



Advisory Circular

Subject: Transport Airplane Propulsion
Engine and Auxiliary Power Unit
Installation Certification Handbook:
“The Propulsion Mega AC”

Date:
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Initiated By:
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1. **PURPOSE.** This advisory circular (AC) provides methods acceptable to the Administrator for showing compliance with the type certification requirements for transport airplane propulsion engine and auxiliary power unit (APU) installations. The policy and the majority of the guidance provided have been previously applied and found to be acceptable for certification of propulsion installations on transport category airplanes.

This AC is intended to provide guidance to airplane manufacturers, modifiers, foreign regulatory authorities, and Federal Aviation Administration (FAA) airplane type certification engineers. These guidelines provide acceptable methods of demonstrating compliance with the pertinent regulations of 14 CFR part 25, commonly referred to as part 25 of the Federal Aviation Regulations (FAR), through Amendment 25-89. The methods and procedures described herein have evolved through many years and represent current certification practice.

Like all AC material, these guidelines are not mandatory and do not constitute regulations. They are derived from previous FAA experience in finding compliance with the airworthiness requirements and represent methods and procedures found to be acceptable by that experience. Although mandatory terms such as “shall” and “must” are used in this AC, because the AC method of compliance is not itself mandatory, these terms apply only to applicants who seek to demonstrate compliance by use of the specific method described by this AC.

2. **CANCELLATION.** The following documents have been incorporated into this Mega AC and are therefore cancelled (as individual documents).

- FAA Order 8110.20, “FAR 25.1203: In-flight Monitoring of Fire Detector Systems,” August 27, 1976,
- FAA Order 8110.16, “Fire Extinguishing Requirements for APU Compartments,” August 12, 1976

- Advisory Circular 25-8, “Auxiliary Fuel System Installation,” May 5, 1986
- Advisory Circular 25-13, “Thrust (Power) Procedures Reduced and Derated Takeoff,” May 4, 1988
- Advisory Circular 25.939-1, “Evaluating Turbine Engine Operating Characteristics,” March 19, 1986
- Advisory Circular 25.963-1, “Fuel Tank Access Covers,” July 29, 1992
- Advisory Circular 25.981-1A, “Guidelines for Substantiating Compliance with the Fuel Tank Temperature Requirements,” January 20, 1971
- Advisory Circular 25-994-1, “Design Considerations to Protect Fuel Systems During a Wheels-Up Landing,” July 24, 1986

3. **APPLICABILITY.** This AC contains guidance for the latest amendment of the regulations and applies to transport category airplanes for which a new, amended, or supplemental type certificate is requested. This guidance should be applied to any portion of the propulsion installation, including airplane fuel systems that have been modified.

The policy extracts contained in this document are presented in order to provide guidelines that can help in understanding and resolving certification issues or making approval decisions. The excerpts from memoranda and letters provided in this AC represent historical views of regulations and requirements which may have evolved since the issuance of the policy in the extract, and may be applicable to a specific airplane model, depending on the certification basis. The applicant and the cognizant certifying authority are advised to check with the FAA and ensure, at the earliest practical time, that a specific policy extract applies to any specific airplane type certification program.

The text of the regulations provided in this AC serve only as a convenience to the reader. The reader is advised to refer to official publications of the regulation whenever a definitive statement of regulation is required. This AC does not constitute an official publication of the regulations in this respect. Only the most current amendment versions of the regulations (as of the date of issuance of this AC) have been included.

4. **RELATED DOCUMENTS.** This advisory circular uses information from the following related regulations, and documents:

a. **Related Federal Aviation Regulations.** Sections that prescribe requirements for the design, substantiation, and certification relating to propulsion engine installations include all sections within 14 CFR part 25, **Subpart E - Propulsion**, and the following related sections:

§ 25.101	General (Performance)
§ 25.581	Lightning Protection.
§ 25.863	Flammable Fluid Fire Protection
§ 25.865	Fire protection of flight controls, engine mounts, and other flight structure
§ 25.867	Fire protection: other components
§ 25.1301	Function and Installation
§ 25.1305	Powerplant Instruments
§ 25.1307	Miscellaneous equipment
§ 25.1309	Equipment, systems and installation
§ 25.1316	System Lightning Protection
§ 25.1337	Powerplant Instruments
§ 25.1351	System Lightning Protection
§ 25.1461	Equipment containing high energy rotors
§ 25.1521	Powerplant Limitations
§ 25.1522	Auxiliary Power unit Limitations
§ 25.1529	Instructions for Continued Airworthiness
§ 25.1541	General (Markings and Placards)
§ 25.1549	Powerplant and auxiliary power unit instruments
§ 25.1551	Oil quantity indication
§ 25.1553	Fuel quantity indicator
§ 25.1555	Control markings
§ 25.1557	Miscellaneous markings and placards
§ 25.1581	General (Airplane Flight Manual)
§ 25.1585	Operating Procedures

b. Advisory Circulars (AC). Copies of this AC, and copies of the propulsion installation-related AC's listed below, may be ordered from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402; or from any of the Government Printing Office bookstores located in major cities throughout the United States. Please note that, because of the large size of this AC, unless a specific request is made for a paper copy, requesters will be sent a CD-ROM (Microsoft Word Version 6/Windows 95 formatted files) for use on their personal computers.

AC 20-18A	Qualification Testing of Turbojet Engine Thrust Reversers, March 16, 1966.
AC 20-24B	Qualification of Fuels, Lubricants, and Additives, December 20, 1985.
AC 20-29B	Use of Aircraft Fuel Anti-icing Additives. January 18, 1972.
AC 20-43C	Aircraft Fuel Control, October 20, 1976.

AC 20-66	Vibration Evaluation of Aircraft Propellers, January 29, 1970.
AC 20-73	Aircraft Ice Protection, April 21, 1971.
AC 20-88A	Guidelines for Marking of Aircraft Powerplant Instruments (Displays), September 30, 1985.
AC 20-100	General Guidelines for Measuring Fire-Extinguishing Agent Concentrations in Powerplant Compartments, September, 21, 1977.
AC 20-104	Revised Powerplant Engineering Report No. 3, Standard Fire Test Apparatus and Procedures (for Flexible Hose Assemblies), April 12, 1978.
AC 20-105A	Engine Power Loss Accident Prevention, November 20, 1980.
AC 20-110H	Index of Aviation Technical Standard Orders, May 6, 1993.
AC 20-114	Manufacturers Service Documents, October 22, 1981.
AC 20-116	Marking Aircraft Fuel Filler Openings with Color Coded Decals, September 17, 1982.
AC20-119	Fuel Drain Valves, February 7, 1983.
AC 20-124	Water Ingestion Testing for Turbine Powered Airplanes, September 30, 1985.
AC 20-125	Water in Aviation Fuels, December 10, 1985.
AC20-128	Design Considerations for Minimizing Hazards Caused by Uncontained Turbine Engine and Auxiliary Power Unit Rotor Failure, March 25, 1997.
AC-20-135	Powerplant Installation and Propulsion System Component Fire Protection Test Methods, February 6, 1990.
AC 23-10	Auxiliary Fuel System Installation Standards and Criteria,

August 5, 1991.

AC 25-7	Flight Test Guide for Certification of Transport Category Airplanes, April 9, 1986.
AC 25-11	Transport Category Airplane Electronic Display Systems, July 16, 1987.
AC 25-19	Certification Maintenance Requirements, November 28, 1994.
AC 25-571	Damage Tolerance and Fatigue Evaluation of Structure, April 29, 1998.
AC 29-2B	Certification of Transport Category Rotorcraft, July 30, 1997
AC 36-4B	Noise Certification Handbook, March 23, 1988.
AC 120-42A	Extended Range Operations with Two-Engine Airplanes (ETOPS), December 30, 1988.
FAA Notice 8110.xx	APU Data Collection Requirements for Extended Twin Engine Operations (ETOPS), February 20, 1992.

c. Technical Standard Orders. Technical Standard Orders can be obtained from the Federal Aviation Administration (FAA), Aircraft Certification Service, Aircraft Engineering Division, Technical Analysis Branch (AIR-120), 800 Independence Ave. SW, Washington, DC 205921.

TSO-C11e	Fire Detectors (Thermal Sensing and Ionization Sensing Types)
TSO-C20	Combustion Heaters
TSO-C42	Propeller Feathering Hose Assemblies (Rubber and Wire Braid Construction)
TSO-C44a	Fuel Flow Meter
TSO-C45	Manifold Pressure Indicating Instruments
TSO-C47	Pressure Instruments - Fuel, Oil, and Hydraulic
TSO-C49a	Electric Tachometer, Magnetic

TSO-C53a	Fuel and Engine Oil System Hose Assemblies
TSO-C55	Fuel and Oil Quantity Instruments (For Reciprocating Engine Aircraft)
TSO-C56a	Engine-Driven Direct Current Generators/Starter-Generators
TSO-C75	Hydraulic Hose Assemblies
TSO-C76	Fuel Drain Valves (Rubber or Tetrafluoroethylene Tube and Wire Braid Construction)
TSO-C77a	Gas Turbine Auxiliary Power Units
TSO-C79	Fire Detectors (Radiation Sensing Type)
TSO-C80	Flexible Fuel and Oil Cell Material

d. Society of Automotive Engineers (SAE) Documents. These documents can be obtained from the Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, Pennsylvania 15096.

AIR 713	Guide for Determining, Presenting, and Substantiating Turbine Engine Starting and Motoring Characteristics (Reaffirmed Pending Revision, October 88) (Reaffirmed Pending Revision, September 1994).
AIR 744	Aerospace Auxiliary Power Sources, dated July 1995.
AIR 781	Guide for Determining Engine Starter Drive Torque Requirements (Reaffirmed Pending Revision, October 1988) (Reaffirmed Pending Revision, September 1994).
AIR 1076	Aircraft Fire Protection, for Reciprocating and Gas Turbine Engine Installations (Reaffirmed Pending Revision, May 89)
AIR 1168/6	(Revision 1) Characteristics of Equipment Components, Equipment Cooling System Design, and Temperature Control System Design, dated July 1994.
AIR 1262	Aircraft, Fire Protection for Helicopter Gas Turbine Powerplant and Related Systems Installations (Reaffirmed Pending Revision, May 89)
AIR 1419	Revision A, Inlet Total-Pressure-Distortion Considerations for Gas Turbine Engines, dated March 1999.
AIR 1423	Electromagnetic Compatibility on Gas Turbine Engines for Aircraft Propulsion, dated August 1977.

- AIR 1425 (Revision A) Methods of Achieving Electromagnetic Compatibility of Gas Turbine Engine Accessories, for Self-Propelled Vehicles, dated December 1998.
- AIR 1537 Report on Aircraft Engine Containment, dated October, 1977.
- AIR 1639 (Revision A) Safety Criteria for Pneumatic Starting Systems, dated March 1999.
- AIR 1666 Performance Testing of Gas Turbine Lube Oil Filter Elements, dated July 1994.
- AIR 1749 Aircraft Engine Fuel Feed and Transfer Component Pressure Definitions, dated February 1991.
- ARP 1797 Aircraft and Aircraft Engine Fuel Pump Low Lubricity Fluid Endurance Test, dated January 1988.
- AIR 1871 (Revision B) Lessons Learned From Developmental and Operational Turbine Engine Monitoring Systems, dated January 1988.
- AIR 1873 Guide to Limited Engine Monitoring Systems for Aircraft Gas Turbine Engines, dated May 1994.
- AIR 1900 (Revision A) Guide to Temperature Monitoring in Aircraft Gas Turbine Engines, dated November 1997.
- AIR 1939 Aircraft and Aircraft Engine Fuel Pump Low Lubricity Fluid Endurance Test , January 1988.
- AIR 4003 Uncontained turbine Rotor Events Data Period 1976 through 1983.
- AIR 4061 (Revision A) Guidelines for Integration of Engine Monitoring Functions with On-Board Aircraft Systems, dated March 1999.
- AIR 4065 Propeller/Propfan In-Flight Thrust Determination, dated June 1993.
- AIR 4068 (Revision A) Gas Turbine Emission Probe Factors, dated September 1996.
- AIR 4204 Commercial Aircraft Auxiliary Power Unit Installations, dated January 1991.
- AIR 4250 Electronic Engine Control Specifications and Standards, dated March 1992.
- AIR 4366 Issues and Concerns Associated with Electronic Propulsion Control System Partitioning, dated May 1996.
- AIR 4391 Industrial and Marine Gas Turbine Engine Starting Systems, dated December 1990.
- AIR 4548 Real-Time Modeling Methods for Gas Turbine Engine Performance, dated December 1995.

- AIR 4770 Uncontained Turbine Rotor Events Data Period 1984 through 1989, dated April 8, 1996.
- AIR 4896 Recommended RMS Terms and Parameters, dated December 1995.
- AIR 4978 (Revision A) Electronic Propulsion Control/Aircraft Interface Control Documents, dated October 1995.
- AIR 5022 Reliability and Safety Process Integration, dated July 1996.
- ARP 166 Propeller Clearance Envelope, dated March 1982.
- ARP 755 Aircraft Propulsion System Performance Station Designation and Nomenclature, dated October 1994.
- ARP 906 Glossary, Aircraft Engine Starting and Auxiliary Power Systems, dated November 1968.
- ARP 949 (Revision B) Turbine Engine Starting System Design Requirements, dated March 1999.
- ARP 1420 (Revision A) Gas Turbine Engine Inlet Flow Distortion Guidelines Engines,
- ARP 1587 (Revision A) Aircraft Gas Turbine Engine Monitoring System Guide dated April 1993.
- ARP 1796 Engine Bleed Air Systems for Aircraft, dated September 1994.
- ARP 4148 (Revision A) Gas Turbine Engine Real Time Performance Model Presentation for Digital Computers, dated May 1996.
- ARP 4191 (Revision B) Gas Turbine Engine Performance Presentation for Digital Computer Programs Using Fortran 77, dated November 1997.
- ARP 4874 Electronic Propulsion Control/Aircraft Interface Control Documents, dated October 1995.
- AS 20 (Revision C) Definitions, Aircraft Reciprocating Engine Performance, dated May 1996.
- AS 177 Operating Instructions for Aircraft Engines (Preparation of), dated September 1995.
- AS 681 (Revision H) Gas Turbine Engine Steady-State and Transient Performance Presentation for Digital Computer Programs, dated March 1999.
- AS 903 Remote Trimming Attachment for Aircraft Turbine Engine Controls, dated January 1988.
- AS 943 Starter, Pneumatic, Aircraft Engine, (General Specification for), dated January 1988.

- AS 1606 Gas Turbine Starter (Jet Fuel Starter) Specification , dated September 1992.
- AS 4273 Fire Testing of Fluid Handling Components for Aircraft Engines and Aircraft Engine Installations, dated August 1996.
- AS 8028 Powerplant Fire Detection Instruments, Thermal & Flame Contact Types (Reciprocating and Turbine Engine Powered Aircraft), dated January 1988.
- AS 8181 Detector Ice Air Intake Duct Aircraft Engines and Airframe Systems (General Requirements for), dated August 1997.
- CRC-530 (Revision 1) Aviation Fuel Properties, dated August 1983.
- CRC-532 (Revision 1) Low Temperature Behavior of Fuels in Simulated Aircraft Tanks, dated September 1983.
- CRC-547 CRC Cross Correlation Aircraft Engine Emission Test Program, dated November 1986.
- CRC-573 Survey of Current Aircraft Engine Conditions, dated February 1991.
- MAP-749 Aircraft Turbine Engine Fuel System Component Endurance Test Procedure (Room Temperature Contaminated Fuel), dated April 1992.

e. Other Documents.

- GAMA Spec. No. 3 Specification for Decal to Minimize the Misfueling of General Aviation Aircraft, dated July 1, 1982.

Copies of this specification may be obtained from General Aviation Manufacturers Association, 1400 K Street NW, Suite 801 Washington DC 20005; or by calling directly to (202) 393-1500.

5. BACKGROUND. In the past, advisory and guidance information applicable to transport airplane propulsion installations has been formally published within advisory circulars. Advisory circulars have not been developed for all of the regulatory requirements applicable to propulsion installations, however. In many instances certification of new technology airplanes results in a need to interpret the existing regulations and to apply new regulations. Issue Papers and Special Conditions have been generated to document the compliance method agreed upon between the applicant and the FAA. In other instances, the applicants, Aircraft Certification Offices, and foreign regulatory authorities have requested interpretation of the intent of specific regulations. This guidance has been documented in the form of policy memorandums that were distributed to all Aircraft Certification Offices (ACO's), letters to applicants and foreign authorities, and Issue Papers. In many instances, this information was not

organized in a way that allowed easy access, and applicants were not aware of revised policy. The purpose of this AC is to formalize existing policy and guidance so that the public and FAA personnel have access to this information in one document. In gathering all relevant powerplant material into one document, the consequent size of this AC is necessarily large; hence, the informal title of “*Propulsion Mega AC*” is used throughout this document to distinguish this AC from others that are referenced.

The guidance contained within this document is presented in a format that lists the:

- a. regulatory text,
- b. intent of the rule,
- c. background of the rule,
- d. policy/compliance methods, and
- e. references.

As noted above, many Subpart E - Propulsion advisory circulars have been incorporated in total into this AC. However, in the interest of maintaining this AC to a manageable size, whenever possible, guidance contained within existing AC’s has been presented in excerpts applicable to the content of that particular section and/or is referenced. Please note that material is also presented for regulations outside the direct area of propulsion responsibility (i.e., Part 25 - Subpart E) to ensure that propulsion-related issues are considered. The intent is to denote the interface between propulsion and the particular regulation, and to provide policy and guidance on the propulsion aspects of demonstrating compliance with the particular regulation.

These methods and procedures are promulgated, in the interest of standardization, for use during all transport category airplane propulsion certification activities. This material is not to be construed as having any legal status and must be treated accordingly. The procedures set forth herein are only one acceptable means of compliance with applicable sections of Part 25. Any alternative means proposed by the applicant should be given due consideration. Applicants are encouraged to use their technical ingenuity and resourcefulness in order to develop more efficient and less costly methods of achieving the objectives of Part 25. Since these methods and procedures are only one acceptable means of compliance, individuals should be guided by the intent of the methods provided in this AC. As deviations from the methods and procedures described in this AC may occur, FAA certification personnel will coordinate what they consider to be major deviations with the Transport Standards Staff (ANM-110) of the FAA’s Transport Airplane Directorate. If in their judgment, however, a deviation is considered to be minor, coordination with ANM-110 may not be necessary.

This “Propulsion Mega AC” is considered to be a living document. As such, it will be amended on an as-needed basis to maintain currency, such as with the issuance of Part 25 rule changes, or the development of substantive new guidance.

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CONTENTS

<u>SECTION</u>	<u>PAGE</u>
Subpart B - Flight (Propulsion Considerations)	
<u>Section 1 Performance</u>	
Section 25.101 (Performance) General.....	Sub. B-1-2
Subpart C - Structures (Propulsion Considerations)	
<u>Section 1 Lightning Protection</u>	
Section 25. 581 Lightning protection	Sub. C-1-2
Subpart D - Design and Construction (Propulsion Considerations)	
<u>Section 1 Fire Protection</u>	
Section 25.863 Flammable fluid fire protection	Sub. D-1-2
Section 25.865 Fire protection of flight controls, engine mounts, and other flight structure.....	Sub. D-1-8
Section 25.867 Fire protection: other components	Sub. D-1-11
Subpart E - Powerplant	
<u>Section 1 General</u>	
Section 25.901 Installation	Sub. E-1-2
Section 25.903 Engines.....	Sub. E-1-18
25.903(a).....	Sub. E-1-21
25.903(b).....	Sub. E-1-22
25.903(c).....	Sub. E-1-24
25.903(d).....	Sub. E-1-33
25.903(e).....	Sub. E-1-45
25.903(f).....	Sub. E-1-52
Section 25.904 Automatic takeoff thrust control system (ATTCS) ...	Sub. E-1-53
Section 25.905 Propellers	Sub. E-1-64
Section 25.907 Propeller Vibration	Sub. E-1-67
Section 25.925 Propeller clearance.....	Sub. E-1-70
Section 25.929 Propeller deicing.....	Sub. E-1-72
Section 25.933 Reversing systems.....	Sub. E-1-74
Section 25.934 Turbojet engine thrust reverser system tests.....	Sub. E-1-103
Section 25.937 Turbopropeller-drag limiting systems	Sub. E-1-106
Section 25.939 Turbine engine operating characteristics	Sub. E-1-108
Section 25.941 Inlet, engine, and exhaust compatibility	Sub. E-1-121
Section 25.943 Negative acceleration.....	Sub. E-1-124
Section 25.945 Thrust or power augmentation system.....	Sub. E-1-129

Section 2 Fuel System

Section 25.951	General.....	Sub. E-2-2
Section 25.952	Fuel system analysis and test.....	Sub. E-2-11
Section 25.953	Fuel system independence.....	Sub. E-2-61
Section 25.954	Fuel system lightning protection.....	Sub. E-2-69
Section 25.955	Fuel flow.....	Sub. E-2-74
Section 25.957	Flow between interconnected tanks.....	Sub. E-2-80
Section 25.959	Unusable fuel supply.....	Sub. E-2-83
Section 25.961	Fuel system hot weather operation.....	Sub. E-2-90
Section 25.963	Fuel tanks: general.....	Sub. E-2-97
Section 25.965	Fuel tank tests.....	Sub. E-2-106
Section 25.967	Fuel system lightning protection.....	Sub. E-2-111
Section 25.969	Fuel tank expansion space.....	Sub. E-2-114
Section 25.971	Fuel tank sump.....	Sub. E-2-117
Section 25.973	Fuel tank filler connection.....	Sub. E-2-120
Section 25.975	Fuel tank vents and carburetor vapor vents.....	Sub. E-2-123
Section 25.977	Fuel tank outlet.....	Sub. E-2-128
Section 25.979	Pressure fueling system.....	Sub. E-2-132
Section 25.981	Fuel tank temperature.....	Sub. E-2-144

Section 3 Fuel System Components

Section 25.991	Fuel Pumps.....	Sub. E-3-2
Section 25.993	Fuel system lines and fittings.....	Sub. E-3-5
Section 25.994	Fuel system components.....	Sub. E-3-8
Section 25.995	Fuel valves.....	Sub. E-3-12
Section 25.997	Fuel strainer or filter.....	Sub. E-3-14
Section 25.999	Fuel system drains.....	Sub. E-3-18
Section 25.1001	Fuel jettisoning system.....	Sub. E-3-21

Section 4 Oil System

Section 25.1011	General.....	Sub. E-4-2
Section 25.1013	Oil Tanks.....	Sub. E-4-7
Section 25.1015	Oil Tank Tests.....	Sub. E-4-12
Section 25.1017	Oil Lines and Fittings.....	Sub. E-4-14
Section 25.1019	Oil Strainer or Filter.....	Sub. E-4-16
Section 25.1021	Oil system drains.....	Sub. E-4-25
Section 25.1023	Oil radiators.....	Sub. E-4-27
Section 25.1025	Oil valves.....	Sub. E-4-29
Section 25.1027	Propeller feathering systems.....	Sub. E-4-31

Section 5 Cooling

Section 25.1041	General.....	Sub. E-5-2
Section 25.1043	Cooling tests.....	Sub. E-5-4
Section 25.1045	Cooling test procedures.....	Sub. E-5-10

Section 6 Induction System

Section 25.1091	Air induction	Sub. E-6-2
Section 25.1093	Induction system icing protection.....	Sub. E-6-7
Section 25.1101	Carburetor air preheater design.....	Sub. E-6-17
Section 25.1103	Induction system ducts and air duct systems	Sub. E-6-18
Section 25.1105	Induction system screens	Sub. E-6-25
Section 25.1107	Inter-coolers and after-coolers	Sub. E-6-26

Section 7 Exhaust System

Section 25.1121	General	Sub. E-7-2
Section 25.1123	Exhaust piping	Sub. E-7-5
Section 25.1125	Exhaust heat exchangers	Sub. E-7-9
Section 25.1127	Exhaust driven turbo-superchargers	Sub. E-7-13

Section 8 Powerplant Controls and Accessories

Section 25.1141	General	Sub. E-8-2
Section 25.1142	Auxiliary power unit controls	Sub. E-8-7
Section 25.1143	Exhaust heat exchangers	Sub. E-8-11
Section 25.1145	Exhaust driven turbo-superchargers	Sub. E-8-15
Section 25.1147	Mixture controls.....	Sub. E-8-18
Section 25.1149	Propeller speed and pitch controls	Sub. E-8-20
Section 25.1153	Propeller feathering controls.....	Sub. E-8-23
Section 25.1155	Reverse thrust and propeller pitch settings below the flight regime.	Sub. E-8-25
Section 25.1157	Carburetor air temperature controls.....	Sub. E-8-31
Section 25.1159	Supercharger controls	Sub. E-8-32
Section 25.1161	Fuel jettisoning system controls	Sub. E-8-33
Section 25.1163	Powerplant accessories	Sub. E-8-34
Section 25.1165	Engine ignition systems	Sub. E-8-36
Section 25.1167	Accessory gearboxes.....	Sub. E-8-39

Section 9 Powerplant Fire Protection

Section 25.1181	Designated fire zones; regions included	Sub. E-9-2
Section 25.1182	Nacelle areas behind firewalls, and engine pod attaching structures containing flammable fluid lines	Sub. E-9-9
Section 25.1183	Flammable fluid-carrying components	Sub. E-9-12
Section 25.1185	Flammable fluids	Sub. E-9-17
Section 25.1187	Drainage and ventilation of fire zones.....	Sub. E-9-20
Section 25.1189	Shutoff means	Sub. E-9-33
Section 25.1191	Firewalls.....	Sub. E-9-39
Section 25.1192	Engine accessory section diaphragm	Sub. E-9-46
Section 25.1193	Cowling and nacelle skin.....	Sub. E-9-48
Section 25.1195	Fire extinguishing systems.....	Sub. E-9-57
Section 25.1197	Fire extinguishing agents	Sub. E-9-69
Section 25.1199	Extinguishing agent containers.....	Sub. E-9-74
Section 25.1201	Fire extinguishing system materials	Sub. E-9-77
Section 25.1203	Fire detector system.....	Sub. E-9-79

Section 25.1207 ComplianceSub. E-9-91

**Subpart F - Equipment
(Propulsion Considerations)**

Section 1 General

Section 25.1301 Function and installation.....Sub. F-1-2
 Section 25.1305 Powerplant instruments.....Sub. F-1-4
 Section 25.1307 Miscellaneous equipmentSub. F-1-18
 Section 25.1309 Equipment, systems, and installation.....Sub. F-1-23

Section 2 Instruments - Installation

Section 25.1316 System Lightning ProtectionSub. F-2-2
 Section 25.1337 Powerplant InstrumentsSub. F-2-9

Section 3 Electrical Systems and Equipment

Section 25.1351 General.....Sub. F-3-2

Section 4 Miscellaneous Equipment

Section 25.1461 Equipment containing high-energy rotorsSub. F-4-2

**Subpart G Equipment
(Propulsion Considerations)**

Section 1 Operating Limitations

Section 25.1521 Powerplant Limitations.....Sub. G-1-2
 Section 25.1522 Auxiliary Power unit LimitationsSub. G-1-11
 Section 25.1529 Instructions for Continued Airworthiness.....Sub. G-1-15

Section 2 Markings and Placards

Section 25.1541 General.....Sub. G-2-2
 Section 25.1549 Powerplant and auxiliary power unit instruments ...Sub. G-2-3
 Section 25.1551 Oil quantity indicationSub. G-2-11
 Section 25.1553 Fuel quantity indicatorSub. G-2-13
 Section 25.1555 Control markingsSub. G-2-16
 Section 25.1557 Miscellaneous markings and placardsSub. G-2-18
 Section 25.1581 General.....Sub. G-2-22
 Section 25.1585 Operating Procedures.....Sub. G-2-28

APPENDICES

APPENDIX 1. Glossary of Acronyms and AbbreviationsAppx. 1-1
APPENDIX 2. Cross-Reference for FAR Part 25 and CAR 4bAppx. 2-1
APPENDIX 3. Fuel System Certification ChecklistAppx. 3-1
APPENDIX 4. Index of Guidance Material and ReferencesAppx. 4-1
APPENDIX 5. Powerplant Installation Special TopicsAppx. 5-1