 461.

74. Section 23.1365 is amended by adding a new paragraph (c) to read as follows:

§ 23.1365 Electric cables and equipment.

* * * * *

(c) Main power cables (including generator cables) in the fuselage must be designed to allow a reasonable degree of deformation and stretching without failure and must—

(1) Be isolated from flammable fluid lines; or

(2) Be shrouded by means of electrically insulated flexible conduit, or equivalent, which is in addition to the normal cable insulation.

Explanation: This proposal provides crashworthiness standards for electrical cables. It would require that electrical cables be designed to allow a reasonable degree of deformation and stretching without failure and be isolated from flammable fluid lines or must be shrouded in insulated flexible conduit. Conference proposal 462 recommended substantially equivalent requirements. A conference commenter questioned whether this proposal is for a specification for the cable or an installation standard since this proposal is substantially equivalent to § 25.1359(c), which has been successfully administered for several years as an installation standard.

Reference: Conference proposal 462.

75. Section 23.1385 is amended in paragraph (c) by removing the phrase ", and must be approved"; by removing paragraph (d); and by redesignating paragraph (e) as paragraph (d); and by revising paragraph (b) to read as follows:

§ 23.1385 Position light system installation.

* * * * *

(b) *Left and right position lights.* Left and right position lights must consist of a red and a green light spaced laterally as far apart as practicable and installed on the airplane such that, with the airplane in the normal flying position, the red light is on the left side and the green light is on the right side.

* * * * *

Explanation: This proposal clarifies the location requirements for the position lights, deletes the requirement for a single circuit, and removes the redundant statement "must be approved". Conference proposal 464 recommended changing paragraph (b) so the location of position lights can be compatible with airplane configurations such as tandem wing, canards, and swept wings. The words "forward on the airplane" in paragraph (b) have been interpreted to mean the first 50 percent of the airplane length.

Conference proposal 465 recommended deleting paragraph (d) since it had been interpreted to prohibit multiple circuits from being installed. A consensus at the conference supported both of these recommendations.

The FAA has further studied these issues and concludes clarification is required and that the proposed requirements are substantively equivalent to the current rule.

Conference proposal 463 recommended that §§ 23.1385 up to 23.1395 and § 23.1401 be rewritten because these sections are too technical. There was no representative at the conference for this proposal to provide clarification or definite details needed. The proposal was not discussed and the FAA plans no further action on proposal 463.

Reference: Conference proposals 463, 464 and 465.

§ 23.1387 [Amended]

76. Section 23.1387 is amended in paragraph (a) by removing the words "forward and rear".

Explanation: Removal of the words "forward and rear" from paragraph (a) is necessary for compatibility with revised § 23.1385.

Reference: Proposal 75.

§ 23.1389 [Amended]

77. Section 23.1389 is amended in paragraph (b) by removing words "Forward and rear" from the heading, by changing the word "position" in the heading to read "Position", and by removing the words "forward and rear" from the first sentence; in paragraph (b)(3) by removing the word "forward" in the last sentence and inserting in its place the words "left and right".

Explanation: These changes are necessary for compatibility with revised § 23.1385.

Reference: Proposal 75.

§ 23.1391 [Amended]

78. Section 23.1391 is amended in the section heading by removing the words "forward and rear" and in the table by removing the words "(forward red and green)" and inserting in their place "(red and green)".

Explanation: These changes are necessary for compatibility with revised § 23.1385.

Reference: Proposal 75.

§ 23.1393 [Amended]

79. Section 23.1393 is amended in the section heading by removing the words "forward and rear".

Explanation: This change is necessary for compatibility with revised § 23.1385.

Reference: Proposal 75.

§ 23.1395 [Amended]

80. Section 23.1395 is amended in the section heading by removing the words "forward and rear".

Explanation: This change is necessary for compatibility with revised § 23.1385.

Reference: Proposal 75.

81. Section 23.1419 is revised to read as follows:

§ 23.1419 Ice protection.

If certification with ice protection provisions is desired, compliance with the requirements of this section and other applicable sections of this part must be shown:

(a) An analysis must be performed to establish, on the basis of the airplane's operation needs, the adequacy of the ice protection system for the various components of the airplane. In addition, tests of the ice protection system must be conducted to demonstrate that the airplane is capable of operating safely in continuous maximum and intermittent maximum icing conditions, as described in appendix C of part 25 of this chapter. As used in this section, "Capable of operating safely," means that airplane performance, controllability, maneuverability, and stability must not be less than that required in part 23, subpart B.

(b) In addition to the analysis and physical evaluation prescribed in paragraph (a) of this section, the effectiveness of the ice protection system and its components must be shown by flight tests of the airplane or its components in measured natural atmospheric icing conditions and by one or more of the following tests, as found necessary to determine the adequacy of the ice protection system—

(1) Laboratory dry air or simulated icing tests, or a combination of both, of the components or models of the components.

(a) Flight dry air tests of the ice protection system as a whole, or its individual components.

(3) Flight test of the airplane or its components in measured simulated icing conditions.

(c) A means must be identified or provided for determining the formation of ice on the critical parts of the airplane. Adequate lighting must be provided for the use of this means during night operation. Also, when monitoring of the external surfaces of the airplane by the flight crew is required for operation of the ice protection equipment, external lighting must be provided that is adequate to enable the monitoring to be done at night. Any illumination that is used must be of a type that will not cause glare or reflection that would handicap crewmembers in the performance of their duties. The Airplane Flight Manual or other approved manual material must describe the means of determining ice formation and must contain information for the safe operation of the airplane in icing conditions.

Explanation: This proposal would continue the minimum requirements for airplane design that have been established by the rulemaking process as necessary for safe operations, would remain compatible with other ice protection provisions, would delete the methods of showing compliance by similarity of design, would provide specific test requirements, would clarify the requirement for information that must be provided to the pilot, and would add a reference for compliance with other applicable sections of part 23.

When an airplane is approved with ice protection provisions in accordance with § 23.1419, it is allowed to be routinely dispatched into icing conditions. The public using such airplanes are entitled to the same minimum level of safety as has been established for design of the airplane in other environments. Subpart B of this part does not differentiate levels of safety by type of operation or by the environment in which the airplane is operated. The proposed final sentence to paragraph (a) makes it clear that these requirements must be met by an airplane approved for icing flights.

When icing requirements were first introduced into part 23, the only sections of part 23 that were identified as directly related to § 23.1419 were §§ 23.929 and 23.1309. Subsequent to that action, part 23 has been amended by adding § 23.1416 and Notices 2 and 4 of the small Airplane Airworthiness Review Program contains a proposal for amending §§ 23.775 and § 23.1323 if an icing approval is desired. Because of these and other applicable requirements in part 23, the introductory statement of this section has been expanded to reference compliance with other requirements.

Conference proposal 467 recommended § 23.1419 be amended by replacing its requirements with substantively identical requirements to those in § 25.1419. The justification given was that normal and transport category airplanes must operate in about the same icing environment, but the normal category airplane is more likely to remain in icing conditions for longer periods of time because it may not have the performance capability to exit the icing enviornment as readily as transport category airplanes.

At the conference, commenters did not disagree with the justification, but opposed the recommendation because—

(1) Adverse accident statistics were not cited in the justification;

(2) They could not anticipate any higher quality of certification resulting from the new requirements;

(3) They considered the current requirements adequate;

(4) The proposed requirements would impose additional burdens, as some certification requirements could now be approved without testing; and

(5) Questions were being resolved in a new advisory circular on icing certification.

The FAA remains unconvinced that part 23 airplanes should have lesser icing certification requirements than other certificated aircarft. FAA and NTSB records include many accidents wherein icing is cited as a causal factor. The practice of certification by similarity of designs is considered inadequate for icing certifications because the effects on the airplane performance, handling, etc., cannot be predicted except by test. Therefore, the requirements in this proposal have been revised to identify testing that is more appropriate for the icing flight approval of an airplane.

Although it was not discussed at the conference, paragraph (c) of this proposal includes additional requirements for a means for determining the formation of ice on the critical parts of the airplane. This is necessary because it is not always possible for the crew to visually determine the formation of ice on critical parts of the airplane. The requirement for determining ice formation will provide a means for the pilot to determine when the ice protection equipment should be activated. The requirement for the Airplane Flight Manual to include information for safe operation of the airplane in icing conditions is more appropriate for inclusion in proposed paragraph (c).

Reference: Conference proposal 467.

82. Section 23.1431 is revised to read as follows:

§ 23.1431 Electronic equipment.

(a) In showing compliance with § 23.1309(b)(1) and (2) with respect to radio and electronic equipment and their installations, critical environmental conditions must be considered.

(b) Radio and electronic equipment, controls, and wiring must be installed so that operation of any unit or system of units will not adversely affect the simultaneous operation of any other radio or electronic unit, or system of units, required by this chapter.

Explanation: This proposal would include electronic equipment that is being installed in part 23 airplanes as well as radio equipment. When the existing regulation was adopted, radio equipment was the primary electronic equipment installed. For standardization in the application of FAA requirements, this proposal is consistent with § 25.1431(a) and (c). Section 23.1309(b)(1) and (2) that are referenced are the proposed regulations in Notice 5, Small Airplane Airworthiness Review Program.

83. Section 23.1435 is amended by revising paragraph (c) to read as follows:

§ 23.1435 Hydraulic systems.

* * * * *

(c) *Accumulators.* Hydraulic accumulators or pressurized reservoirs must not be installed on the engine side of any firewall unless—

(1) It is an integral part of an engine or propeller, or

(2) It is a nonpressurized reservoir and the total capacity of all such nonpressurized reservoirs is one quart or less.

Explanation. Conference proposal 469 recommended adding to § 23.1435(c) a requirement that propeller unfeathering accumulators be considered as an integral part of the propeller and small (1 quart max.) nonpressurized reservoirs be acceptable. Propeller unfeathering accumulators have been accepted as an integral part of a propeller. The conference discussion supported clarification of the requirement and the allowance of some small accumulators, such as for the brake systems on single-engine airplanes. The FAA has further considered these issues and concludes such accumulators should be allowed provided their total capacity is limited to one quart or less.

Proposals 468 and 470 recommended that § 23.1435 be applicable only for hydraulic systems fed by pumps and a new § 23.1436 be added for hydraulic systems with no pumps. These proposals were not accepted since the existing § 23.1435 has been applicable for both types of hydraulic systems without any problems.

Reference: Conference proposals 468, 469, and 470.

84. Section 23.1441 is amended by revising paragraphs (a) and (d); and by adding a new paragraph (e) to read as follows:

§ 23.1441 Oxygen equipment and supply.

(a) If certification with supplemental oxygen equipment is requested, or the airplane is approved for operations at or above altitudes where oxygen is required to be used by the operating rules, oxygen equipment must be provided that meets the requirements of this section and §§ 23.1443 through 23.1449. Portable oxygen equipment may be used to meet the requirements of this part if the portable equipment is shown to comply with the applicable requirements, is identified in airplane type design, and its stowage provisions are found to be in compliance with the requirements of § 23.561.

* * * * *

(d) Each required flight crewmember must be provided with—

(1) Demand oxygen equipment if the airplane is to be certificated for operation above 25,000 feet.

(2) Pressure demand oxygen equipment if the airplane is to be certificated of operation above 40,000 feet.

(e) There must be a means, readily available to the crew in flight, to shut off the oxygen supply at the high pressure source. This shutoff requirement does not apply to chemical oxygen generators.

Explanation. This proposal clarifies the type design requirements in relation to the operating rules, requires installation of demand or pressure demand crewmember oxygen equipment predicated on the airplane's maximum certificated operating altitude, clarifies the requirements relative to portable equipment, and requires a means for crewmembers to shut off the oxygen supply at the source during flight.

Conference proposal 471 recommended requiring a means for the crewmembers to shut off the oxygen supply at the source. The justification given was that, as the result of recent service difficulty investigations, it was noted that some airplane oxygen system installations have been installed with a manual shutoff valve at the supply source, apparently to prevent system leakage during periods when it is not needed. A preflight procedure called for turning the system "on" if flight to an altitude requiring oxygen was anticipated. With the oxygen system shut off, oxygen was not readily available to the crew and passengers, if unexpected incidents of inflight depressurization occurred as the result of smoke in the cockpit, turbine failures, windshield cracking, etc. The need for oxygen supply shutoff was also made evident by several cockpit fires when escaping oxygen accelerated the fire. Fortunately, these fires occurred on the ground and caused no injuries.

While the explanation for this conference proposal cited rationale for readily available shutoff control of oxygen at the source, the actual proposal only addressed shutoff capability if there were a means for shutting off oxygen system pressure. At the conference, one commenter, noting this loophole, reminded conferees of its existence. The same commenter pointed out that the proposed requirement could not be applied to chemical oxygen generating systems. Another commenter, remarked that consideration should be given to requiring that the shutoff means be easily visible to the crewmembers without twisting or turning their bodies to see it. Accordingly, proposed paragraph (e) eliminates the ambiguity and provides an exception for chemical oxygen generators.

Conference proposal 471 also recommended revising § 23.1441 by requiring demand oxygen equipment above 20,000 feet and pressure demand oxygen equipment above 40,000 feet.

At the conference, one commenter, believing that the present requirements that allow continuous flow oxygen equipment for crewmembers and passengers are satisfactory, wanted a further explanation of why they were now considered inadequate. The commenter also wanted to know how previous oxygen system installations were approved. Another commenter questioned the 40,000 foot altitude requirement for pressure demand oxygen equipment because it was halfway up to a flight level. Still another commenter concurred with the proposed altitudes for demand and pressure demand oxygen equipment.

Oxygen requirements for part 23 airplanes were promulgated in 1970. At that time, few small airplanes were pressurized or even capable of operating at altitudes above 18,000 feet. In establishing standards that were simple as well as appropriate, no differentiation was made between crewmember and passenger oxygen requirements.

Prior to 1970, advisory material was available to provide an acceptable means for installing oxygen systems. (Advisory Circular AC 43.13–2, Acceptable Methods, Techniques, and Practices; Aircraft Alterations.)

More recently, airplane performance has improved so that some single-engine airplanes are certificated to 25,000 feet maximum operating altitude and some multiengine airplanes to more than 35,000 feet maximum operating altitude. The 40,000 foot altitude requirement for pressure demand equipment cannot be selected to match a flight level inasmuch as a person breathing 100 percent oxygen without pressure can only get the equivalent of breathing air at 12,000 feet.

As explained in Advisory Circular (AC) 91–8B, continuous flow systems provided adequate oxygen protection for the flight crew up to 25,000 feet and for passengers up to 40,000 feet. Above 40,000 feet, the pressure demand system is necessary. Pressure breathing is intended only for short periods to allow safe descent in emergencies.

In response to conference comments and questions, the FAA offers the following information:

Barometric pressure decreases as altitude increases, causing a reduced oxygen partial pressure in inspired air. At increased altitudes the amount of oxygen reaching body tissues is reduced, resulting in a condition known as hypoxia. Pilot performance is degraded when hypoxia impairs functions of the brain and other organs. Although night vision deterioration is noticeable at an altitude of 5,000 feet, other significant hypoxic effects usually do not occur in normal healthy pilots in unpressurized airplanes below 12,000 feet. From 12,000 to 15,000 feet altitude, in addition to impairment of judgment, memory, and alertness, headache, drowsiness and either a sense of well-being or irritability may occur. At altitudes above 15,000 feet, peripheral vision is lost. The ability to take corrective action is lost in 5 to 12 minutes at 20,000 feet, followed soon thereafter by unconsciousness. In order to maintain oxygen partial pressure in the lungs at a safe level, it is necessary to increase the concentration of oxygen in the inspired air by adding oxygen.

The three types of oxygen systems used in civil aviation are the continuous-flow, demand, and pressure demand systems. The continuous-flow system, as the name implies, provides a constant flow of oxygen to the mask. The flow rate may be manually adjusted or automatically controlled to increase flow with an increase in cabin altitude. The most common continuous-flow mask installed in part 23 airplanes due to its low cost and oxygen economy is the open port dilution rebreathing mask. This mask incorporates a rebreather bag to collect the first portion of the exhaled gases of an exhalation that are high in oxygen content so that these oxygen rich gases can be reinhaled through an orifice in the mask during the next inspiration and dilutes the oxygen flowing into the mask. Unfortunately, such masks cannot automatically provide more oxygen to a pilot who needs an increase because of emotional stress or physical activity.

The demand system delivers a mixture of oxygen and air to the mask only when the user inhales. Up to an altitude of 36,000 feet, it automatically increases the percentage of oxygen in the mixture with increasing altitude. The demand system can provide the user with a mixture of oxygen and air that produces the same effect as breathing air at an altitude of 5,000 feet. The mixture becomes 100 percent oxygen at an altitude of 36,000 feet. At an altitude of 39,000 feet, breathing

100 percent oxygen produces the same effect as breathing air at 10,000 feet.

The pressure demand system delivers 100 percent oxygen to the mask at a positive pressure that, in effect, supercharges the lungs due to the differential pressure between the mask and surrounding barometric pressure. While the pressure demand system can extend the effect of breathing air at an altitude of 10,000 feet to slightly above an airplane altitude of 40,000 feet, there is an increased effort in breathing. Under normal conditions the body only exerts an effort during inhalation, whereas exhalation occurs when the breathing muscles relax. The reverse is true during pressure breathing where exhalation requires effort and inhalation occurs when the breathing muscles relax. For these reasons, pressure breathing systems are appropriate only for short term emergency use in pressurized airplanes. Neither continuous flow nor demand oxygen systems are suitable in unpressurized airplanes for flight above 40,000 feet.

Performance of the various types of oxygen systems is based upon a normal, healthy individual wearing a mask with a good mask-to-face seal. This does not take into account other factors such as degree of training, physical activity, duration of exposure, general health or altitude tolerance of the user. Since all conditions may not be ideal and safety of the flight is dependent upon alert crewmembers, it is appropriate to require demand oxygen if the airplane is to be certificated for operation above 25,000 feet and pressure demand oxygen equipment if the airplane is to be certificated for operation above 40,000 feet.

Reference: Conference proposal No. 471.

85. Section 23.1443 is revised to read as follows:

§ 23.1443 Minimum mass flow of supplemental oxygen.

(a) If continuous flow oxygen equipment is installed, an applicant must show compliance with the requirements of either paragraphs (a)(1) and (a)(2) or paragraph (a)(3) of this section.

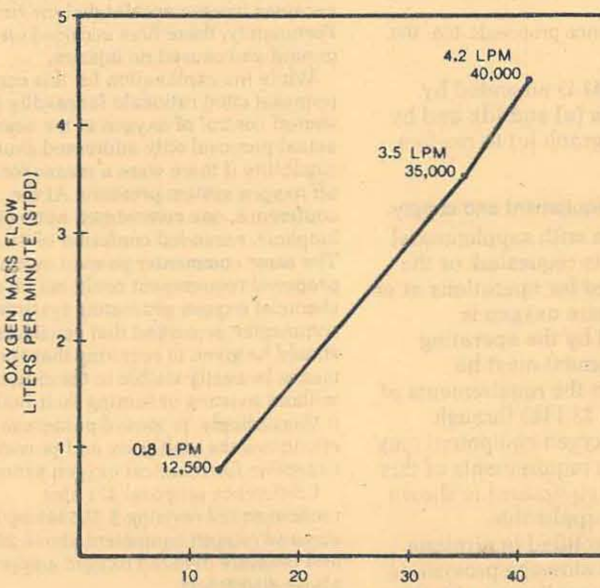
(1) For each passenger, the minimum mass flow of supplemental oxygen required at various cabin pressure altitudes may not be less than the flow required to maintain, during inspiration and while using the oxygen equipment (including masks) provided, the following mean tracheal oxygen partial pressures;

(i) At cabin pressure altitudes above 10,000 feet up to and including 18,500 feet, a mean tracheal oxygen partial pressure of 100 mm. Hg when breathing 15 liters per minute, Body Temperature, Pressure, Saturated (BTPS) and with a tidal volume of 700 cc. with a constant time interval between respirations.

(ii) At cabin pressure altitudes above 18,500 feet up to and including 40,000 feet, a mean tracheal oxygen partial pressure of 83.8 mm. Hg when breathing 30 liters per minute, BTPS, and with a tidal volume of 1,100 cc. with a constant time interval between respirations.

(2) For each flight crewmember, the minimum mass flow may not be less than the flow required to maintain, during inspiration, a mean tracheal oxygen partial pressure of 149 mm. Hg when breathing 15 liters per minute, BTPS, and with a maximum tidal volume of 700 cc. with a constant time interval between respirations.

(3) The minimum mass flow of supplemental oxygen supplied for each user must be at a rate not less than that shown in the following figure for each altitude up to and including the maximum operating altitude of the airplane.



(b) If demand equipment is installed for use by flight crewmembers, the minimum mass flow of supplemental oxygen required for each crewmember may not be less than the flow required to maintain, during inspiration, a mean tracheal oxygen partial pressure of 122 mm. Hg up to and including a cabin pressure altitude of 35,000 feet, and 95 percent oxygen between cabin pressure altitudes of 35,000 and 40,000 feet, when breathing 20 liters per minute BTPS. In addition, there must be means to allow the crew to use undiluted oxygen at their discretion.

(c) If first-aid oxygen equipment is installed, the minimum mass flow of oxygen to each user may not be less than 4 liters per minute, STPD. However, there may be a means to decrease this flow to not less than 2 liters per minute, STPD, at any cabin altitude. The quantity of oxygen required is based upon an average flow rate of 3 liters per minute per person for whom first-aid oxygen is required.

(d) As used in this section:

(1) BTPS means Body Temperature, and Pressure, Saturated (which is, 37° C, and the ambient pressure to which the body is exposed, minus 47 mm. Hg, which is the tracheal pressure displaced by water vapor pressure when the breathed air becomes saturated with water vapor at 37° C).

(2) STPD means Standard, Temperature, and Pressure, Dry (which is, 0° C at 760 mm. Hg with no water vapor).

Explanation: This proposal modifies the oxygen flow rates for small airplanes. These new requirements are needed for current and future airplanes that will be certificated to higher altitudes where oxygen is required.

Conference proposal 472 recommended revising § 23.1443 by designating the present paragraph as paragraph (a) and adding a new paragraph (b) to read essentially the same as § 25.1443(b). The justification given was that "The oxygen flow rate requirements of parts 23 and 25 are different. However, both regulations provide requirements needed to ensure continuous flow rates up to cabin pressure altitudes of 40,000 feet. Proposed § 23.1443 is a combination of these requirements. Proposed § 23.1443(a) contains current § 23.1443 with regard to continuous flow requirements, and § 23.1443(b) is derived from § 25.1443 for demand system requirements. The language of the recommended change would allow § 23.1443 to cover both continuous flow oxygen and demand systems without interpretation from part 25."

When presented for comment at the conference, the proponent of proposal 472 explained that the oxygen requirements for parts 23 and 25 are different and this proposal would make them similar. This proposal would allow § 23.1443 to cover both continuous flow oxygen systems and demand oxygen systems without bringing in an interpretation of part 25, as has been required in the past.

Conference proposal 473 recommended revising § 23.1443 essentially as shown in this proposal since the oxygen flow rate requirements of parts 23 and 25 are different. However, both regulations provide requirements needed to ensure continuous flow rates up to cabin pressure altitudes of 40,000 feet. Proposed § 23.1443 is a combination of these requirements. Sections 23.1443 (a)(1) and (a)(2) contain the continuous flow requirements of part 25 and allow the applicant to comply with those requirements or with paragraph (a)(3), which is the current continuous flow requirement of part 23. Demonstrating compliance with proposed § 23.1443(a)(3) is easier, but results in a larger volume of oxygen and more weight. Demonstrating compliance with §§ 23.1443 (a)(1) and (a)(2) is harder, but results in a lesser volume of oxygen. By allowing the applicant to choose either method of compliance, this requirement permits freedom of design.

When presented for comment at the conference, the FAA confirmed that this conference proposal would allow alternatives of continuous flow oxygen equipment or demand oxygen equipment. With a good face-fitting mask, less oxygen will be used with a demand system than with a continuous flow system. Studies on altitude sickness and the impairment of ability to function on continuous flow equipment at altitudes above 25,000-feet leads the FAA to reconsider this issue, especially for flight crews.

Proposed paragraph (c) provides the flow rate requirements for first-aid oxygen equipment if installed, but does not require its installation. These requirements are identical to the first-aid oxygen flow rate requirements in part 25. With the recent addition on commuter category airplanes in part 23, first-aid oxygen equipment is more likely to be installed in part 23 airplanes.

Proposed paragraph (d) is clarifying by providing definitions of the term "BTPS" and "STPD" as used in this section.

Post conference review of these comments and the oxygen requirements of parts 91, 121, and 135 led to the conclusion that (1) adding the equivalent of the part 25 oxygen requirements to part 23 will provide adequate protection for both flight crew and passengers; and (2) that crewmembers should have demand oxygen equipment for operations above 25,000 feet.

Reference: Conference proposals 472 and 473.

86. Part 23 is amended by adding a new § 23.1445 to read as follows:

§ 23.1445 Oxygen distribution system.

(a) Except for flexible lines from oxygen outlets to the dispensing units, or where shown to be otherwise suitable to the installation, nonmetallic tubing must not be used for any oxygen line that is normally pressurized during flight.

(b) Nonmetallic oxygen distribution lines must not be routed where they may be subjected to elevated temperatures, electrical arcing, and released flammable fluids that might result from any probable failure.

Explanation: This proposal will establish standards for oxygen distribution systems not heretofore required. These requirements will prevent installation of plastic hoses in pressurized oxygen systems.

Conference proposal 474 recommended adopting equipment standards for oxygen systems essentially the same as proposed here. The justification given was that several accidents have occurred in airplanes where nylon tubing was used in an oxygen system pressurized to 70 psi. Because oxygen can support vigorous combustion, oxygen system installations warrant special attention in certification programs.

When presented for comment at the conference, the two commenters agreed that pressurized plastic tubing is inappropriate for oxygen system but did not completely agree with the proposal because they believed the rules should not specifically preclude all nonmetallic tubing. Some composite airplanes may need nonmetallic oxygen lines for lightning strike protection. In view of these comments, a phrase that allows a showing of suitability to the installation was added to the proposal.

Reference: Conference proposal 474.

87. Section 23.1447 is amended by revising paragraph (e) to read as follows:

§ 23.1447 Equipment standards for oxygen dispensing units

* * * * *

(e) If certification for operation above 30,000 feet is requested, the dispensing units must meet the following requirements:

(1) The dispensing units for passengers must be automatically presented to each occupant before the cabin pressure altitude exceeds 15,000 feet.

(2) The dispensing units for crewmembers must be automatically presented to each crewmember before the cabin pressure altitude exceeds 15,000 feet, or the units must be of the quick-donning type, connected to an oxygen supply terminal that is immediately available to crewmembers at their station.

* * * * *

Explanation: This proposal would add presentation requirements for the demand oxygen equipment required by § 23.1441(d) and allow the option of quick-donning type oxygen dispensing units.

Conference proposal 475 recommended essentially the same proposal as presented here. When presented for comment at the conference, the commenters agreed some changes were needed but did not agree on what should be done. The FAA agreed to reconsider the entire oxygen rules package. Post conference review of these comments and the proposals and other technical data has led to the set of proposals herein. These proposals would add oxygen system requirements similar to part 25 and also allow some alternatives under certain conditions.

Reference: Conference proposal 475.

88. Part 23 is amended by adding a new appendix H to read as follows:

Appendix H to Part 23—Installation of an automatic power reserve (APR) system

H23.1, *General.*

(a) This appendix specifies requirements for installation of an APR engine power control system that automatically advances power or thrust on the operating engine(s) in the event any engine fails during takeoff.

(b) With the APR system and associated systems functioning normally, all applicable requirements (except as provided in this appendix) must be met without requiring any action by the crew to increase power or thrust.

H23.2, *Definitions.*

(a) "Automatic power reserve system" means the entire automatic system used only during takeoff, including all devices both mechanical and electrical that sense engine failure, transmit signals, actuate fuel controls or power levers on operating engines, including power sources, to achieve the scheduled power increase and furnish cockpit information on system operation.

(b) "Selected takeoff power", notwithstanding the definition of "Takeoff Power" in part 1 of the Federal Aviation Regulations, means the power obtained from each initial power setting approved for takeoff.

(c) "Critical Time Interval", as illustrated in figure H1, means that period starting at V_1 minus one second and ending at the intersection of the engine and APR failure flight path line with the minimum performance all engine flight path line. The engine and APR failure flight path line intersects the one-engine-inoperative flight path line at 400 feet above the takeoff surface. The engine and APR failure flight path is based on the airplane's performance and must have a positive gradient of at least 0.5 percent at 400 feet above the takeoff surface.

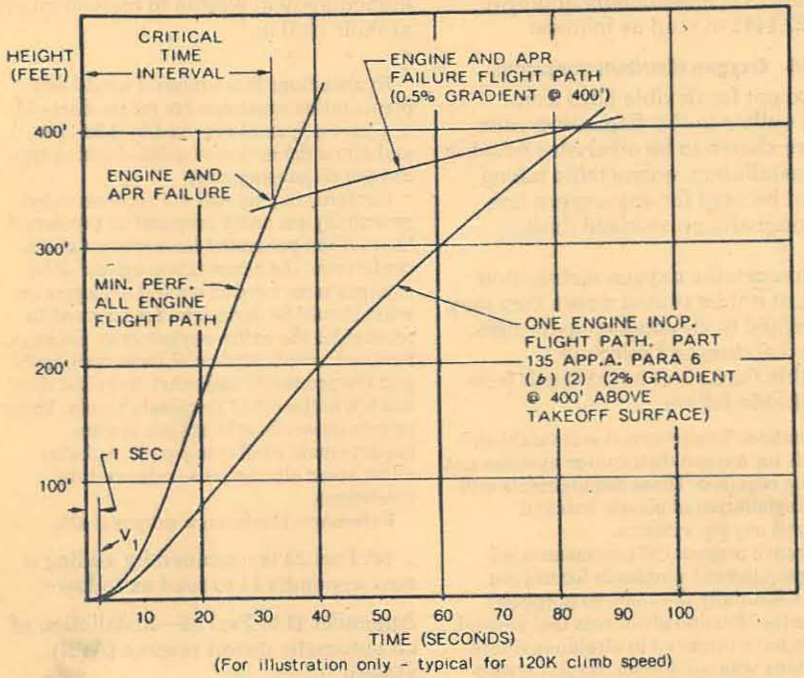


Figure H1.—Critical Time Interval Illustration.

H23.3, *Reliability and performance requirements.*

(a) It must be shown that, during the critical time interval, an APR failure that increases or does not affect power on either engine will not create a hazard to the airplane, or it must be shown that such failures are improbable.

(b) It must be shown that, during the critical time interval, there are no failure modes of the APR system that would result in a failure that will decrease the power on either engine or it must be shown that such failures are extremely improbable.

(c) It must be shown that, during the critical time interval, there will be no failure of the APR system in combination with an engine failure or it must be shown that such failures are extremely improbable.

(d) All applicable performance requirements must be met with an engine failure occurring at the most critical point during takeoff with the APR system functioning normally.

H23.4, *Power setting.*

The selected takeoff power set on each engine at the beginning of the takeoff roll may not be less than—

(a) The power necessary to attain, at V_1, 90 percent of the maximum takeoff power approved for the airplane for the existing conditions;

(b) That required to permit normal operation of all safety-related systems and equipment that are dependent upon engine power or power lever position; and

(c) That shown to be free of hazardous engine response characteristics when power is advanced from the selected takeoff power level to the maximum approved takeoff power.

H23.5, *Powerplant controls—general.*

(a) In addition to the requirements of § 23.1141 of this part, no single failure or malfunction (or probable combination thereof) of the APR, including associated systems, may cause the failure of any powerplant function necessary for safety.

(b) The APR must be designed to—

(1) Provide a means to verify to the flight crew before takeoff that the APR is in an operating condition to perform its intended function;

(2) Automatically advance power on the operating engines following an engine failure during takeoff to achieve the maximum attainable takeoff power without exceeding engine operating limits;

(3) Prevent deactivation of the APR by manual adjustment of the power levers following an engine failure;

(4) Provide a means for the flight crew to deactivate the automatic function. This means must be designed to prevent inadvertent deactivation; and

(5) Allow normal manual decrease or increase in power up to the maximum takeoff power approved for the airplane under the existing conditions through the use of power levers, as stated in § 23.1141(c) of this part, except as provided under paragraph H23.5(c) of this appendix.

(c) For airplanes equipped with limiters that automatically prevent engine operating limits from being exceeded, other means may be used to increase the maximum level of power controlled by the power levers in the event of an APR failure. The means must be located on or forward of the power levers, must be easily identified and operated under all operating conditions by single action of any pilot with the hand that is normally used to actuate the power levers, and must meet the requirements of § 23.777(a), (b), and (c) of this part.

H23.6, *Powerplant instruments.*

In addition to the requirements of § 23.1305 of this part:

(a) A means must be provided to indicate when the APR is in the armed or ready condition.

(b) If the inherent flight characteristics of the airplane do not provide warning that an engine has failed, a warning system independent of the APR must be provided to give the pilot a clear warning of any engine failure during takeoff.

(c) Following an engine failure at V_1 or above, there must be means for the crew to readily and quickly verify that the APR has operated satisfactorily.

Explanation: This proposal incorporates the additional requirements needed in § 23.904 for approval of an automatic system designed to increase power or thrust on the remaining operating engine(s) if an engine loses power on takeoff. This proposal was developed from special conditions since part 23 does not contain airworthiness standards for APR systems.

Conference proposal 319 recommended incorporated essentially the same proposal as presented here with the justification that small airplane manufacturers are currently installing APR systems and requesting certification. One conference commenter opposed adoption of these requirements and presented a list of requirements as an alternative. This alternate list was similar to the alternate special conditions this commenter offered, prior to the conference, in response to the Notice of Proposed Special Conditions published in the **Federal Register** (49 FR 35123, September 6, 1984).

The conference discussion provided no additional information to that previously offered in comment to the cited notice of proposed special conditions. Those comments to the cited notice are on public record and have been discussed and dispositioned in the Adoption of Final Special Conditions published in the **Federal Register** (50 FR 5369, February 8, 1985).

This proposal would add a new § 23.904 plus a new appendix H to this part and would maintain parallelism with similar requirements in part 25 of this chapter.

Reference: Conference proposal 319, cited special conditions.

Issued in Washington, DC, on September 17, 1990.

David W. Ostrowski,

Acting Director, Aircraft Certification Service.

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