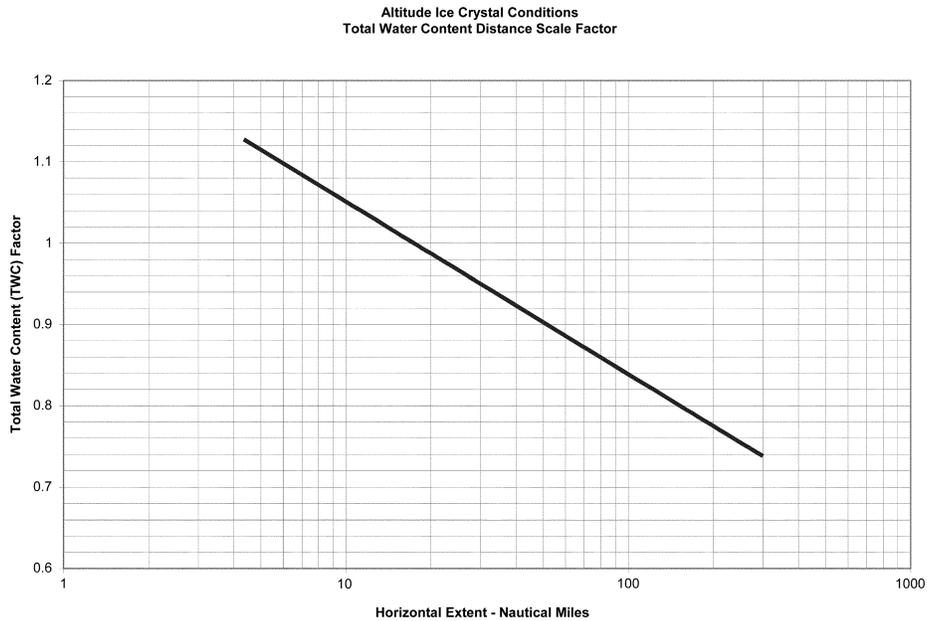


FIGURE D3 — Exposure Length Influence on TWC



[Amdt. 33-34, 79 FR 65538, Nov. 4, 2014]

PART 34—FUEL VENTING AND EXHAUST EMISSION REQUIREMENTS FOR TURBINE ENGINE POWERED AIRPLANES

Subpart A—General Provisions

- Sec.
- 34.1 Definitions.
- 34.2 Abbreviations.
- 34.3 General requirements.
- 34.4 Incorporation by reference.
- 34.5 Special test procedures.
- 34.6 Aircraft safety.
- 34.7 Exemptions.
- 34.9 Exceptions.

Subpart B—Engine Fuel Venting Emissions (New and In-Use Aircraft Gas Turbine Engines)

- 34.10 Applicability.
- 34.11 Standard for fuel venting emissions.

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

- 34.20 Applicability.

- 34.21 Standards for exhaust emissions.
- 34.23 Exhaust Emission Standards for Engines Manufactured on and after July 18, 2012.
- 34.25 Non-volatile particulate emissions standards (nvPM).

Subpart D—Exhaust Emissions (In-Use Aircraft Gas Turbine Engines)

- 34.30 Applicability.
- 34.31 Standards for exhaust emissions.

Subpart E—Certification Provisions

- 34.48 Derivative engines for emissions certification purposes.

Subpart F [Reserved]

Subpart G—Test Procedures for Engine Exhaust Gaseous Emissions (Aircraft and Aircraft Gas Turbine Engines)

- 34.60 Introduction.

§ 34.1

14 CFR Ch. I (1–1–25 Edition)

34.61–34.71 [Reserved]

Subpart H—Test Procedures and Compliance Demonstration for Non-Volatile Particulate Matter Emissions

34.71 Non-Volatile Particulate Matter (nvPM) Test Procedures.

34.73 Demonstration of compliance for nvPM emissions.

AUTHORITY: 42 U.S.C. 4321 *et seq.*, 7572; 49 U.S.C. 106(g), 40113, 44701–44702, 44704, 44714.

SOURCE: Docket No. 25613, 55 FR 32861, Aug. 10, 1990, unless otherwise noted.

Subpart A—General Provisions

§ 34.1 Definitions.

As used in this part, all terms not defined herein shall have the meaning given them in the Clean Air Act, as amended (42 U.S.C. 7401 *et seq.*):

Act means the Clean Air Act, as amended (42 U.S.C. 7401 *et seq.*).

Administrator means the Administrator of the Federal Aviation Administration or any person to whom he has delegated his authority in the matter concerned.

Administrator of the EPA means the Administrator of the Environmental Protection Agency and any other officer or employee of the Environmental Protection Agency to whom the authority involved may be delegated.

Aircraft as used in this part means any airplane as defined in 14 CFR part 1 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.

Characteristic level has the meaning given in Appendix 6 of ICAO Annex 16 as of July 2008 (incorporated by reference, see §34.4). The characteristic level is a calculated emission level for each pollutant based on a statistical assessment of measured emissions from multiple tests.

Class TP means all aircraft turboprop engines.

Class TF means all turbofan or turbojet aircraft engines or aircraft engines designed for applications that

otherwise would have been fulfilled by turbojet and turbofan 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 Title 49 of the United States Code and Title 14 of the Code of Federal Regulations.

Commercial aircraft gas turbine engine means a turboprop, turbofan, or turbojet commercial aircraft engine.

Date of manufacture of an engine is the date the inspection acceptance records reflect that the engine is complete and meets the FAA approved type design.

Derivative engine for emissions certification purposes means an engine that is similar in design to an engine that has demonstrated compliance with the applicable exhaust emission standards of this part, as determined by the FAA, and has a U.S. type certificate issued in accordance with part 33 of this chapter.

Emission measurement system means all of the equipment necessary to transport the emission sample and measure the level of emissions. This includes the sample system and the instrumentation system.

Engine model means all commercial aircraft turbine engines which are of the same general series, displacement, and design characteristics and are approved under the same type certificate.

Excepted, as used in §34.9, means an engine that may be produced and sold that does not meet otherwise applicable standards. Excepted engines must conform to regulatory conditions specified for an exception in §34.9. Excepted engines are subject to the standards of this part even though they are not required to comply with the otherwise

applicable requirements. Engines excepted with respect to certain standards must comply with other standards from which they are not specifically excepted.

Exempt means an engine that does not meet certain applicable standards but may be produced and sold under the terms allowed by a grant of exemption issued pursuant to §34.7 of this part and part 11 of this chapter. Exempted engines must conform to regulatory conditions specified in the exemption as well as other applicable regulations. Exempted engines are subject to the standards of this part even though they are not required to comply with the otherwise applicable requirements. Engines exempted with respect to certain standards must comply with other standards as a condition of the exemption.

Exhaust emissions means substances emitted into the atmosphere from the exhaust discharge nozzle of an aircraft or aircraft engine.

In-use aircraft gas turbine engine means an aircraft gas turbine engine which is in service.

Introduction date means the date of manufacture of the first individual production engine of a given engine model or engine type certificate family to be certificated. Neither test engines nor engines not placed into service affect this date.

New aircraft turbine engine means an aircraft gas turbine engine which has never been in service.

Non-volatile particulate matter (nvPM) means emitted particles that remain at the exhaust nozzle exit plane of a gas turbine engine, and that did not volatilize after being heated to a temperature of at least 350 °C.

Power setting means the power or thrust output of an engine in terms of kilonewtons thrust for turbojet and turbofan engines or shaft power in terms of kilowatts for turboprop engines.

Rated output (rO) means the maximum power/thrust available for take-off at standard day conditions as approved for the engine by the Federal Aviation Administration, including re-heat contribution where applicable, but excluding any contribution due to water injection, expressed in kilowatts

or kilonewtons (as applicable), rounded to at least three significant figures.

Rated pressure ratio (rPR) means the ratio between the combustor inlet pressure and the engine inlet pressure achieved by an engine operation at rated output, rounded to at least three significant figures.

Reference day conditions means the reference ambient conditions to which the measured smoke, nvPM, and gaseous emissions must be corrected. The reference day conditions are as follows:

- (1) Temperature = 15 °C,
- (2) Specific humidity = 0.00634 kg H₂O/kg of dry air, and
- (3) Pressure = 101.325 kPa

Sample system means the system which provides for the transportation of the gaseous emission sample from the sample probe to the inlet of the instrumentation system.

Shaft power means only the measured shaft power output of a turboprop engine.

Smoke means the matter in exhaust emissions which obscures the transmission of light.

Smoke number (SN) means the dimensionless term quantifying smoke emissions.

Standard day conditions means the following ambient conditions: temperature = 15 °C, specific humidity = 0.00634 kg H₂O/kg dry air, and pressure = 101.325 kPa.

Taxi/idle (in) means those aircraft operations involving taxi and idle between the time of landing roll-out and final shutdown of all propulsion engines.

Taxi/idle (out) means those aircraft operations involving taxi and idle between the time of initial starting of the propulsion engine(s) used for the taxi and the turn onto the duty runway.

Tier, as used in this part, is a designation related to the NO_x emission standard for the engine as specified in §34.21 or §34.23 of this part (e.g., Tier 0).

[Doc. No. 25613, 55 FR 32861, Aug. 10, 1990; 55 FR 37287, Sept. 10, 1990, as amended by Amdt. 34-3, 64 FR 5558, Feb. 3, 1999; Amdt. 34-5, 77 FR 76849, Dec. 31, 2012; Amdt. 34-5A, 78 FR 63016, Oct. 23, 2013; Amdt. 34-7, 89 FR 31085, Apr. 24, 2024]

§ 34.2

14 CFR Ch. I (1–1–25 Edition)

§ 34.2 Abbreviations.

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

CO ₂	Carbon dioxide
CO	Carbon monoxide
EPA	United States Environmental Protection Agency
FAA	Federal Aviation Administration, United States Department of Transportation
g	Gram(s)
HC	Hydrocarbon(s)
HP	Horsepower
hr	Hour(s)
H ₂ O	Water
kg	Kilogram(s)
kJ	Kilojoule(s)
kN	Kilonewton(s)
kW	Kilowatt(s)
lbf	Pound force
LTO	Landing and takeoff
m	Meter(s)
mg	Milligram(s)
µg	Microgram(s)
min	Minute(s)
MJ	Megajoule(s)
NO _x	Oxides of nitrogen
nvPM	Non-volatile particulate matter
nvPM _{mass}	Non-volatile particulate matter mass
nvPM _{MC}	Non-volatile particulate matter mass concentration
nvPM _{num}	Non-volatile particulate matter number
Pa	Pascal(s)
rO	Rated output
rPR	Rated pressure ratio
sec	Second(s)
SP	Shaft power
SN	Smoke number
T	Temperature in degrees Kelvin
TIM	Time in mode
°C	Degrees Celsius
%	Percent

[Doc. No. FAA–2023–2434, Amdt. 34–7, 89 FR 31085, Apr. 24, 2024]

§ 34.3 General requirements.

(a) This part provides for the approval or acceptance by the Administrator or the Administrator of the EPA 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 Administrator of the EPA 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 responsibilities of the Administrator of the EPA and the Secretary of Transportation under sections 231 and 232 of the Clean Air Act.

(b) Under section 232 of the Act, the Secretary of Transportation issues regulations to ensure compliance with 40 CFR part 1031. This authority has been delegated to the Administrator of the FAA in accordance with 49 CFR 1.47.

(c) This part applies to civil airplanes that are powered by aircraft gas turbine engines of the classes specified herein and that have U.S. standard airworthiness certificates.

(d) Pursuant to the definition of “aircraft” in 40 CFR 1031.205, this regulation applies to civil airplanes that are powered by aircraft gas turbine engines of the classes specified herein and that have foreign airworthiness certificates that are equivalent to U.S. standard airworthiness certificates. This regulation applies only to those foreign civil airplanes that, if registered in the United States, would be required by applicable regulations to have a U.S. standard airworthiness certificate in order to conduct the operations intended for the airplane. Pursuant to 40 CFR 1031.5, this regulation does not apply where it would be inconsistent with an obligation assumed by the United States to a foreign country in a treaty, convention, or agreement.

(e) Reference in this regulation to 40 CFR part 1031 refers to title 40 of the Code of Federal Regulations, chapter I—Environmental Protection Agency, part 1031, Control of Air Pollution from Aircraft and Aircraft Engines (40 CFR part 1031).

(f) This part contains regulations that implement compliance with certain standards contained in 40 CFR part 1031. If EPA takes any action, including the issuance of an exemption or issuance of a revised or alternate procedure, test method, or other regulation, the effect of which is to relax or delay the effective date of any provision of 40 CFR part 1031 that is made applicable to an aircraft under this

part, the Administrator of FAA will grant a general administrative waiver of the more stringent requirements until this part is amended to reflect the requirements relaxed by EPA.

(g) Unless otherwise stated, all terminology and abbreviations in this part that are defined in 40 CFR part 1031 have the meaning specified in that part, and all terms in 40 CFR part 1031 that are not defined in that part but that are used in this part have the meaning given them in the Clean Air Act, Public Law 91-604, as amended.

(h) All interpretations of 40 CFR part 1031 that are promulgated by the EPA also apply to this part.

(i) If the EPA, under 40 CFR part 1031, approves or accepts any testing and sampling procedures or methods, analytical techniques, or related equipment not identical to those specified in that part, this part requires an applicant to show that such alternate, equivalent, or otherwise non-identical procedures have been complied with, and that such alternate equipment was used to show compliance, unless the applicant elects to comply with those procedures, methods, techniques, and equipment specified in 40 CFR part 1031.

(j) If the EPA, under 40 CFR 1031, prescribes special test procedures for any aircraft or aircraft engine that is not susceptible to satisfactory testing using the procedures in 40 CFR part 1031, the applicant must demonstrate to the FAA Administrator that they are in compliance with those special test procedures.

(k) Wherever 40 CFR part 1031 requires agreement, acceptance, or approval by the Administrator of the EPA, this part requires a showing that such agreement or approval has been obtained.

(l) Pursuant to 42 U.S.C. 7573, no state or political subdivision thereof may adopt or attempt to enforce any standard respecting emissions of any air pollutant from any aircraft or engine thereof unless that standard is identical to a standard made applicable to the aircraft by the terms of this part.

(m) If EPA, by regulation or exemption, relaxes a provision of 40 CFR part 1031 that is implemented in this part,

no state or political subdivision thereof may adopt or attempt to enforce the terms of this part that are superseded by the relaxed requirement.

(n) If any provision of this part is rendered inapplicable to a foreign aircraft as provided in 40 CFR 1031.5 (international agreements), and paragraph (d) of this section, that provision may not be adopted or enforced against that foreign aircraft by a state or political subdivision thereof.

(o) For exhaust emissions requirements of this part that apply beginning February 1, 1974, January 1, 1976, January 1, 1978, January 1, 1984, and August 9, 1985, continued compliance with those requirements is shown for engines for which the type design has been shown to meet those requirements, if the engine is maintained in accordance with applicable maintenance requirements of 14 CFR chapter I. All methods of demonstrating compliance and all model designations previously found acceptable to the Administrator shall be deemed to continue to be an acceptable demonstration of compliance with the specific standards for which they were approved.

(p) Each applicant must allow the Administrator to make, or witness, any test necessary to determine compliance with the applicable provisions of this part.

[Doc. No. FAA-2023-2434, Amdt. 34-7, 89 FR 31085, Apr. 24, 2024]

§ 34.4 Incorporation by Reference.

Certain material is incorporated by reference into this part with the approval of the Director of the Federal Register under 5 U.S.C. 552(a) and 1 CFR part 51). All approved material is available for inspection at the FAA and at the National Archives and Records Administration (NARA). Contact the FAA Office of Rulemaking (ARM), 800 Independence Avenue SW, Washington, DC 20590 (telephone 202-267-9677) For information on the availability of this material at NARA, visit www.archives.gov/federal-register/cfr/ibr-locations or email fr.inspection@nara.gov.

(a) The material may be obtained from the following source: International Civil Aviation Organization

§ 34.5

14 CFR Ch. I (1–1–25 Edition)

(ICAO): Document Sales Unit, 999 University Street, Montreal, Quebec H3C 5H7, Canada, phone + 1 514-954-8022, or *www.icao.int*.

(1) Annex 16 to the Convention on International Civil Aviation: Environmental Protection, Volume II—Aircraft Engine Emissions, Third Edition, July 2008 (ICAO Annex 16); in §§34.1 and 34.60.

(2) Annex 16 to the Convention on International Civil Aviation: Environmental Protection, Volume II—Aircraft Engine Emissions, Fourth Edition, July 2017 (ICAO Annex 16, Volume II), in §§34.71 and 34.73.

(b) [Reserved]

[Doc. No. FAA–2023–2434, Amdt. 34–7, 89 FR 31086, Apr. 24, 2024]

§ 34.5 Special test procedures.

The Administrator or the Administrator of the EPA 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 Administrator of the EPA shall consult with the other.

§ 34.6 Aircraft safety.

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

(b) Consistent with 40 CFR part 1031, if the FAA Administrator determines that any emission control regulation in this part cannot be safely applied to an aircraft, that provision may not be adopted or enforced against that aircraft by any state or political subdivision thereof.

[Docket No. 25613, 55 FR 32861, Aug. 10, 1990, as amended by Amdt. No. 34–7, 89 FR 31086, Apr. 24, 2024]

§ 34.7 Exemptions.

Notwithstanding part 11 of the Federal Aviation Regulations (14 CFR part 11), all petitions for rulemaking involving either the substance of an emission standard or test procedure prescribed

by the EPA that is incorporated in this FAR, or the compliance date for such standard or procedure, must be submitted to the EPA. Information copies of such petitions are invited by the FAA. Petitions for rulemaking or exemption involving provisions of this FAR that do not affect the substance or the compliance date of an emission standard or test procedure that is prescribed by the EPA, and petitions for exemptions under the provisions for which the EPA has specifically granted exemption authority to the Secretary of Transportation are subject to part 11 of the Federal Aviation Regulations (14 CFR part 11). Petitions for rulemaking or exemptions involving these FARs must be submitted to the FAA.

(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 a 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, or for the purpose of returning an aircraft to service.

(3) Official visits by representatives of foreign governments.

(4) Other flights the Administrator determines, after consultation with the Administrator of the EPA, 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 engine models.* The emissions standards of this part do not apply to engines of very low 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. Engines manufactured under this provision must be reported

to the FAA by serial number on or before the date of manufacture and exemptions granted under this provision are not transferable to any other engine. This exemption is limited to the requirements of § 34.21 only.

(c) *Exemptions for new engines in other categories.* The emissions standards of this part do not apply to engines for which the Administrator determines, with the concurrence of the Administrator of the EPA, that application of any standard under § 34.21 is not justified, based on 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; and

(5) Other factors which the Administrator, after consultation with the Administrator of the EPA, may deem relevant to the case in question.

(d) *Applicants seeking exemption from other emissions standards of this part and 40 CFR 1031.15.* Applicants must request exemption from both the FAA and the EPA, even where the underlying regulatory requirements are the same. The FAA and EPA will jointly consider such exemption requests, and will assure consistency in the respective agency determinations.

(e) Applications for exemption from this part shall be submitted in duplicate to the Administrator in accordance with the procedures established by the Administrator in part 11.

(f) The Administrator shall publish in the FEDERAL REGISTER the name of the organization to whom exemptions are granted and the period of such exemptions.

(g) No state or political subdivision thereof may attempt to enforce a standard respecting emissions from an aircraft or engine if such aircraft or engine has been exempted from such standard under this part.

[Doc. No. 25613, 55 FR 32861, Aug. 10, 1990, as amended by Amdt. 34-5, 77 FR 76850, Dec. 31, 2012; Amdt. 34-7, 89 FR 31087, Apr. 24, 2024]

§ 34.9 Exceptions.

(a) *Spare engines.* Certain engines that meet the following description are excepted:

(1) This exception allows production of an engine for installation on an in-service aircraft. A spare engine may not be installed on a new aircraft.

(2) Each spare engine must be identical to a sub-model previously certificated to meet all applicable requirements.

(3) A spare engine may be used only when the emissions of the spare do not exceed the certification requirements of the original engine, for all regulated pollutants.

(4) No separate approval is required to produce spare engines.

(5) The record for each engine excepted under this paragraph (c) must indicate that the engine was produced as an excepted spare engine.

(6) Engines produced under this exception must be labeled “EXCEPTED SPARE” in accordance with § 45.13 of this chapter.

(b) On and after July 18, 2012, and before August 31, 2013, a manufacturer may produce up to six Tier 4 compliant engines that meet the NO_x standards of paragraph (d)(1)(vi) of this section rather than § 34.23(a)(2). No separate approval is required to produce these engines. Engines produced under this exception are to be labeled “COMPLY” in accordance with § 45.13 of this chapter.

[Doc. No. FAA-2012-1333, 77 FR 76850, Dec. 31, 2012]

Subpart B—Engine Fuel Venting Emissions (New and In-Use Aircraft Gas Turbine Engines)

§ 34.10 Applicability.

(a) The provisions of this subpart are applicable to all new aircraft gas turbine engines of classes T3, T8, TSS, and TF equal to or greater than 36 kN (8,090 lb) 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 kN (8,090 lb) rated output manufactured after February 1, 1974.

(b) The provisions of this subpart are also applicable to all new aircraft gas turbine engines of class TF less than 36

§ 34.11

kN (8,090 lb) rated output and class TP manufactured on or after January 1, 1975, and to all in-use aircraft gas turbine engines of class TF less than 36 kN (8,090 lb) rated output and class TP manufactured after January 1, 1975.

[Doc. No. FAA-2012-1333, 77 FR 76850, Dec. 31, 2012]

§ 34.11 Standard for fuel venting emissions.

(a) No liquid 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.

(c) As applied to an airframe or an engine, any manufacturer or operator may show compliance with the liquid fuel venting and emissions requirements of this section that were effective beginning February 1, 1974 or January 1, 1975, by any means that prevents the intentional discharge of fuel from fuel nozzle manifolds after the engines are shut down. Acceptable means of compliance include one of the following:

(1) Incorporation of an FAA-approved system that recirculates the fuel back into the fuel system.

(2) Capping or securing the pressurization and drain valve.

(3) Manually draining the fuel from a holding tank into a container.

[Docket No. 25613, 55 FR 32861, Aug. 10, 1990, as amended by Amdt. No. 34-7, 89 FR 31087, Apr. 24, 2024]

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

§ 34.20 Applicability.

The provisions of this subpart are applicable to all aircraft gas turbine en-

14 CFR Ch. I (1–1–25 Edition)

gines of the classes specified beginning on the dates specified in § 34.21.

§ 34.21 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 a smoke number (SN) of 30.

(b) Exhaust emissions of smoke from each new aircraft gas turbine engine of class TF and of rated output of 129 kN (29,000 lb) thrust or greater, manufactured on or after January 1, 1976, shall not exceed

$SN = 83.6 (rO)^{-0.274}$ (rO is in kN).

(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 a smoke number (SN) of 25.

(d) Gaseous exhaust emissions from each new aircraft gas turbine engine shall not exceed:

(1) For Classes TF, T3, T8 engines greater than 26.7 kN (6,000 lb) rated output:

(i) Engines manufactured on or after January 1, 1984:

Hydrocarbons: 19.6 g/kN rO.

(ii) Engines manufactured on or after July 7, 1997:

Carbon Monoxide: 118 g/kN rO.

(iii) Engines of a type or model of which the date of manufacture of the first individual production model was on or before December 31, 1995, and for which the date of manufacture of the individual engine was on or before December 31, 1999 (Tier 2):

Oxides of Nitrogen: $(40 + 2(rPR))$ g/kN rO.

(iv) Engines of a type or model of which the date of manufacture of the first individual production model was after December 31, 1995, or for which the date of manufacture of the individual engine was after December 31, 1999 (Tier 2):

Oxides of Nitrogen: $(32 + 1.6(rPR))$ g/kN rO.

(v) The emission standards prescribed in paragraphs (d)(1)(iii) and (iv) of this

section apply as prescribed beginning July 7, 1997.

(vi) The emission standards of this paragraph apply as prescribed after December 18, 2005. For engines of a type or model of which the first individual production model was manufactured after December 31, 2003 (Tier 4):

(A) That have a rated pressure ratio of 30 or less and a maximum rated output greater than 89 kN:

Oxides of Nitrogen: $(19 + 1.6(\text{rPR})) \text{ g/kN rO}$.

(B) That have a rated pressure ratio of 30 or less and a maximum rated output greater than 26.7 kN but not greater than 89 kN:

Oxides of Nitrogen: $(37.572 + 1.6(\text{rPR}) - 0.2087(\text{rO})) \text{ g/kN rO}$.

(C) That have a rated pressure ratio greater than 30 but less than 62.5, and a maximum rated output greater than 89 kN:

Oxides of Nitrogen: $(7 + 2(\text{rPR})) \text{ g/kN rO}$.

(D) That have a rated pressure ratio greater than 30 but less than 62.5, and a maximum rated output greater than 26.7 kN but not greater than 89 kN:

Oxides of Nitrogen: $(42.71 + 1.4286(\text{rPR}) - 0.4013(\text{rO}) + 0.00642(\text{rPR} \times \text{rO})) \text{ g/kN rO}$.

(E) That have a rated pressure ratio of 62.5 or more:

Oxides of Nitrogen: $(32 + 1.6(\text{rPR})) \text{ g/kN rO}$.

(2) For Class TSS Engines manufactured on or after January 1, 1984:

Hydrocarbons: $140 (0.92)^{\text{rPR}} \text{ g/kN rO}$.

(e) Smoke exhaust emissions from each gas turbine engine shall not exceed:

(1)(A) For Class TF of rated output less than 26.7 kN (6,000 lbf) manufactured on or after August 9, 1985, and before July 18, 2012:

$\text{SN} = 83.6(\text{rO})^{-0.274}$ (rO is in kN) not to exceed a maximum of SN = 50.

(B) For Classes TF, T3, and T8 of rated output less than 26.7 kN (6,000 lbf) manufactured on or after July 18, 2012, and before January 1, 2023:

$\text{SN} = 83.6(\text{rO})^{-0.274}$ or 50.0, whichever is smaller.

(C) For Classes TF, T3, and T8 of rated output of 26.7 kN (6,000 lbf) or less manufactured on or after January 1, 2023:

$\text{SN} = 83.6(\text{rO})^{-0.274}$ or 50.0, whichever is smaller.

(2) For Classes T3, T8, TSS, and TF of rated output greater than or equal to 26.7 kN (6,000 lbf) manufactured on or after January 1, 1984, and before January 1, 2023:

$\text{SN} = 83.6(\text{rO})^{-0.274}$ (rO is in kN) not to exceed a maximum of SN = 50.

(3) For Class TP of rated output equal to or greater than 1,000 kW manufactured on or after January 1, 1984:

$\text{SN} = 187(\text{rO})^{-0.168}$ (rO is in kW).

(4) For Class TSS manufactured on or after January 1, 2023:

$\text{SN} = 83.6(\text{rO})^{-0.274}$ (rO is in kN) not to exceed a maximum of SN = 50.

(f) The standards set forth in paragraphs (a), (b), (c), (d), and (e) of this section refer to a composite gaseous emission sample representing the operation cycles and exhaust smoke emission emitted during operation of the engine as specified in the applicable sections of subpart G of this part, and measured and calculated in accordance with the procedures set forth in subpart G.

(g) Where a gaseous emission standard is specified by a formula, calculate and round the standard to three significant figures or to the nearest 0.1 g/kN (for standards at or above 100 g/kN). Where a smoke standard is specified by a formula, calculate and round the standard to the nearest 0.1 SN. Engines comply with an applicable standard if the testing results show that the engine type certificate family's characteristic level does not exceed the numerical level of that standard, as described in § 34.60.

[Doc. No. 25613, 55 FR 32861, Aug. 10, 1990; 55 FR 37287, Sept. 10, 1990, as amended by Amdt. 34-3, 64 FR 5559, Feb. 3, 1999; Amdt. 34-4, 74 FR 19127, Apr. 28, 2009; Amdt. 34-5, 77 FR 76851, Dec. 31, 2012; Amdt. No. 34-7, 89 FR 31087, Apr. 24, 2024]

§ 34.23

14 CFR Ch. I (1–1–25 Edition)

§ 34.23 Exhaust Emission Standards for Engines Manufactured on and after July 18, 2012.

The standards of this section apply to aircraft engines manufactured on and after July 18, 2012, unless otherwise exempted or excepted. Where a gaseous emission standard is specified by a formula, calculate and round the standard to three significant figures or to the nearest 0.1 g/kN (for standards at or above 100 g/kN). Where a smoke standard is specified by a formula, calculate and round the standard to the nearest 0.1 SN. Engines comply with an applicable standard if the testing results

show that the engine type certificate family's characteristic level does not exceed the numerical level of that standard, as described in § 34.60.

(a) Gaseous exhaust emissions from each new aircraft gas turbine engine shall not exceed:

(1) [Reserved]

(2) Except as provided in §§ 34.9(b) and 34.21(c), for Classes TF, T3 and T8 engines manufactured on and after July 18, 2012, and for which the first individual production model was manufactured on or before December 31, 2013 (Tier 6):

TIER 6 OXIDES OF NITROGEN EMISSION STANDARDS FOR SUBSONIC ENGINES

Class	Rated pressure ratio— rPR	Rated output rO (kN)	NO _x (g/kN)
TF, T3, T8	rPR ≤ 30	26.7 < rO ≤ 89.0	38.5486 + 1.6823 (rPR) - 0.2453 (rO) - (0.00308 (rPR) (rO)).
		rO > 89.0	16.72 + 1.4080 (rPR).
	30 < rPR < 82.6	26.7 < rO ≤ 89.0	46.1600 + 1.4286 (rPR) - 0.5303 (rO) + (0.00642 (rPR) (rO)).
		rO > 89.0	-1.04 + 2.0 (rPR).
rPR ≥ 82.6	rO ≥ 26.7		32 + 1.6 (rPR).

(3) Engines exempted from paragraph (a)(2) of this section produced on or before December 31, 2016 must be labeled "EXEMPT NEW" in accordance with § 45.13 of this chapter. No exemptions to

the requirements of paragraph (a)(2) of this section will be granted after December 31, 2016.

(4) For Class TSS Engines manufactured on and after July 18, 2012:

GASEOUS EMISSION STANDARDS FOR SUPERSONIC ENGINES

Class	Rated output rO ¹ (kN)	NO _x (g/kN)	CO (g/kN)
TSS	All	36 + 2.42 (rPR)	4,550 (rPR) ^{-1.03}

¹rO is the rated output with afterburning applied.

(b) Gaseous exhaust emissions from each new aircraft gas turbine engine shall not exceed:

dividual production model was manufactured after December 31, 2013 (Tier 8):

(1) For Classes TF, T3 and T8 engines of a type or model of which the first in-

TIER 8 OXIDES OF NITROGEN EMISSION STANDARDS FOR SUBSONIC ENGINES

Class	Rated pressure ratio— rPR	Rated output rO (kN)	NO _x (g/kN)
TF, T3, T8	rPR ≤ 30	26.7 < rO ≤ 89.0	40.052 + 1.5681 (rPR) - 0.3615 (rO) - (0.0018 (rPR) (rO)).
		rO > 89.0	7.88 + 1.4080 (rPR).

TIER 8 OXIDES OF NITROGEN EMISSION STANDARDS FOR SUBSONIC ENGINES—Continued

Class	Rated pressure ratio— rPR	Rated output rO (kN)	NO _x (g/kN)
	30 < rPR < 104.7	26.7 < rO ≤ 89.0	41.9435 + 1.505 (rPR) - 0.5823 (rO) + (0.005562 (rPR) (rO)).
		rO > 89.0	- 9.88 + 2.0 (rPR).
	rPR ≥ 104.7	rO ≥ 26.7	32 + 1.6 (rPR).

(c) Engines (including engines that are determined to be derivative engines for the purposes of emission certification) type certificated with characteristic levels at or below the NO_x standards of §34.21(d)(1)(vi) of this part (as applicable based on rated output and rated pressure ratio) and introduced before July 18, 2012, may be produced through December 31, 2012, without meeting the NO_x standard of paragraph (a)(2) of this section.

[Doc. No. 34-5, 77 FR 76851, Dec. 31, 2012, as amended by Amdt. 34-5A, 78 FR 63017, Oct. 23, 2013; 78 FR 65554, Nov. 1, 2013; Amdt. No. 34-7, 89 FR 31087, Apr. 24, 2024]

§34.25 Non-volatile particulate emissions standards (nvPM).

The standards of this section apply to an aircraft engine of Class TF, T3, or T8 with a rated output greater than 26.7 kN that is manufactured after January 1, 2023. Where a maximum nvPM_{MC} standard is expressed as a formula, calculate and round the standard

to the nearest 1.0 µg/m³. Where an nvPM_{mass} standard is expressed as a formula, calculate and round the standard to three significant figures or to the nearest 0.1 mg/kN. Where an nvPM_{num} standard is expressed as a formula, calculate and round the standard to three significant figures. Engines comply with an applicable standard if the test results show that the engine type certificate family's characteristic level does not exceed the numerical level of the nvPM standard when tested as described in subpart H of this part.

(a) Except as provided in paragraph (b) or (c) of this section;

(1) The characteristic level for the maximum nvPM_{MC} expressed in units of µg/m³ must not exceed the following:
 $nvPM_{MC} = 10^{(3 + 2.9rO^{-0.274})}$

and

(2) The characteristic level for nvPM mass expressed in [mg/kN] and for nvPM number expressed in [particles/kN] must not exceed the following:

TABLE 1 TO PARAGRAPH (a)(2)

Class	Rated output (rO) (kN)	nvPM _{mass} (mg/kN)	nvPM _{num} (particles/kN)
TF, T3, T8	26.7 < rO ≤ 200	4646.9 - 21.497 (rO)	2.669 × 10 ¹⁶ - 1.126 × 10 ¹⁴ (rO).
	rO > 200	347.5	4.170 × 10 ¹⁵ .

(b) For a change in type design by the type design holder, when the application for an amended type certificate is filed after January 1, 2023:

(1) If the engine qualifies as a derivative engine in accordance with §34.48 of this part, no testing is required for the engine to use the same nvPM certificated parameters (nvPM_{mass}, nvPM_{num}, and maximum nvPM_{MC}) as the engine it is derived from; or

(2) If the engine does not qualify as a derivative engine in accordance with §34.48 of this part, the applicant must demonstrate compliance with each requirement in paragraph (a) of this section.

(c) For issuance of an original type certificate when an application for type certification is filed after January 1, 2023, the applicant must demonstrate that the engine does not exceed:

§ 34.30

14 CFR Ch. I (1–1–25 Edition)

(1) For maximum $nvPM_{MC}$: as prescribed in paragraph (a)(1) of this section; and

(2) For the characteristic level for $nvPM_{mass}$ expressed in units of [mg/kN], and for $nvPM_{num}$ expressed in units of [particles/kN], the following:

TABLE 2 TO PARAGRAPH (c)(2)

Class	Rated output (rO) (kN)	$nvPM_{mass}$ (mg/kN)	$nvPM_{num}$ (particles/kN)
TF, T3, T8	26.7 < rO ≤ 150	1251.1 – 6.914 (rO)	1.490×10^{16} – 8.080×10^{13} (rO).
	rO > 150	214.0	2.780×10^{15} .

(d) For engines type certificated after January 1, 2023 and prior to May 24, 2024, compliance with this part must be demonstrated no later than August 22, 2024.

[Doc. No. FAA–2023–2434, Amdt. No. 34–7, 89 FR 31087, Apr. 24, 2024, as amended by Amdt. No. 34–7A, 89 FR 37972, May 7, 2024]

Subpart D—Exhaust Emissions (In-use Aircraft Gas Turbine Engines)

§ 34.30 Applicability.

The provisions of this subpart are applicable to all in-use aircraft gas turbine engines certificated for operation within the United States of the classes specified, beginning on the dates specified in § 34.31.

§ 34.31 Standards for exhaust emissions.

(a) Exhaust emissions of smoke from each in-use aircraft gas turbine engine of Class T8, beginning February 1, 1974, shall not exceed a smoke number (SN) of 30.

(b) Exhaust emissions of smoke from each in-use aircraft gas turbine engine of Class TF and of rated output of 129 kN (29,000 lb) thrust or greater, beginning January 1, 1976, shall not exceed $SN = 83.6(rO)^{-0.274}$ (rO is in kN).

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

[Doc. No. FAA–2012–1333, 77 FR 76852, Dec. 31, 2012]

Subpart E—Certification Provisions

§ 34.48 Derivative engines for emissions certification purposes.

(a) *General.* A type certificate holder may request from the FAA a determination that an engine configuration is considered a derivative engine for emissions certification purposes (all gaseous emissions and either $nvPM$ or smoke number as applicable). To be considered a derivative engine for emissions certification purposes under this part, the configuration must have been derived from the original engine that was certificated to the requirements of part 33 of this chapter and one of the following:

(1) The FAA has determined that a safety issue exists that requires an engine modification.

(2) Emissions from the derivative engines are determined to be similar. In general, this means the emissions must meet the criteria specified in paragraph (b) of this section. The FAA may amend the criteria of paragraph (b) in unusual circumstances, for individual cases, consistent with good engineering judgment.

(3) All of the regulated emissions from the derivative engine are lower than the original engine.

(b) *Emission similarity* (1) The type certificate holder must demonstrate that the proposed derivative engine model's emissions meet the applicable standards and differ from the original model's emission rates within the following ranges and values:

- (i) ±3.0 g/kN for NO_x .
- (ii) ±1.0 g/kN for HC.
- (iii) ±5.0 g/kN for CO.

(iv) ±2.0 SN for smoke (where applicable).

(v) The following values apply for maximum nvPM_{MC} , $\text{nvPM}_{\text{mass}}$, and nvPM_{num} (where applicable):

(A) maximum nvPM_{MC} :

(1) $\pm 200 \mu\text{g}/\text{m}^3$ if the characteristic level of maximum nvPM_{MC} is below $1,000 \mu\text{g}/\text{m}^3$; or

(2) $\pm 20\%$ of the characteristic level if the characteristic level for maximum nvPM_{MC} is at or above $1,000 \mu\text{g}/\text{m}^3$.

(B) $\text{nvPM}_{\text{mass}}$:

(1) $80 \text{ mg}/\text{kN}$ if the characteristic level for $\text{nvPM}_{\text{mass}}$ emissions is below $400 \text{ mg}/\text{kN}$; or

(2) $\pm 20\%$ of the characteristic level if the characteristic level for $\text{nvPM}_{\text{mass}}$ emissions is greater than or equal to $400 \text{ mg}/\text{kN}$.

(C) nvPM_{num} :

(1) 4×10^{14} particles/kN if the characteristic level for nvPM_{num} emissions is below 2×10^{15} particles/kN; or

(2) $\pm 20\%$ of the characteristic level if the characteristic level for nvPM_{num} emissions is greater than or equal to 2×10^{15} particles/kN.

(2) If the characteristic level of the original certificated engine model (or any other sub-models within the emission type certificate family tested for certification) before modification is at or above 95% of the applicable standard for any pollutant, an applicant must measure the proposed derivative engine model's emissions for all pollutants to demonstrate that the derivative engine's resulting characteristic levels will not exceed the applicable emission standards. If the characteristic levels of the originally certificated engine model (and all other sub-models within the emission type certificate family tested for certification) are below 95% of the applicable standard for each pollutant, the applicant may use engineering analysis consistent with good engineering judgment to demonstrate that the derivative engine will not exceed the applicable emission standards. The engineering analysis must address all modifications from the original engine, including those approved for previous derivative engines.

(3) In unusual circumstances and consistent with good engineering judgment, the FAA may adjust the ranges specified in paragraph (b)(1) of this section to evaluate a proposed derivative engine.

(c) *Continued production allowance.* Derivative engines for emissions certification purposes may continue to be produced after the applicability date for new emissions standards when the engines conform to the specifications of this section.

(d) *Non-derivative engines.* If the FAA determines that an engine model does not meet the requirements for a derivative engine for emissions certification purposes, the type certificate holder is required to demonstrate that the engine complies with the emissions standards applicable to a new engine type.

[Doc. No. 34-5, 77 FR 76852, Dec. 31, 2012, as amended by Amdt. No. 34-7, 89 FR 31088, Apr. 24, 2024]

Subpart F [Reserved]

Subpart G—Test Procedures for Engine Exhaust Gaseous Emissions (Aircraft and Aircraft Gas Turbine Engines)

§ 34.60 Introduction.

(a) Use the equipment and procedures specified in Appendix 3, Appendix 5, and Appendix 6 of ICAO Annex 16, as applicable, to demonstrate whether engines meet the applicable gaseous emission standards specified in subpart C of this part. Measure the emissions of all regulated gaseous pollutants. Use the equipment and procedures specified in Appendix 2 and Appendix 6 of ICAO Annex 16 to determine whether engines meet the applicable smoke standard specified in subpart C of this part. The compliance demonstration consists of establishing a mean value from testing the specified number of engines, then calculating a "characteristic level" by applying a set of statistical factors that take into account the number of engines tested. Round each characteristic level to the same number of decimal places as the corresponding emission standard. For turboprop engines, use the procedures specified for turboprop engines, consistent with good engineering judgment.

(b) Use a test fuel that meets the specifications described in Appendix 4 of ICAO Annex 16. The test fuel must not have additives whose purpose is to

suppress smoke, such as organometallic compounds.

(c) Prepare test engines by including accessories that are available with production engines if they can reasonably be expected to influence emissions. The test engine may not extract shaft power or bleed service air to provide power to auxiliary gearbox-mounted components required to drive aircraft systems.

(d) Test engines must reach a steady operating temperature before the start of emission measurements.

(e) In consultation with the EPA, the FAA may approve alternative procedures for measuring emissions, including testing and sampling methods, analytical techniques, and equipment

specifications that differ from those specified in this part. Manufacturers and operators may request approval of alternative procedures by written request with supporting justification to the FAA and to the Designated EPA Program Officer. To be approved, one of the following conditions must be met:

(1) The engine cannot be tested using the specified procedures; or

(2) The alternative procedure is shown to be equivalent to, or more accurate or precise than, the specified procedure.

(f) The following landing and takeoff (LTO) cycles apply for emissions testing and for calculating weighted LTO values:

LTO TEST CYCLES AND TIME IN MODE

Mode	Class					
	TP		TF, T3, T8		TSS	
	TIM (min)	% of rO	TIM (min)	% of rO	TIM (min)	% of rO
Taxi/idle	26.0	7	26.0	7	26.0	5.8
Takeoff	0.5	100	0.7	100	1.2	100
Climbout	2.5	90	2.2	85	2.0	65
Descent	NA	NA	NA	NA	1.2	15
Approach	4.5	30	4.0	30	2.3	34

(g) Engines comply with an applicable standard if the testing results show that the engine type certificate family's characteristic level does not exceed the numerical level of that standard, as described in the applicable appendix of Annex 16.

(h) The system and procedure for sampling and measurement of gaseous emissions shall be as specified by in Appendices 2, 3, 4, 5 and 6 to the International Civil Aviation Organization (ICAO) Annex 16, Environmental Protection, Volume II, Aircraft Engine Emissions, Third Edition, July 2008 (incorporated by reference, see §34.4).

[Doc. No. FAA–2012–1333, 77 FR 76853, Dec. 31, 2012, as amended by Doc. No. FAA–2018–0119, Amdt. 34–6, 83 FR 9170, Mar. 5, 2018; Doc. No. FAA–2023–2434; Amdt. No. 34–7, 89 FR 31088, Apr. 24, 2024]

§§ 34.61–34.71 [Reserved]

Subpart H—Test Procedures and Compliance Demonstration for Non-Volatile Particulate Matter Emissions

SOURCE: Doc. No. FAA–2023–2434; Amdt. No. 34–7, 89 FR 31088, Apr. 24, 2024, unless otherwise noted.

§34.71 Non-volatile particulate matter (nvPM) test procedures.

For each Class TF, T3, or T8 engine manufactured after January 1, 2023, that has a rated output greater than 26.7 kN, the test procedures for measuring each required nvPM parameter are as follows:

(a) Measure the emissions of all nvPM parameters required in this part, as applicable.

(b) Collect data from at least three engine tests, with each test conducted

at the reference LTO time/thrust combinations shown in paragraph (h) of this section.

(c) For the engines referenced in paragraph (b) of this section, all emissions certification tests may be conducted on one or more engines of the same type design.

(d) Use a test fuel that meets the specifications described in Appendix 4 of ICAO Annex 16, Volume II (incorporated by reference, see §34.4). The test fuel must not have any additive whose purpose is to suppress nvPM emissions.

(e) (1) When conducting test measurements in accordance with paragraphs (a) through (c) of this section, use the equipment and procedures specified in Appendix 1, Appendix 4, Appendix 6, and Appendix 7 of ICAO Annex 16, Volume II (incorporated by reference, see §34.4), when demonstrating whether an engine meets the applicable nvPM limit specified in §34.25 of this part.

(2) An applicant that seeks to use a procedure or equipment that differs from any specified in this part must request FAA approval in writing with supporting justification before the alternative procedure or equipment may be used to demonstrate compliance. The FAA will consult with the EPA on any such request. The FAA may approve the requested alternative for measuring nvPM, including testing and sampling methods, analytical techniques, and equipment specifications. Each request must meet one of the following conditions:

- (i) The engine cannot be tested using a specified procedure; or
- (ii) The alternative procedure is shown to be equivalent to, or more accurate or precise than, the specified procedure.

(f) Any engine accessory included in a type design that may reasonably be expected to influence either nvPM emissions or measurements must be installed on the engine before testing. The test engine must not extract shaft power or bleed service air to provide power to auxiliary gearbox-mounted components necessary to drive aircraft systems;

(g) For each percentage of rated output thrust level prescribed in paragraph (h) of this section, a test engine

must reach and maintain a steady operating condition before any nvPM emission measurement is made;

(h) The following landing and takeoff (LTO) cycles apply for nvPM emissions testing and for calculating weighted LTO values:

TABLE 1 TO PARAGRAPH (h)

Mode	Class TF, T3, T8	
	TIM (min)	% of rO
Taxi/idle	26.0	7
Takeoff	0.7	100
Climbout	2.2	85
Descent	NA	NA
Approach	4.0	30

(i) An engine complies with an applicable limit if the test results show that the engine type certificate family's characteristic level does not exceed any limit for maximum nvPM_{MC}, nvPM_{num}, and nvPM_{mass} described in §34.25.

(j) All measurements collected during engine tests required in paragraph (b) of this section must be used in the calculation of nvPM. Before any calculations are made, the FAA must approve the exclusion of any measurements that the applicant seeks to exclude, including any justification for such exclusions.

(k) The system and procedure for sampling and measurement of gaseous emissions shall be as specified by Appendices 1, 4, 6, and 7 of ICAO Annex 16, Volume II (incorporated by reference, see §34.4).

§ 34.73 Demonstration of compliance for nvPM emissions.

(a) Each compliance demonstration by an applicant requires:

- (1) Establishing a mean value from tests conducted on one or more engines;
 - (2) Calculating a “characteristic level” by applying a set of statistical factors that take into account the number of engines tested in accordance with §34.71(b) of this part; and
 - (3) Rounding each characteristic level to the same number of decimal places as the corresponding emission limit.
- (b) In demonstrating compliance with this subpart, an applicant must use the

§ 34.73

14 CFR Ch. I (1–1–25 Edition)

nvPM measurements collected in accordance with §34.71 as follows:

(1) An engine complies with an applicable standard when the engine type certificate family's characteristic level does not exceed any nvPM limit described in §34.25 of this part; and

(2) A compliance demonstration consists of:

(i) Determining the maximum $nvPM_{MC}$, and the mean value for $nvPM_{mass}$ and $nvPM_{num}$ from the data collected in accordance with paragraph §34.71(f) of this part;

(ii) Correcting each data point to standard temperature and pressure conditions;

(iii) Applying the appropriate statistical factor shown in Table 6-1 of Appendix 6 of ICAO Annex 16, Volume II (incorporated by reference, see §34.4) to account for the number of engines tested; and

(iv) Rounding each characteristic level to the same number of decimal places as the corresponding nvPM limit in §34.25 of this part.

(c) (1) In determining maximum $nvPM_{MC}$, an applicant must use one of the following evaluation methods for all engines measured in accordance with §34.71(c) of this part and using the thrust settings given in §34.71(h) of this part. An applicant may choose to measure additional thrust settings; while there is no restriction on the number of thrust settings measured, the same thrust settings must be used on each engine tested. A dataset consists of $nvPM_{MC}$ measurements made at each thrust setting across the thrust range chosen by the applicant for each engine. Plot all $nvPM_{MC}$ measurements versus thrust setting.

(i) Method 1—

(A) Average the individual data points measured at each thrust setting to develop one dataset of nvPM mass concentration for each engine tested, creating an average dataset for each engine; and

(B) Use the averages generated in paragraph (c)(1) of this section to develop a single curve fit to determine the overall maximum $nvPM_{MC}$ value;

(ii) Method 2—

(A) Measure individual data points of $nvPM_{MC}$ versus thrust. Using all datasets generated for each engine

physically tested, develop a single, separate curve fit;

(B) Determine the maximum $nvPM_{MC}$ from each engine curve fit resulting from paragraph (c)(1) of this section; and

(C) If more than one engine is physically tested, average the $nvPM_{MC}$ values from paragraph (c)(2) of this section to determine the overall maximum $nvPM_{MC}$ value for the model tested; or

(iii) Method 3—

(A) Develop a curve fit of $nvPM_{MC}$ versus thrust for each test conducted on each engine physically tested;

(B) From each curve fit developed in paragraph (c)(1) of this section, use the resultant curve fit equation to solve for each maximum;

(C) Average the maximum values for each engine physically tested; and

(D) Average the maximum values determined in paragraph (c)(1)(iii)(C) of this section to determine the overall average maximum $nvPM_{MC}$ value.

(2) Using the data measured in §34.71(b) of this part, determine the nvPM characteristic levels for $nvPM_{num}$ and $nvPM_{mass}$ as follows:

(i) Average all $nvPM_{num}$ and $nvPM_{mass}$ measurements in units of number of particles per kN or mg per kN, as applicable, from each emissions test at each percentage of rated output thrust setting;

(ii) Multiply the averaged measurement from paragraph (a)(2)(i) of this section by the appropriate time in mode (TIM) as shown in §34.71(h);

(iii) Sum the products from paragraph (a)(2)(ii) of this section to determine the LTO values for $nvPM_{num}$ and $nvPM_{mass}$; and

(iv) Divide the result of paragraph (a)(2)(iii) of this section by the characteristic level factor, shown in Table A6-1 of Appendix 6 of ICAO Annex 16, Volume II (incorporated by reference, see §34.4), for the number of engines physically tested to determine the $nvPM_{mass}$ and $nvPM_{num}$ characteristic values.

(d) The data used to determine the regressed curves must meet a 90% confidence interval, CI_{90} , limit of $\pm 1.5\%$ of each nvPM limit specified in §34.25 of this part. If a certification test fails to meet the CI_{90} limit, the engine type

may still comply with the requirements. Failure may be caused by excessive data scatter, too few data points, or erroneous data used to regress an accurate curve. Without deleting or removing any prior measurement data, additional data acquired from further tests may improve the CI_{90} by adding to the sample population.

(e) The following information must be reported to the FAA substantiating compliance with nvPM limits of §34.25 of this part:

(1) The values of nvPM emissions measured and computed in accordance with the procedures and calculated as required by this subpart in §34.71 of this part and paragraphs (a) through (d) of this section;

(2) For each engine tested:

(i) Engine model, series, and serial number;

(ii) Rated thrust (kN);

(iii) Overall pressure ratio;

(iv) The methods of data acquisition; and

(v) The method of data analysis chosen by the applicant under paragraphs (a) through (d) of this section.

(3) Demonstration that the fuel used for each test is in compliance with the fuel specification listed in Appendix 4 of ICAO Annex 16, Volume II (incorporated by reference, see §34.4). For the fuel used for nvPM emissions certification, include the following fuel characteristics:

(i) Hydrogen/carbon ratio;

(ii) Net heat of combustion (MJ/kg);

(iii) Hydrogen content (mass per cent);

(iv) Total aromatics content (volume per cent);

(v) Naphthalene content (volume per cent); and

(vi) Sulfur content (ppm by mass).

(4) For each engine tested for certification purposes, the following values measured and computed in accordance with the procedures of §34.71 of this part:

(i) Fuel flow (kg/s) at each thrust setting of the LTO cycle;

(ii) nvPM EI_{mass} (mg/kg of fuel) at each thrust setting of the LTO cycle;

(iii) nvPM mass emission rate [nvPM $EI_{mass} \times$ fuel flow] in mg/s;

(iv) nvPM EI_{num} (particles/kg of fuel) at each thrust setting of the LTO cycle;

(v) nvPM number emission rate [nvPM $EI_{num} \times$ fuel flow] in particles/s;

(vi) Total gross emissions of nvPM mass measured over the LTO cycle in mg;

(vii) Total gross emissions of nvPM number measured over the LTO cycle in particles;

(viii) LTO nvPM $_{mass}$ /thrust in mg/kN;

(ix) LTO nvPM $_{num}$ /thrust in particles/kN; and

(x) Maximum nvPM $_{MC}$ in $\mu\text{g}/\text{m}^3$; and

(5) For each engine tested for certification purposes, the characteristic levels for the maximum nvPM $_{MC}$, the LTO nvPM $_{mass}$ /thrust, and the LTO nvPM $_{num}$ /thrust.

PART 35—AIRWORTHINESS STANDARDS: PROPELLERS

Subpart A—General

Sec.

35.1 Applicability.

35.2 Propeller configuration.

35.3 Instructions for propeller installation and operation.

35.4 Instructions for Continued Airworthiness.

35.5 Propeller ratings and operating limitations.

35.7 Features and characteristics.

Subpart B—Design and Construction

35.11 [Reserved]

35.13 [Reserved]

35.15 Safety analysis.

35.16 Propeller critical parts.

35.17 Materials and manufacturing methods.

35.19 Durability.

35.21 Variable and reversible pitch propellers.

35.22 Feathering propellers.

35.23 Propeller control system.

35.24 Strength.

Subpart C—Tests and Inspections

35.31 [Reserved]

35.33 General.

35.34 Inspections, adjustments and repairs.

35.35 Centrifugal load tests.

35.36 Bird impact.

35.37 Fatigue limits and evaluation.

35.38 Lightning strike.

35.39 Endurance test.

35.40 Functional test.

35.41 Overspeed and overtorque.