PART 87—CONTROL OF AIR POLLUTION FROM AIRCRAFT AND AIRCRAFT ENGINES

Subpart A—General Provisions
Sec.
87.1 Definitions.
87.2 Abbreviations.
87.3 General requirements.
87.4 [Reserved]
87.5 Special test procedures.
87.6 Aircraft safety.
87.7 Exemptions.

Subpart B—Engine Fuel Venting Emissions
(New and In-Use Aircraft Gas Turbine Engines)
87.10 Applicability.
87.11 Standard for fuel venting emissions.

Subpart C—Exhaust Emissions (New Aircraft Gas Turbine Engines)
87.20 Applicability.
87.21 Standards for exhaust emissions.

Subpart D—Exhaust Emissions (In-Use Aircraft Gas Turbine Engines)
87.30 Applicability.
87.31 Standards for exhaust emissions.

Subparts E–F [Reserved]

Subpart G—Test Procedures for Engine Exhaust Gaseous Emissions (Aircraft and Aircraft Gas Turbine Engines)
87.60 Introduction.
87.61 Turbine fuel specifications.
87.62 Test procedure (propulsion engines).
87.63 [Reserved]
87.64 Sampling and analytical procedures for measuring gaseous exhaust emissions.
87.65—87.70 [Reserved]
87.71 Compliance with gaseous emission standards.

Subpart H—Test Procedures for Engine Smoke Emissions (Aircraft Gas Turbine Engines)
87.80 Introduction.
87.81 Fuel specifications.
87.82 Sampling and analytical procedures for measuring smoke exhaust emissions.
87.83—87.88 [Reserved]
87.89 Compliance with smoke emission standards.

AUTHORITY: Secs. 231, 301(a), Clean Air Act, as amended (42 U.S.C. 7571, 7601(a)), unless otherwise noted.

SOURCE: 47 FR 58470, Dec. 30, 1982, unless otherwise noted.

Subpart A—General Provisions
§ 87.1 Definitions.
(a) As used in this part, all terms not defined herein shall have the meaning given them in the Act:
Act means the Clean Air Act, as amended (42 U.S.C. 7401 et seq.).
Administrator means the Administrator of the Environmental Protection Agency and any other officer or employee of the Environmental Protection Agency to whom authority involved may be delegated.
Aircraft means any airplane for which a U.S. standard airworthiness certificate or equivalent foreign airworthiness certificate is issued.
Aircraft engine means a propulsion engine which is installed in or which is manufactured for installation in an aircraft.
Aircraft gas turbine engine means a turboprop, turbofan, or turbojet aircraft engine.
Class TP means all aircraft turboprop engines.
Class TF means all turbofan or turbojet aircraft engines except engines of class T3, T8, and TSS.
Class T3 means all aircraft gas turbine engines of the JT3D model family.
Class T8 means all aircraft gas turbine engines of the JT8D model family.
Class TSS means all aircraft gas turbine engines employed for propulsion of aircraft designed to operate at supersonic flight speeds.
Commercial aircraft engine means any aircraft engine used or intended for use by an “air carrier,” (including those engaged in “intrastate air transportation”) or a “commercial operator” (including those engaged in “intrastate air transportation”) as these terms are defined in the Federal Aviation Act and the Federal Aviation Regulations.
Commercial aircraft gas turbine engine means a turboprop, turbofan, or turbojet commercial aircraft engine.
Emission measurement system means all of the equipment necessary to transport and measure the level of
§ 87.2 Abbreviations.

The abbreviations used in this part have the following meanings in both upper and lower case:

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO</td>
<td>Carbon Monoxide</td>
</tr>
<tr>
<td>FAA</td>
<td>Federal Aviation Administration, Department of Transportation</td>
</tr>
<tr>
<td>HC</td>
<td>Hydrocarbon(s)</td>
</tr>
<tr>
<td>hr.</td>
<td>Hour(s)</td>
</tr>
<tr>
<td>LTO</td>
<td>Landing takeoff</td>
</tr>
<tr>
<td>min.</td>
<td>Minute(s)</td>
</tr>
<tr>
<td>NOx</td>
<td>Oxides of nitrogen</td>
</tr>
<tr>
<td>rO</td>
<td>Rated output</td>
</tr>
<tr>
<td>rPR</td>
<td>Rated pressure ratio</td>
</tr>
<tr>
<td>sec.</td>
<td>Seconds</td>
</tr>
<tr>
<td>SP</td>
<td>Shaft power</td>
</tr>
<tr>
<td>SN</td>
<td>Smoke number</td>
</tr>
<tr>
<td>T</td>
<td>Temperature, degrees Kelvin</td>
</tr>
<tr>
<td>TIM</td>
<td>Time in mode</td>
</tr>
<tr>
<td>W</td>
<td>Watt(s)</td>
</tr>
<tr>
<td>°</td>
<td>Degree</td>
</tr>
<tr>
<td>%</td>
<td>Percent</td>
</tr>
</tbody>
</table>

§ 87.3 General requirements.

(a) This part provides for the approval or acceptance by the Administrator or the Secretary of testing and sampling methods, analytical techniques, and related equipment not identical to those specified in this part. Before either approves or accepts any
such alternate, equivalent, or otherwise nonidentical procedures or equipment, the Administrator or the Secretary shall consult with the other in determining whether or not the action requires rulemaking under sections 231 and 232 of the Clean Air Act, as amended, consistent with the Administrator’s and the Secretary’s responsibilities under sections 231 and 232 of the Act. (42 U.S.C. 7571, 7572).

(b) Under section 232 of the Act, the Secretary issues regulations to insure compliance with this part.

(c) With respect to aircraft of foreign registry, these regulations shall apply in a manner consistent with any obligation assumed by the United States in any treaty, convention or agreement between the United States and any foreign country or foreign countries.

§ 87.5 Special test procedures.

The Administrator or the Secretary may, upon written application by a manufacturer or operator of aircraft or aircraft engines, approve test procedures for any aircraft or aircraft engine that is not susceptible to satisfactory testing by the procedures set forth herein. Prior to taking action on any such application, the Administrator or the Secretary shall consult with the other.

§ 87.6 Aircraft safety.

The provisions of this part will be revised if at any time the Secretary determines that an emission standard cannot be met within the specified time without creating a safety hazard.

§ 87.7 Exemptions.

(a) Exemptions based on flights for short durations at infrequent intervals. The emission standards of this part do not apply to engines which power aircraft operated in the United States for short durations at infrequent intervals. Such operations are limited to:

1. Flights of an aircraft for the purpose of export to a foreign country, including any flights essential to demonstrate the integrity of an aircraft prior to its flight to a point outside the United States.

2. Flights to a base where repairs, alterations or maintenance are to be performed, or to a point of storage, and flights for the purpose of returning an aircraft to service.

3. Official visits by representatives of foreign governments.

4. Other flights the Secretary determines, after consultation with the Administrator, to be for short durations at infrequent intervals. A request for such a determination shall be made before the flight takes place.

(b) Exemptions for very low production models. The emission standards of this part do not apply to engines of very low total production after the date of applicability. For the purpose of this part, “very low production” is limited to a maximum total production for United States civil aviation applications of no more than 200 units covered by the same type certificate after January 1, 1984.

1. A maximum annual production rate after January 1, 1984 of 20 units covered by the same type certificate; and

2. A maximum total production after January 1, 1984 of 200 units covered by the same type certificate.

(c) Exemptions for New Engines in Other Categories. The emission standards of this part do not apply to engines for which the Secretary determines, with the concurrence of the Administrator, application of any standard under §87.21 is not justified, based upon consideration of:

1. Adverse economic impact on the manufacturer.

2. Adverse economic impact on the aircraft and airline industries at large.

3. Equity in administering the standards among all economically competing parties.

4. Public health and welfare effects.

5. Other factors which the Secretary, after consultation with the Administrator, may deem relevant to the case in question.

(d) Time Limited Exemptions for In Use Engines. The emission standards of this part do not apply to aircraft or aircraft engines for time periods which the Secretary determines, with the concurrence of the Administrator, that any applicable standard under §87.11(a),
§ 87.10 Applicability.

(a) The provisions of this subpart are applicable to all new aircraft gas turbines of classes T3, T8, TSS and TF equal to or greater than 36 kilonewton rated output, manufactured on or after January 1, 1974, and to all in-use aircraft gas turbine engines of classes T3, T8, TSS and TF equal to or greater than 36 kilonewton rated output manufactured after February 1, 1974.

(b) The provisions of this subpart are also applicable to all new aircraft gas turbines of class TF less than 36 kilonewton rated output and class TP manufactured after January 1, 1975. [49 FR 41002, Oct. 18, 1984]

§ 87.11 Standard for fuel venting emissions.

(a) No fuel venting emissions shall be discharged into the atmosphere from any new or in-use aircraft gas turbine engine subject to the subpart. This paragraph is directed at the elimination of intentional discharge to the atmosphere of fuel drained from fuel nozzle manifolds after engines are shut down and does not apply to normal fuel seepage from shaft seals, joints, and fittings.

(b) Conformity with the standard set forth in paragraph (a) of this section shall be determined by inspection of the method designed to eliminate these emissions.

Subpart C—Exhaust Emissions (New Aircraft Gas Turbine Engines)

§ 87.20 Applicability.

The provisions of this subpart are applicable to all aircraft gas turbine engines of the classes specified beginning on the dates specified.

§ 87.21 Standards for exhaust emissions.

(a) Exhaust emissions of smoke from each new aircraft gas turbine engine of class T8 manufactured on or after February 1, 1974, shall not exceed: Smoke number of 30.

(b) Exhaust emissions of smoke from each new aircraft gas turbine engine of class TF and of rated output of 129 kilonewtons thrust or greater, manufactured on or after January 1, 1976, shall not exceed:

\[ SN = 83.6(r_0)^{-0.274} \] (\( r_0 \) is in kilonewtons).

(c) Exhaust emission of smoke from each new aircraft gas turbine engine of class T3 manufactured on or after January 1, 1978, shall not exceed: Smoke number of 25.

(d) Gaseous exhaust emissions from each new commercial aircraft gas turbine engine shall not exceed:
§ 87.31 Standards for exhaust emissions.

(a) Exhaust emissions of smoke from each in-use aircraft gas turbine engine of Class TF, beginning February 1, 1974, shall not exceed: Smoke number of 30.

(b) Exhaust emissions of smoke from each in-use aircraft gas turbine engine of class T8 and of rated output of 129 kilonewtons thrust or greater, beginning January 1, 1976, shall not exceed: Smoke number of 30.

(c) The standards set forth in paragraphs (a) and (b) of this section refer to exhaust smoke emissions emitted during operations of the engine as specified in the applicable section of subpart H of this part, and measured and calculated in accordance with the procedures set forth in this subpart.

§ 87.30 Applicability.

The provisions of this subpart are applicable to all in-use aircraft gas turbine engines certified for operation within the United States of the classes specified beginning on the dates specified.
§ 87.60 Test Procedures for Engine Exhaust Gaseous Emissions (Aircraft and Aircraft Gas Turbine Engines)

§ 87.60 Introduction.
(a) Except as provided under § 87.5, the procedures described in this subpart shall be the test program to determine the conformity of new aircraft gas turbine engines with the applicable standards set forth in this part.

(b) The test consists of operating the engine at prescribed power settings on an engine dynamometer (for engines producing primarily shaft power) or thrust measuring test stand (for engines producing primarily thrust). The exhaust gases generated during engine operation are sampled continuously for specific component analysis through the analytical train.

(c) The exhaust emission test is designed to measure hydrocarbons, carbon monoxide, carbon dioxide, and oxides of nitrogen concentrations, and to determine mass emissions through calculations during a simulated aircraft landing-takeoff cycle (LTO). The LTO cycle is based on time in mode data during high activity periods at major airports. The test for propulsion engines consists of at least the following four modes of engine operation: taxi/idle, takeoff, climbout, and approach. The mass emission for the modes are combined to yield the reported values.

(d) When an engine is tested for exhaust emissions on an engine dynamometer or test stand, the complete engine shall be used with all accessories which might reasonably be expected to influence emissions to the atmosphere installed and functioning, if not otherwise prohibited by § 87.62(a)(2).

§ 87.61 Turbine fuel specifications.
For exhaust emission testing, fuel meeting the specifications listed in this section shall be used. Additives used for the purpose of smoke suppression (such as organometallic compounds) shall not be present.

Property and Allowable Range of Values
Density kg/m³ at 15 °C: 780–820.
Distillation temperature, °C: 10% boiling point, 155–201; final boiling point, 235–285.
Net heat of combustion, MJ/kg: 42.86–43.50.
Aromatics, volume %: 15–23.
Naphthalenes, volume %: 1.0–3.5.
Smoke point, mm: 20–28.
Hydrogen, mass %: 13.4–14.1.
Sulfur, mass %: less than 0.3%.
Kinematic viscosity at –20 °C, mm²/s: 2.5–6.5.


§ 87.62 Test procedure (propulsion engines).
(a)(1) The engine shall be tested in each of the following engine operating modes which simulate aircraft operation to determine its mass emission rates. The actual power setting, when corrected to standard day conditions, should correspond to the following percentages of rated output. Analytical correction for variations from reference day conditions and minor variations in actual power setting should be specified and/or approved by the Secretary:

<table>
<thead>
<tr>
<th>Mode</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TP</td>
</tr>
<tr>
<td>Taxi/idle</td>
<td>(1)</td>
</tr>
<tr>
<td>Takeoff</td>
<td>100</td>
</tr>
<tr>
<td>Climbout</td>
<td>90</td>
</tr>
<tr>
<td>Approach</td>
<td>NA</td>
</tr>
</tbody>
</table>

1 See paragraph (a)(2) of this section.

(2) The taxi/idle operating modes shall be carried out at a power setting of 7% rated thrust unless the Secretary determines that the unique characteristics of an engine model undergoing certification testing at 7% would result in substantially different HC and CO emissions than if the engine model were tested at the manufacturers recommended idle power setting. In such cases the Secretary shall specify an alternative test condition.

(3) The times in mode (TIM) shall be as specified below:
Environmental Protection Agency

§ 87.80  
Introduction.  
Except as provided under §87.5, the procedures described in this subpart shall be the test program to determine the conformity of new and in-use gas turbine engines with the applicable standards set forth in this part. The test is essentially the same as that described in §§87.60 through 87.62, except that the test is designed to determine the smoke emission level at various operating points representative of engine usage in aircraft. Other smoke measurement systems may be used if shown to provide comparable data.

Subpart H—Test Procedures for Engine Smoke Emissions (Aircraft Gas Turbine Engines)  

§ 87.80  
Introduction.
§ 87.81 Fuel specifications.
Fuel having specifications as provided in §87.61 shall be used in smoke emission testing.

§ 87.82 Sampling and analytical procedures for measuring smoke exhaust emissions.
The system and procedures for sampling and measurement of smoke emissions shall be as specified by Appendix 2 to International Civil Aviation Organization (ICAO) Annex 16, Volume II, Environmental Protection, Aircraft Engine Emissions, Second Edition, July 1993, which are incorporated herein by reference. This incorporation by reference was approved by the Director of the Federal Register in accordance with 5 U.S.C. 552(a) and 1 CFR part 51. These materials are incorporated as they exist on the date of the approval and a notice of any change in these materials will be published in the FEDERAL REGISTER. Frequent changes are not anticipated. Copies may be inspected at U.S. EPA, OAR, 401 M St., SW., Washington, DC 20460, or at the Office of the Federal Register, 800 North Capitol Street, NW., suite 700, Washington, DC. Copies of this document can be obtained from the International Civil Aviation Organization (ICAO), Document Sales Unit, P.O. Box 400, Succursale: Place de L’Aviation Internationale, 1000 Sherbrooke Street West, Suite 400, Montreal, Quebec, Canada H3A 2R2.


PART 88—CLEAN-FUEL VEHICLES

Subpart A—Emission Standards for Clean-Fuel Vehicles

Sec. 88.101–94 General applicability.
88.102–94 Definitions.
88.103–94 Abbreviations.
88.105–94 Clean-fuel fleet emission standards for heavy-duty engines.

Subpart B—California Pilot Test Program

88.201–94 Scope.
88.203–94 Abbreviations.
88.204–94 Sales requirements for the California Pilot Test Program.
88.205–94 California Pilot Test Program Credits Program.
88.206–94 State opt-in for the California Pilot Test Program.

TABLES TO SUBPART B OF PART 88

Subpart C—Clean-Fuel Fleet Program

88.301–93 General applicability.
88.302–93 Definitions.
88.302–94 Definitions.