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Part II

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40 CFR Parts 87 and 1068
Control of Air Pollution From Aircraft and Aircraft Engines; Proposed Emission Standards and Test Procedures; Proposed Rule

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Parts 87 and 1068

[EPA–HQ–OAR–2010–0687; FRL–9437–2]

RIN 2060–AO70

Control of Air Pollution From Aircraft and Aircraft Engines; Proposed Emission Standards and Test Procedures

AGENCY: Environmental Protection Agency (EPA).

ACTION: Proposed rule.

SUMMARY: This action proposes several new NO_X emission standards, compliance flexibilities, and other regulatory requirements for aircraft turbofan or turbojet engines with rated thrusts greater than 26.7 kilonewtons (kN). We also are proposing certain other requirements for gas turbine engines that are subject to exhaust emission standards. First, we are proposing to clarify when the emission characteristics of a new turbofan or turbojet engine model have become different enough from its existing parent engine design that it must conform to the most current emission standards. Second, we are proposing a new reporting requirement for manufacturers of gas turbine engines that are subject to any exhaust emission standard to provide us with timely and consistent emission-related information. Third, and finally, we are proposing amendments to aircraft engine test and emissions measurement procedures. EPA actively participated in the United Nation's International Civil Aviation Organization (ICAO) proceedings in which most of these proposed requirements were first developed. These proposed regulatory requirements have largely been adopted or are actively under consideration by its member states. By adopting such similar standards, therefore, the United States will maintain consistency with these international efforts.

DATES: Comments must be received on or before September 26, 2011.

Hearing: The public hearing will be held on August 11, 2011 at the Sheraton Chicago O'Hare Airport Hotel, 6501 North Mannheim Road, Rosemont, IL 60018. Telephone (847)699–6300. See section VII for more information about public hearings.

ADDRESSES: Submit your comments, identified by Docket ID No. EPA–HQ–OAR–2010–0687, by one of the following methods:

http://www.regulations.gov: Follow the on-line instructions for submitting comments.

- *E-mail: A-and-R–Docket@epamail.epa.gov.*
- *Fax:* 202–566–9744.

Mail: EPA Docket center, EPA West (Air Docket), Attention Docket ID No. EPA–HQ–OAR–2010–0687, Mailcode: Mail Code 2822T, 1200 Pennsylvania Ave., NW., Washington, DC 20460. Please include a total of two copies. In addition, please mail a copy of your comments to the contact person identified below (see **FOR FURTHER INFORMATION CONTACT**). Please mail a copy of your comments on the information collection provisions to the Office of Information and Regulatory Affairs, Office of Management and Budget (OMB), Attn: Desk Officer for EPA, 725 17th Street, NW., Washington, DC 20503.

Instructions: Direct your comments to Docket ID No. EPA–HQ–OAR–2010–0687. EPA's policy is that all comments received will be included in the public docket without change and may be made available online at *http://www.regulations.gov,* including any personal information provided, unless the comment includes information claimed to be Confidential Business Information (CBI) or other information whose disclosure is restricted by statute. Do not submit information that you consider to be CBI or otherwise protected through *http://www.regulations.gov* or e-mail. The *http://www.regulations.gov* Web site is an ''anonymous access'' system, which means EPA will not know your identity or contact information unless you provide it in the body of your comment. If you send an e-mail comment directly to EPA without going through *http://www.regulations.gov* your e-mail address will be automatically captured and included as part of the comment that is placed in the public docket and made available on the Internet. If you submit an electronic comment, EPA recommends that you include your name and other contact information in the body of your comment and with any disk or CD–ROM you submit. If EPA cannot read your comment due to technical difficulties and cannot contact you for clarification, EPA may not be able to consider your comment. Electronic files should avoid the use of special characters, any form of encryption, and be free of any defects or viruses.

Docket: All documents in the docket are listed in the *http://www.regulations.gov* index. Although listed in the index, some information is not publicly available, *e.g.,* CBI or other information whose disclosure is restricted by statute. Certain other material, such as copyrighted material, will be publicly available only in hard copy. Publicly available docket materials are available either electronically in *http://www.regulations.gov* or in hard copy at EPA Docket Center, EPA/DC, EPA West, Room 3334, 1301 Constitution Ave., NW., Washington, DC. The Public Reading Room is open from 8:30 a.m. to 4:30 p.m., Monday through Friday, excluding legal holidays. The telephone number for the Public Reading Room is (202) 566–1744, and the telephone number for the EPA Docket Center is 202–566–1742

FOR FURTHER INFORMATION CONTACT: Richard Wilcox, Office of Transportation and Air Quality, Office of Air and Radiation, Environmental Protection Agency, 2000 Traverwood Drive, Ann Arbor, MI 48105; telephone number: (734) 214–4390; fax number: (734) 214–4816; e-mail address: *wilcox.rich@epa.gov.*

SUPPLEMENTARY INFORMATION:

Does this action apply to me?

Entities potentially regulated by this action are those that manufacture and sell aircraft engines and aircraft in the United States. Regulated categories include:

Category	NAICS [a] Codes	SIC Codes [b]	Examples of potentially affected entities
Industry	336412	3724	Manufacturers of new aircraft engines.
Industry	336411	3721	Manufacturers of new aircraft.

[a] North American Industry Classification System (NAICS)
[b] Standard Industrial Classification (SIC) system code

This table lists the types of entities that EPA is now aware could potentially be regulated by this action. Other types of entities not listed in the table could also be regulated. To determine whether your activities are regulated by this

action, you should carefully examine the applicability criteria in 40 CFR 87.1 (part 87). If you have any questions regarding the applicability of this action to a particular entity, consult the person listed in the preceding **FOR FURTHER INFORMATION CONTACT** section.

Table of Contents

I. Overview and Background

This section summarizes the major provisions of the proposed rule for aircraft gas turbine engines. It also contains background on the EPA's standard setting authority and responsibilities under the Clean Air Act, the connection between our emission standards and those of the international community, and a brief regulatory history for this source of emissions.

A. Summary of the Proposal

We are proposing several new emission standards and other regulatory requirements for aircraft turbofan and turbojet engines [1] with rated thrusts greater than 26.7 kilonewtons (kN). First, we are proposing two new tiers of more stringent emission standards for oxides of nitrogen (NO_X). The proposed standards would apply differently to two classes of these engines, *i.e.,* ''newly-certified engines'' and ''newly-manufactured engines.'' The newly-certified engine standards would apply to aircraft engines that have received a new type certificate and have never been manufactured prior to the effective date of the new emission standards. Requirements for newly-manufactured engines would apply to aircraft engines that were previously certified and manufactured in compliance with preexisting standards, and would require manufacturers to either comply with the newer standards by a specified future date or cease production. Newly-manufactured engine standards are also sometimes referred to as ''production cutoff'' standards. Second, we are proposing certain time-limited flexibilities, *i.e.,* the potential for exemptions or exceptions as defined in the regulations for newly-manufactured engines that may not be able to comply with the first tier of the proposed NO_X standards because of specific technical or economic reasons.

We are also proposing a number of additional changes that would apply to a wider range of aircraft gas turbine engines [2] than those that would be subject to the proposed new emission standards. First, we are proposing to define a derivative engine for emissions certification purposes. The intent of this definition is to distinguish when the emission characteristics of a new turbofan engine model vary sufficiently from its existing parent engine design, and must show compliance with the emission standard for a newly-certificated engine. Second, we are proposing new reporting requirements for manufacturers that produce gas turbine engines subject to any exhaust emission standard. This would provide us with timely and consistent emission data and other information that is necessary to conduct emission analyses and develop appropriate public policy for the aviation sector. Specifically, reports would be required for turbofan engines with rated thrusts greater than 26.7 kN, which are subject to gaseous emission and smoke standards, in addition to turbofans less than or equal to 26.7 kN, and all turboprop engines, that are only subject to smoke standards. Third, we are proposing amendments to the test and measurement procedures for aircraft engines. Finally, as described in section IV., we are proposing minor amendments to provisions addressing definitions, acronyms and abbreviations, general applicability and

[1] Turbofan and turbojet engines will be collectively referred to as turbofan engines hereafter for convenience.

[2] The term gas turbine engine includes turbofan, turbojet, and turboprop engines designs. The rated output for turbofan and turbojet engines is normally expressed as kilonewtons (kN) thrust. The rated output for turboprop engines is normally expressed as shaft horsepower (hp) or shaft kilowatt (kW).

requirements, exemptions, and incorporation by reference.

Most of these proposed regulatory requirements have already been adopted or are actively under consideration by the United Nation's International Civil Aviation Organization (ICAO). The proposed requirements would bring the United States into alignment with the international standards and recommended practices.

B. EPA's Authority and Responsibilities Under the Clean Air Act

Section 231(a)(2)(A) of the Clean Air Act (CAA) directs the Administrator of EPA to, from time to time, propose aircraft engine emission standards applicable to the emission of any air pollutant from classes of aircraft engines which in her judgment causes or contributes to air pollution that may reasonably be anticipated to endanger public health or welfare. (See 42 U.S.C. 7571(a)(2)(A).) Section 231(a)(2)(B) directs EPA to consult with the Administrator of the Federal Aviation Administration (FAA) on such standards, and prohibits EPA from changing aircraft emission standards if such a change would significantly increase noise and adversely affect safety. 42 U.S.C. 7571(a)(2)(B)(i)–(ii). Section 231(a)(3) provides that after we propose standards, the Administrator shall issue such standards ''with such modifications as he deems appropriate.'' 42 U.S.C. 7571(a)(3). The U.S. Court of Appeals for the DC Circuit has held that this provision confers an unusually broad degree of discretion on EPA to adopt aircraft engine emission standards as the Agency determines are reasonable. *NACAA* v. *EPA,* 489 F.3d 1221 (DC Cir. 2007).

In addition, under CAA section 231(b) EPA is required to ensure, in consultation with the U.S. Department of Transportation (DOT), that the effective date of any standard provides the necessary time to permit the development and application of the requisite technology, giving appropriate consideration to the cost of compliance. 42 U.S.C. 7571(b). Section 232 then directs the FAA to prescribe regulations to insure compliance with EPA's standards. 42 U.S.C. 7572. Finally, section 233 of the CAA vests the authority to promulgate emission standards for aircraft or aircraft engines only in EPA. States are preempted from adopting or enforcing any standard respecting aircraft engine emissions unless such standard is identical to EPA's standards. 42 U.S.C. 7573. Section VI. of today's proposal further discusses our coordination with DOT through the FAA.[3] It also describes DOT's responsibility under the CAA to enforce the aircraft emission standards established by EPA.

C. Interaction With the International Community

We began regulating the emissions from aircraft engines in 1973. Since that time, we have worked with the FAA and later with the International Civil Aviation Organization (ICAO) to develop international standards and other recommended practices pertaining to aircraft engine emissions. ICAO was established in 1944 by the United Nations (by the Convention on International Civil Aviation, the ''Chicago Convention'') ''* * * in order that international civil aviation may be developed in a safe and orderly manner and that international air transport services may be established on the basis of equality of opportunity and operated soundly and economically.'' [4] ICAO's responsibilities include developing aircraft technical and operating standards, recommending practices, and generally fostering the growth of international civil aviation. The United States is currently one of 190 participating member States of ICAO.[5] [6]

In the interests of global harmonization and international air commerce, the Chicago Convention urges a high degree of uniformity by its member States. Nonetheless, the Convention also recognizes that member States may adopt their own unique airworthiness standards and that some may adopt standards that are more stringent than those agreed upon by ICAO.

The Convention has a number of other features that govern international commerce. First, States that wish to use aircraft in international transportation must adopt emission standards and other recommended practices that are at least as stringent as ICAO's standards. States may ban the use of any aircraft within their airspace that does not meet ICAO standards.[7] Second, States are required to recognize the airworthiness certificates of any State whose standards are at least as stringent as ICAO's standards, thereby assuring that aircraft of any member State will be permitted to operate in any other member State.[8] Third, and finally, to ensure that international commerce is not unreasonably constrained, a participating nation which elects to adopt more stringent standards is obligated to notify ICAO of the differences between its standards and ICAO standards.[9] However, if a nation sets tighter standards than ICAO, air carriers not based in that nation (foreign-flagged carriers) would only be required to comply with ICAO standards or more stringent standards imposed by their own nations, if applicable.

ICAO Council's Committee on Aviation Environmental Protection (CAEP) undertakes ICAO's technical work in the environmental field. The Committee is responsible for evaluating, researching, and recommending measures to the ICAO Council that address the environmental impact of international civil aviation. CAEP is composed of various task groups, work groups, and other contributing committees whose contributing members include atmospheric, economic, aviation, environmental, and other professionals. At CAEP meetings, the United States is represented by the FAA, which plays an active role at these meetings. EPA has historically been a principal participant in the development of U.S. policy in various ICAO/CAEP working groups and other international venues, assisting and advising FAA on aviation emissions, technology, and policy matters. If ICAO adopts a CAEP proposal for a new environmental standard, it then becomes part of ICAO standards and recommended practices (Annex 16 to the Chicago Convention).[10]

[3] The functions of the Secretary of Transportation under part B of title II of the Clean Air Act (§§ 231–234, 42 U.S.C. 7571–7574) have been delegated to the Administrator of the FAA. 49 CFR 1.47(g).

[4] International Civil Aviation Organization (ICAO), ''Convention on International Civil Aviation,'' Ninth Edition, Document 7300/9, 2006. Copies of this document can be obtained from the ICAO Web site located at *http://www.icao.int.*

[5] Members of ICAO's Assembly are generally termed member States or contracting States. These terms are used interchangeably throughout this preamble.

[6] There are currently 190 Contracting States according to ICAO website located at *http://www.icao.int.*

[7] ICAO, ''Convention on International Civil Aviation,'' Article 87, Ninth Edition, Document 7300/9, 2006. Copies of this document can be obtained from the ICAO website located at *http://www.icao.int/icaonet/arch/doc/7300/7300_9ed.pdf.*

[8] ICAO, ''Convention on International Civil Aviation,'' Article 33, Ninth Edition, Document 7300/9, 2006. Copies of this document can be obtained from the ICAO Web site located at *http://www.icao.int/icaonet/arch/doc/7300/7300_9ed.pdf.*

[9] ICAO, ''Convention on International Civil Aviation,'' Articles 38, Ninth Edition, Document 7300/9, 2006. Copies of this document can be obtained from the ICAO Web site located at *http://www.icao.int/icaonet/arch/doc/7300/7300_9ed.pdf.*

[10] ICAO, ''Aircraft Engine Emissions,'' International Standards and Recommended Practices, Environmental Protection, Annex 16, Volume II, Second Edition, July 2008. A copy of this document is in docket number EPA–HQ–OAR–2010–0687.

D. Brief History of EPA's Regulation of Aircraft Engine Emissions

As mentioned above, we initially regulated gaseous exhaust emissions, smoke, and fuel venting from aircraft engines in 1973.[11] Since that time, we have occasionally revised those regulations. Two of these revisions are most pertinent to today's proposal. First, in a 1997 rulemaking, we made our emission standards and test procedures more consistent with those of ICAO for turbofan engines used in commercial aviation with rated thrusts greater than 26.7kN.[12] These ICAO requirements are generally referred to as CAEP/2 standards. (The numbering nomenclature for CAEP requirements is discussed in the next section.) That action included new NO_X emission standards for newly-manufactured commercial turbofan engines (those engines built after the effective date of the regulations that were already certified to pre-existing standards) [13] and for newly-certified commercial turbofan engines (those engine models that received their initial type certificate after the effective date of the regulations). It also included a CO emission standard for newly-manufactured commercial turbofan engines. Second, in our most recent rulemaking in 2005, we promulgated more stringent NO_X emission standards for newly-certified commercial turbofan engines.[14] That final rule brought the U.S. standards closer to alignment with ICAO CAEP/4 requirements that were effective in 2004. In ruling on a petition for judicial review of the 2005 rule filed by the National Association of Clean Air Agencies (NACAA), the U.S. Court of Appeals held that EPA's approach of tracking the ICAO standards was reasonable and permissible under the CAA. *NACAA* v. *EPA,* 489 F.3d 1221, 1230–32 (DC Cir. 2007).

E. Brief History of ICAO Regulation of Aircraft Engine Emissions

The first international standards and recommended practices for aircraft engine emissions was recommended by CAEP's predecessor, the Committee on Aircraft Engine Emissions (CAEE), and adopted by ICAO in 1981.[15] These standards limited aircraft engine emissions of HC, CO, and NO_X. In 1994, ICAO adopted a CAEP/2 proposal to tighten the original NO_X standard by 20 percent and amend the test procedures.[16] At the next CAEP meeting (CAEP/3) in 1995, the Committee recommended a further tightening of 16 percent and additional test procedure amendments, but in 1997 the ICAO Council rejected this stringency proposal and approved only the test procedure amendments. At the CAEP/4 meeting in 1998, the Committee adopted a similar 16 percent NO_X reduction proposal, which ICAO approved on 1998. The CAEP/4 standards applied only to new engine designs certified after December 31, 2003 (*i.e.,* the requirements did not also apply to newly-manufactured engines unlike the CAEP/2 standards). In 2004, CAEP/6 recommended a 12 percent NO_X reduction, which ICAO approved in 2005.[17] [18] The CAEP/6 standards applied to newly-certified engine models beginning after December 31, 2007. At the most recent meeting, CAEP/8 recommended a further tightening of the NO_X standards by 15 percent for newly-certified engines.[19] [20] The Committee also recommended that the CAEP/6 standards be applied to newly-manufactured engines. ICAO is currently considering the CAEP/8 recommendations. We expect final ICAO action regarding the CAEP/8 recommendations in 2011.

II. Why is EPA taking this action?

As mentioned above, section 231(a)(2)(A) of the CAA authorizes the EPA Administrator to ''from time to time, issue proposed emission standards applicable to the emission of any air pollution from any class or classes of aircraft or aircraft engines which in his judgment causes, or contributes to air pollution which may reasonably be anticipated to endanger public health or welfare.'' 42 U.S.C. 7571(a)(2)(A).

One of the principal components of aircraft exhaust emissions is NO_X. NO_X is a precursor to the formation of tropospheric ozone.[21] Many commercial airports are located in urban areas and many of these areas have ambient pollutant levels above the National Ambient Air Quality Standards (NAAQS) for ozone and fine particulate matter ($PM_{2.5}$) (*i.e.,* they are in nonattainment for ozone and $PM_{2.5}$). This section discusses the contribution of aircraft engines used in commercial service with rated thrusts greater than 26.7kN to the national NO_X emissions inventory and to NO_X emission inventories in selected ozone nonattainment areas, the potential effect of NO_X emissions in the upper atmosphere on ground level $PM_{2.5}$ in addition to the health and welfare impacts of NO_X and PM emissions.

A. Inventory Contribution

In contrast to all other mobile sources, whose emissions occur completely at ground level, the emissions from aircraft and aircraft engines can be divided into two flight regimes. The first regime includes the emissions that are released in the lower layer of the atmosphere and directly affect local and regional ambient air quality. These emissions generally occur at or below 3,000 feet above ground level, *i.e.,* during the landing and takeoff (LTO) cycle. The aircraft operations that comprise an LTO cycle are: engine idle at the terminal gate (and sometimes during ground delays while holding for the active runway); taxiing between the terminal and the runway; take-off; climb-out; and approach to the airport. The second regime includes emissions that occur above 3,000 feet above ground level,

[11] U.S. EPA, ''Emission Standards and Test Procedures for Aircraft;'' Final Rule, 38 FR 19088, July 17, 1973.

[12] U.S. EPA, ''Control of Air Pollution from Aircraft and Aircraft Engines; Emission Standards and Test Procedures;'' Final Rule, 62 FR 25356, May 8, 1997. While ICAO's standards were not limited to ''commercial'' aircraft engines, our 1997 standards were explicitly limited to commercial engines, as our finding that NO_X and CO emissions from aircraft engines cause or contribute to air pollution which may reasonably be anticipated to endanger public health or welfare was so limited, See 62 FR 25358. As explained later in today's notice, we are proposing to expand the scope of that finding and of our standards to include such emissions from both commercial and non-commercial aircraft engines, in order to bring our standards into full alignment with ICAO's.

[13] This does not mean that in 2005 we promulgated requirements for the re-certification or retrofit of existing in-use engines.

[14] U.S. EPA, ''Control of Air Pollution from Aircraft and Aircraft Engines; Emission Standards and Test Procedures;'' Final Rule, 70 FR 2521, November 17, 2005.

[15] ICAO, Foreword of ''Aircraft Engine Emissions,'' International Standards and Recommended Practices, Environmental Protection, Annex 16, Volume II, Third Edition, July 2008. A copy of this document is in docket number EPA–HQ–OAR–2010–0687.

[16] CAEP conducts its work over a period of years. Each work cycle is numbered sequentially and that identifier is used to differentiate the results from one CAEP to another by convention. The first technical meeting on aircraft emission standards was CAEP's successor, *i.e.,* CAEE. The first meeting of CAEP, therefore, is referred to as CAEP/2.

[17] CAEP/5 did not address new aircraft engine emission standards.

[18] ICAO, ''Aircraft Engine Emissions,'' Annex 16, Volume II, Third Edition, July 2008, Amendment 4 effective on July 20, 2008. Copies of this document can be obtained from the ICAO Web site at *http://www.icao.int.*

[19] CAEP/7 did not address new aircraft engine emission standards.

[20] ICAO, ''Committee on Aviation Environmental Protection (CAEP), Report of the Eighth Meeting, Montreal, February 1–12, 2010,'' CAEP/8–WP/80. A copy of this document is in docket number EPA–HQ–OAR–2010–0687.

[21] Ground-level ozone, the main ingredient in smog, is formed by complex chemical reactions of volatile organic compounds (VOC) and NO_X in the presence of heat and sunlight. Standards that reduce NO_X emissions will help address ambient ozone levels. They can also help reduce particulate matter (PM) levels as NO_X emissions can also be part of the secondary formation of PM. See Section II.B below.

known as non-LTO emissions. Collectively, the emissions associated with all ground and flight operations are generally referred to as full flight emissions.

The aircraft engine NO_X emission inventories for the LTO and non-LTO flight regimes described above are discussed separately in the following sections.

1. Landing and Takeoff Emissions

In this section, we will discuss NO_X emission inventories for commercial turbine-engine aircraft, both nationally and for selected ozone nonattainment areas (NAAs). These inventories reflect emissions during the landing and takeoff cycle only. The most recent comprehensive analysis of historical and current LTO emissions from aircraft engines comes from a study undertaken for us by Eastern Research Group (ERG).[22] The study analyzed the national emissions of commercial aircraft operations in the United States, and showed that in the most recent year studied (2008), such aircraft operations contributed about 97 thousand tons to the national NO_X inventory. A summary of the national inventory of LTO NO_X emissions is shown in Table 1.

When these nationwide LTO emissions are compared to the total U.S. mobile source inventory for 2009, they account for less than one percent of the total. However, such a comparison may be a bit misleading, as it only includes those aircraft emissions that occur below 3,000 feet altitude, while comparing them to the entirety of other mobile source emissions. In the U.S., LTO emissions account for only about ten percent of full flight NO_X emissions. When considering full flight aircraft emissions (*i.e.,* including both LTO and non-LTO emissions), the contribution of aircraft to the total mobile source NO_X inventory is approximately 7.7 percent.[23]

TABLE 1—CURRENT NATIONAL NO_X EMISSIONS FROM COMMERCIAL AIRCRAFT

Aircraft category	2008 total NO_X (thousand tons)
Air Carrier	86
Commuter/Air Taxi	11
Total Commercial	97

In addition, it is important to assess the contribution of commercial aircraft LTO NO_X emissions on a local level, especially in areas containing or adjacent to airports. The historical analysis conducted by ERG also included an assessment of selected ozone nonattainment areas (NAAs). The NAAs selected for study were chosen as follows. First, the 25 ozone NAAs with airports which had high commercial traffic volumes were identified. Second, the 25 ozone NAAs with the largest population were identified. These lists were combined. However, there was some overlap, and this led to a total of 41 NAAs being identified for the study. These 41 NAAs collectively include 200 airports, accounting for about 70 percent of commercial air traffic operations. Although 41 NAAs were studied, the non-aircraft emissions data source that the aircraft emissions were compared to for this analysis did not distinguish between the Boston NAA in Massachusetts and the greater Boston NAA in New Hampshire. Thus, aircraft emissions from those two NAAs were combined into a single NAA for the purpose of this analysis, yielding 40 NAAs for study. Current (2008) and projected (2020) NO_X emissions for these 40 NAAs, as well as the percent contribution of aircraft to total mobile source inventories (as compared to 2005 and 2020 mobile source inventories), are shown in Table 2.[24] [25] The relative contribution of aircraft in any given NAA varies based on activity in other transportation and industrial sectors. As can be seen from this table, expected growth in aircraft operations in many of these areas combined with anticipated reductions in NO_X emissions from other mobile source categories results in the growth of the relative contribution of aircraft LTO emissions to mobile source NO_X emissions in NAAs.

TABLE 2—CURRENT NO_X EMISSIONS IN SELECTED OZONE NONATTAINMENT AREAS

Nonattainment area	2008 total NO_X (tons)	2008 aircraft percent of mobile source NO_X	2020 aircraft percent of mobile source NO_X
Albuquerque, NM	380	1.6	4.3
Anchorage, AK	2,538	23.4	49.3
Aspen	16	2.0	6.6
Atlanta, GA	5,808	2.6	8.2
Baltimore, MD	1,148	1.3	4.4
Boston—including MA and NH NAAs	2,032	1.0	2.7
Charlotte-Gastonia-Rock Hill, NC-SC	1,917	2.6	10.0
Chicago-Gary-Lake County, IL-IN	6,007	1.8	5.0
Cincinnati-Hamilton, OH-KY-IN	1,287	1.5	3.3
Cleveland-Akron-Lorain, OH	680	0.5	1.3
Dallas-Fort Worth, TX	3,880	1.7	6.9
Denver-Boulder-Greeley-Fort Collins-Loveland, CO	2,649	2.5	7.1
Detroit-Ann Arbor, MI	2,312	1.1	3.0
El Paso, TX	223	0.9	1.1
Greater Connecticut, CT	405	0.8	2.4
Houston-Galveston-Brazoria, TX	3,045	1.3	3.4
Indianapolis, IN	1,089	1.4	3.0

[22] ''Historical Assessment of Aircraft Landing and Take-off Emissions (1986–2008),'' Eastern Research Group, May 2011. A copy of this document can be found in public docket EPA–HQ–OAR–2010–0687.

[23] U.S. EPA, ''Comparison of Aircraft LTO and Full Flight NO_X Emissions to Total Mobile Source NO_X Emissions,'' memorandum from John Mueller, Assessment and Standards Division, Office of Transportation and Air Quality, to docket EPA–HQ–OAR–2010–0687, May 10, 2011.

[24] U.S. EPA, ''Relative Contribution of Aircraft to Total Mobile Source NO_X Emissions in Selected Ozone Nonattainment Areas,'' memorandum from John Mueller, Assessment and Standards Division, Office of Transportation and Air Quality, to docket EPA–HQ–OAR–2010–0687, May 10, 2011.

[25] U.S. EPA, ''Addendum to ''Relative Contribution of Aircraft to Total Mobile Source NO_X Emissions in Selected Ozone Nonattainment Areas,'''' memorandum from John Mueller, Assessment and Standards Division, Office of Transportation and Air Quality, to docket EPA–HQ–OAR–2010–0687, May 17, 2011.

TABLE 2—CURRENT NO_X EMISSIONS IN SELECTED OZONE NONATTAINMENT AREAS—Continued

Nonattainment area	2008 total NO_X (tons)	2008 aircraft percent of mobile source NO_X	2020 aircraft percent of mobile source NO_X
Las Vegas, NV	2,308	6.0	15.8
Los Angeles South Coast Air Basin, CA	6,479	1.5	4.5
Louisville, KY-IN	1,211	1.9	6.2
Memphis, TN-AR	2,988	6.3	16.8
Milwaukee-Racine, WI	557	0.9	3.2
Minneapolis-St Paul, MN	2,154	1.0	5.1
New York-N. New Jersey-Long Island, NY-NJ-CT	10,093	2.3	6.3
Philadelphia-Wilmington-Atlantic City, PA-NY-MD-DE	2,308	1.0	2.8
Phoenix-Mesa, AZ	2,298	1.4	3.3
Pittsburgh-Beaver Valley, PA	480	0.5	1.1
Providence (entire State), RI	232	1.0	2.3
Raleigh-Durham-Chapel Hill, NC	565	1.0	3.2
Reno, NV	246	1.9	4.4
Riverside County (Coachella Valley), CA	70	0.2	0.5
Sacramento Metro, CA	603	1.0	2.0
Salt Lake City, UT	1,235	4.4	14.1
San Diego, CA	1,035	1.4	3.4
San Francisco Bay Area, CA	4,405	2.7	6.7
San Joaquin Valley, CA	74	0.0	0.1
Seattle-Tacoma, WA	1,958	1.4	3.9
St. Louis, MO-IL	810	0.6	1.6
Syracuse, NY	139	0.8	1.9
Washington, DC-MD-VA	2,983	2.0	6.2

Table 3 shows how commercial aircraft operations are projected to rise in the future on a nationwide basis. As operations increase, the inventory impact of these aircraft on national and local NO_X inventories will also increase, as was seen in Table 2.

TABLE 3—CURRENT AND PROJECTED COMMERCIAL AIRCRAFT OPERATIONS

Year	Air carrier operations (millions)	Commuter/air taxi operations (millions)	Total commercial operations (millions)	Total increase in commercial operations over 2008 (percent)
2008	14.1	13.8	27.9	.....
2020	16.5	14.1	30.5	9
2030	20.6	16.0	36.6	31

Source: December 2010 FAA TAF, which is located at *http://aspm.faa.gov/main/taf.asp*.

2. Non-LTO Emissions

Historically, emphasis has been placed on evaluating emissions during LTO operations given their obvious impact on local air quality. Less emphasis has been placed on evaluating emissions from non-LTO operations (emissions at altitudes greater than 3,000 feet above ground level) based on the assumption that such emissions have a lesser impact on local air quality. However, modeling by Barrett *et al.* (2010) finds that these upper atmosphere emissions may adversely affect public health more than was previously thought.[26] Based on the data and methodology of the authors, this effect is caused primarily by two pathways:

The formation of fine particulate matter, *i.e.,* $PM_{2.5}$, from emission of gaseous precursors of PM (NO_X and SO_2) in the upper atmosphere that are then transported to the lower atmosphere. (The formation of secondary $PM_{2.5}$ from NO_X is discussed further in section II.B.1.b).

Aviation NO_X emissions promote ozone formation throughout the troposphere and hence increase hydroxyl radical (OH) concentrations. This increases the oxidation of non-aviation SO_2 (such as that emitted from power stations) in the gas phase relative to aqueous oxidation and dry deposition thereby increasing atmospheric sulfate (a type of $PM_{2.5}$) concentrations.

The authors of this work estimated that full flight emissions cause almost 10,000 premature mortalities (their central estimate) per year worldwide, with over 450 per year in the U.S. The pollutants emitted during cruise operations were estimated to be about 80 percent of the population-weighed $PM_{2.5}$ from aviation, with the remainder being associated with LTO operations (although they note the LTO portion may be under-estimated). The study asserts that over 380 premature mortalities per year in the U.S. can be attributed to secondary $PM_{2.5}$ associated with non-LTO operations. We request comments on the results of these studies and the existence of other research into this area.

B. Health, Environmental and Air Quality Impacts

NO_X emissions from aircraft and other mobile and stationary sources contribute to the formation of ozone. In addition, NO_X emissions at low altitude

[26] Barrett, S. R. H., R. E. Britter and I. A. Waitz, 2010. Global mortality attributable to aircraft cruise emissions. *Environmental Science & Technology* 44 (19), pp. 7736–7742. DOI: 10.1021/es101325r.

also react in the atmosphere to form secondary fine particulate matter ($PM_{2.5}$), particularly ammonium nitrate. In the following sections we discuss the adverse health and welfare effects associated with NO_X emissions, in addition to the current and projected levels of ozone and PM across the country. The ICAO NO_X standards with which we are proposing to align will help reduce ambient ozone and secondary PM levels and thus will help areas with airports achieve or maintain compliance with the National Ambient Air Quality Standards (NAAQS).[27]

1. Background on Ozone, PM and NO_X

a. What is ozone?

Ground-level ozone pollution is typically formed by the reaction of VOC and NO_X in the lower atmosphere in the presence of sunlight. These pollutants, often referred to as ozone precursors, are emitted by many types of pollution sources, such as highway and nonroad motor vehicles and engines, power plants, chemical plants, refineries, makers of consumer and commercial products, industrial facilities, and smaller area sources.

The science of ozone formation, transport, and accumulation is complex.[28] Ground-level ozone is produced and destroyed in a cyclical set of chemical reactions, many of which are sensitive to temperature and sunlight. When ambient temperatures and sunlight levels remain high for several days and the air is relatively stagnant, ozone and its precursors can build up and result in more ozone than typically occurs on a single high-temperature day. Ozone can be transported hundreds of miles downwind from the sources of precursor emissions, resulting in elevated ozone levels even in areas with low local VOC or NO_X emissions.

b. What is particulate matter?

The discussion includes $PM_{2.5}$ because the NO_X emitted by aircraft engines can react in the atmosphere to form nitrate, a component of $PM_{2.5}$. Particulate matter is a generic term for a broad class of chemically and physically diverse substances. It can be principally characterized as discrete particles that exist in the condensed (liquid or solid) phase spanning several orders of magnitude in size. Since 1987, EPA has delineated that subset of inhalable particles small enough to penetrate to the thoracic region (including the tracheobronchial and alveolar regions) of the respiratory tract (referred to as thoracic particles). Current NAAQS use $PM_{2.5}$ as the indicator for fine particles (with $PM_{2.5}$ referring to particles with a nominal mean aerodynamic diameter less than or equal to 2.5 μm), and use PM_{10} as the indicator for purposes of regulating the coarse fraction of PM_{10} (referred to as thoracic coarse particles or coarse-fraction particles; generally including particles with a nominal mean aerodynamic diameter greater than 2.5 μm and less than or equal to 10 μm, or $PM_{10-2.5}$). Ultrafine particles are a subset of fine particles, generally less than 100 nanometers (0.1 μm) in aerodynamic diameter.

Fine particles are produced primarily by combustion processes and by transformations of gaseous emissions (*e.g.,* SO_X, NO_X and VOC) in the atmosphere. The chemical and physical properties of $PM_{2.5}$ may vary greatly with time, region, meteorology, and source category. Thus, $PM_{2.5}$ may include a complex mixture of different pollutants including sulfates, nitrates, organic compounds, elemental carbon and metal compounds. These particles can remain in the atmosphere for days to weeks and travel hundreds to thousands of kilometers.

c. What is NO_X?

Nitrogen dioxide (NO_2) is a member of the NO_X family of gases. Most NO_2 is formed in the air from the oxidation of nitric oxide (NO) emitted when fuel is burned at a high temperature. NO_2 can dissolve in water vapor and further oxidize to form nitric acid which reacts with ammonia to form nitrates, an important component of ambient PM. NO_X along with non-methane hydrocarbon (NMHC) are the two major precursors of ozone. The health effects of ozone, ambient PM and NO_X are covered in section II.B.2.

2. Health Effects Associated With Exposure to Ozone, PM and NO_X

a. What are the health effects of ozone?

The health and welfare effects of ozone are well documented and are assessed in EPA's 2006 Air Quality Criteria Document (ozone AQCD) and 2007 Staff Paper.[29] [30] People who are more susceptible to effects associated with exposure to ozone can include children, the elderly, and individuals with respiratory disease such as asthma. Those with greater exposures to ozone, for instance due to time spent outdoors (*e.g.,* children and outdoor workers), are of particular concern. Ozone can irritate the respiratory system, causing coughing, throat irritation, and breathing discomfort. Ozone can reduce lung function and cause pulmonary inflammation in healthy individuals. Ozone can also aggravate asthma, leading to more asthma attacks that require medical attention and/or the use of additional medication. Thus, ambient ozone may cause both healthy and asthmatic individuals to limit their outdoor activities. In addition, there is suggestive evidence of a contribution of ozone to cardiovascular-related morbidity and highly suggestive evidence that short-term ozone exposure directly or indirectly contributes to non-accidental and cardiopulmonary-related mortality, but additional research is needed to clarify the underlying mechanisms causing these effects. In a recent report on the estimation of ozone-related premature mortality published by the National Research Council (NRC), a panel of experts and reviewers concluded that short-term exposure to ambient ozone is likely to contribute to premature deaths and that ozone-related mortality should be included in estimates of the health benefits of reducing ozone exposure.[31] Animal toxicological evidence indicates that with repeated exposure, ozone can

[27] The discussion of PM health and welfare effects throughout this notice relates exclusively to the effects of the proposed NO_X emission standards on the formation of secondary PM from nitrate formation in the atmosphere. Presently, there are no emission standards for PM emitted directly from aircraft turbine engines. The current and planned future work programs for CAEP/ICAO are developing PM test procedures and information to characterize the amount and type of these emissions from aircraft engines that are in production. Ultimately, this information will be used to assess the need for an aircraft turbine engine PM standard (*i.e.,* whether PM emissions from aircraft cause or contribute to air pollution which may reasonably be anticipated to endanger public health or welfare), with standard setting as appropriate.

[28] U.S. EPA Air Quality Criteria for Ozone and Related Photochemical Oxidants (Final). U.S. Environmental Protection Agency, Washington, DC, EPA 600/R–05/004aF–cF, 2006. This document is available in Docket EPA–HQ–OAR–2010–0687. This document may be accessed electronically at: *http://www.epa.gov/ttn/naaqs/standards/ozone/s_o3_cr_cd.html.*

[29] U.S. EPA Air Quality Criteria for Ozone and Related Photochemical Oxidants (Final). U.S. Environmental Protection Agency, Washington, DC, EPA 600/R–05/004aF–cF, 2006. This document is available in Docket EPA–HQ–OAR–2010–0687. This document may be accessed electronically at: *http://www.epa.gov/ttn/naaqs/standards/ozone/s_o3_cr_cd.html.*

[30] U.S. EPA (2007) Review of the National Ambient Air Quality Standards for Ozone, Policy Assessment of Scientific and Technical Information. OAQPS Staff Paper.EPA–452/R–07–003. This document is available in Docket EPA–HQ–OAR–2010–0687. This document is available electronically at: *http://www.epa.gov/ttn/naaqs/standards/ozone/s_o3_cr_sp.html.*

[31] National Research Council (NRC), 2008. *Estimating Mortality Risk Reduction and Economic Benefits from Controlling Ozone Air Pollution.* The National Academies Press: Washington, DC. A copy of this document is in docket number EPA–HQ–OAR–2010–0687.

inflame and damage the lining of the lungs, which may lead to permanent changes in lung tissue and irreversible reductions in lung function. The respiratory effects observed in controlled human exposure studies and animal studies are coherent with the evidence from epidemiologic studies supporting a causal relationship between acute ambient ozone exposures and increased respiratory-related emergency room visits and hospitalizations in the warm season. In addition, there is suggestive evidence of a contribution of ozone to cardiovascular-related morbidity and non-accidental and cardiopulmonary mortality.

b. What are the health effects of PM?

Scientific studies show ambient PM is associated with a series of adverse health effects. These health effects are discussed in detail in EPA's Integrated Science Assessment for Particulate Matter (ISA).[32] The ISA summarizes evidence associated with $PM_{2.5}$, $PM_{10-2.5}$, and ultrafine particles (UFPs), and concludes the following.

The ISA concludes that health effects associated with short-term exposures (hours to days) to ambient $PM_{2.5}$ include mortality, cardiovascular effects, such as altered vasomotor function and hospital admissions and emergency department visits for ischemic heart disease and congestive heart failure, and respiratory effects, such as exacerbation of asthma symptoms in children and hospital admissions and emergency department visits for chronic obstructive pulmonary disease (COPD) and respiratory infections.[33] The ISA notes that long-term exposure to $PM_{2.5}$ (months to years) is associated with the development/progression of cardiovascular disease, premature mortality, and respiratory effects, including reduced lung function growth, increased respiratory symptoms, and asthma development.[34] The ISA concludes that the currently available scientific evidence from epidemiologic, controlled human exposure, and toxicological studies supports a causal association between short- and long-term exposures to $PM_{2.5}$ and cardiovascular effects and mortality. Furthermore, the ISA concludes that the collective evidence supports likely causal associations between short- and long-term $PM_{2.5}$ exposures and respiratory effects. The ISA also concludes that the scientific evidence is suggestive of a causal association for reproductive and developmental effects and cancer, mutagenicity, and genotoxicity and long-term exposure to $PM_{2.5}$.[35]

For $PM_{10-2.5}$, the ISA concludes that the current evidence is suggestive of a causal relationship between short-term exposures and cardiovascular effects, such as hospitalization for ischemic heart disease. There is also suggestive evidence of a causal relationship between short-term $PM_{10-2.5}$ exposure and mortality and respiratory effects. Data are inadequate to draw conclusions regarding the health effects associated with long-term exposure to $PM_{10-2.5}$.

For ultrafine particulates (UFPs), the ISA further concludes that there is suggestive evidence of a causal relationship between short-term exposures and cardiovascular effects, such as changes in heart rhythm and blood vessel function. It also concludes that there is suggestive evidence of association between short-term exposure to UFPs and respiratory effects. Data are inadequate to draw conclusions regarding the health effects associated with long-term exposure to UFP's.

c. What are the health effects of NO_X?

Information on the health effects of NO_2 can be found in the EPA Integrated Science Assessment (ISA) for Nitrogen Oxides.[36] The EPA has concluded that the findings of epidemiologic, controlled human exposure, and animal toxicological studies provide evidence that is sufficient to infer a likely causal relationship between respiratory effects and short-term NO_2 exposure. The ISA concludes that the strongest evidence for such a relationship comes from epidemiologic studies of respiratory effects including symptoms, emergency department visits, and hospital admissions. The ISA also draws two broad conclusions regarding airway responsiveness following NO_2 exposure. First, the ISA concludes that NO_2 exposure may enhance the sensitivity to allergen-induced decrements in lung function and increase the allergen-induced airway inflammatory response following 30-minute exposures of asthmatics to NO_2 concentrations as low as 0.26 ppm. In addition, small but significant increases in non-specific airway hyper-responsiveness were reported following 1-hour exposures of asthmatics to 0.1 ppm NO_2. Second, exposure to NO_2 has been found to enhance the inherent responsiveness of the airway to subsequent nonspecific challenges in controlled human exposure studies of asthmatic subjects. Enhanced airway responsiveness could have important clinical implications for asthmatics since transient increases in airway responsiveness following NO_2 exposure have the potential to increase symptoms and worsen asthma control. Together, the epidemiologic and experimental data sets form a plausible, consistent, and coherent description of a relationship between NO_2 exposures and an array of adverse health effects that range from the onset of respiratory symptoms to hospital admission.

Although the weight of evidence supporting a causal relationship is somewhat less certain than that associated with respiratory morbidity, NO_2 has also been linked to other health endpoints. These include all-cause (non-accidental) mortality, hospital admissions or emergency department visits for cardiovascular disease, and decrements in lung function growth associated with chronic exposure.

3. Environmental Effects Associated With Exposure to Ozone, PM and NO_X

a. Deposition of Nitrogen

Emissions of NO_X from aircraft engines contribute to atmospheric deposition of nitrogen in the U.S. Atmospheric deposition of nitrogen contributes to acidification, altering biogeochemistry and affecting animal and plant life in terrestrial and aquatic ecosystems across the U.S. The sensitivity of terrestrial and aquatic ecosystems to acidification from nitrogen deposition is predominantly governed by geology. Prolonged exposure to excess nitrogen deposition in sensitive areas acidifies lakes, rivers and soils. Increased acidity in surface waters creates inhospitable conditions for biota and affects the abundance and nutritional value of preferred prey species, threatening biodiversity and ecosystem function. Over time, acidifying deposition also removes essential nutrients from forest soils, depleting the capacity of soils to neutralize future acid loadings and

[32] U.S. EPA (2009) Integrated Science Assessment for Particulate Matter, EPA 600/R–08/139F. A copy of this document is in docket number EPA–HQ–OAR–2010–0687.

[33] U.S. EPA (2009). Integrated Science Assessment for Particulate Matter (Final Report). U.S. Environmental Protection Agency, Washington, DC, EPA/600/R–08/139F, 2009. Section 2.3.1.1.

[34] U.S. EPA (2009). Integrated Science Assessment for Particulate Matter (Final Report). U.S. Environmental Protection Agency, Washington, DC, EPA/600/R–08/139F, 2009. page 2–12, Sections 7.3.1.1 and 7.3.2.1.

[35] U.S. EPA (2009). Integrated Science Assessment for Particulate Matter (Final Report). U.S. Environmental Protection Agency, Washington, DC, EPA/600/R–08/139F, 2009. Section 2.3.2.

[36] U.S. EPA (2008). *Integrated Science Assessment for Oxides of Nitrogen—Health Criteria (Final Report).* EPA/600/R–08/071. Washington, DC: U.S. EPA. A copy of this document is in docket number EPA–HQ–OAR–2010–0687.

negatively affecting forest sustainability. Major effects include a decline in sensitive forest tree species, such as red spruce (*Picea rubens*) and sugar maple (*Acer saccharum*); and a loss of biodiversity of fishes, zooplankton, and macro invertebrates.

In addition to the role nitrogen deposition plays in acidification, nitrogen deposition also leads to nutrient enrichment and altered biogeochemical cycling. In aquatic systems increased nitrogen can alter species assemblages and cause eutrophication. In terrestrial systems nitrogen loading can lead to loss of nitrogen sensitive lichen species, decreased biodiversity of grasslands, meadows and other sensitive habitats, and increased potential for invasive species.

Adverse impacts on soil chemistry and plant life have been observed for areas heavily influenced by atmospheric deposition of nutrients, metals and acid species, resulting in species shifts, loss of biodiversity, forest decline and damage to forest productivity. Across the U.S. there are many terrestrial and aquatic ecosystems that have been identified as particularly sensitive to nitrogen deposition. The most extreme effects resulting from nitrogen deposition on aquatic ecosystems are due to nitrogen enrichment which contributes to ''hypoxic'' zones devoid of life. Three hypoxia zones of special concern in the U.S. are the zones located in the Gulf of Mexico, the Chesapeake Bay in the mid-Atlantic region, and Long Island Sound, in the northeast U.S.[37]

The deposition of airborne particles can reduce the aesthetic appeal of buildings and culturally important articles through soiling, and can contribute directly (or in conjunction with other pollutants) to structural damage by means of corrosion or erosion.[38] Particles affect materials principally by promoting and accelerating the corrosion of metals, by degrading paints, and by deteriorating building materials such as concrete and limestone. Particles contribute to these effects because of their electrolytic, hygroscopic, and acidic properties, and their ability to adsorb corrosive gases (principally sulfur dioxide).

b. Visibility Effects

NO_X emissions contribute to visibility impairment in the U.S. through the formation of secondary $PM_{2.5}$.[39] Visibility impairment is caused by light scattering and absorption by suspended particles and gases. Visibility is important because it has direct significance to people's enjoyment of daily activities in all parts of the country. Individuals value good visibility for the well-being it provides them directly, where they live and work, and in places where they enjoy recreational opportunities. Visibility is also highly valued in significant natural areas, such as national parks and wilderness areas, and special emphasis is given to protecting visibility in these areas. For more information on visibility see the final 2009 PM ISA.[40]

c. Plant and Ecosystem Effects of Ozone

Elevated ozone levels contribute to environmental effects, with impacts to plants and ecosystems being of most concern. Ozone can produce both acute and chronic injury in sensitive species depending on the concentration level and the duration of the exposure. Ozone effects also tend to accumulate over the growing season of the plant, so that even low concentrations experienced for a longer duration have the potential to create chronic stress on vegetation. Ozone damage to plants includes visible injury to leaves and impaired photosynthesis, both of which can lead to reduced plant growth and reproduction, resulting in reduced crop yields, forestry production, and use of sensitive ornamentals in landscaping. In addition, the impairment of photosynthesis, the process by which the plant makes carbohydrates (its source of energy and food), can lead to a subsequent reduction in root growth and carbohydrate storage below ground, resulting in other, more subtle plant and ecosystems impacts. These latter impacts include increased susceptibility of plants to insect attack, disease, harsh weather, interspecies competition and overall decreased plant vigor. The adverse effects of ozone on forest and other natural vegetation can potentially lead to species shifts and loss from the affected ecosystems, resulting in a loss or reduction in associated ecosystem goods and services. Lastly, visible ozone injury to leaves can result in a loss of aesthetic value in areas of special scenic significance like national parks and wilderness areas. The final 2006 Ozone Air Quality Criteria Document presents more detailed information on ozone effects on vegetation and ecosystems.

4. Impacts on Ambient Air Quality

The aircraft NO_X emission standards we are proposing would impact ambient concentrations of air pollutants. Nationally, levels of $PM_{2.5}$, ozone, and NO_X are declining.[41] However as of 2008, approximately 127 million people lived in counties that exceeded any NAAQS.[42] These numbers do not include the people living in areas where there is a future risk of failing to maintain or attain the NAAQS.

States with nonattainment areas are required to take action to bring those areas into compliance in the future. Based on the final rule designating and classifying 8-hour ozone nonattainment areas for the 1997 standard (69 FR 23951, April 30, 2004), most 8-hour ozone nonattainment areas will be required to attain the ozone NAAQS in the 2007 to 2013 time frame and then maintain the NAAQS thereafter. EPA is reconsidering the 2008 ozone NAAQS. If EPA promulgates different ozone NAAQS as a result of the reconsideration, these standards would replace the 2008 ozone NAAQS and EPA would subsequently designate nonattainment areas for the revised primary ozone NAAQS. The attainment dates for areas designated nonattainment for a revised primary ozone NAAQS could range from 2015 to 2032, depending on the severity of the problem.[43]

Areas designated as not attaining the 1997 $PM_{2.5}$ NAAQS will need to attain the 1997 standards in the 2010 to 2015 time frame, and then maintain them thereafter. The 2006 24-hour $PM_{2.5}$

[37] U.S. EPA (2008). *Nitrogen Dioxide/Sulfur Dioxide Secondary NAAQS Review: Integrated Science Assessment (ISA).* Washington, DC: U.S. Environmental Protection Agency. Retrieved on March 18, 2009 from *http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=180903.*

[38] U.S. EPA (2005). Review of the National Ambient Air Quality Standards for Particulate Matter: Policy Assessment of Scientific and Technical Information, OAQPS Staff Paper. Retrieved on April 9, 2009 from *http://www.epa.gov/ttn/naaqs/standards/pm/data/pmstaffpaper_20051221.pdf.*

[39] U.S. EPA (2004). *Air Quality Criteria for Particulate Matter (AQCD).* Volume I Document No. EPA600/P–99/002aF and Volume II Document No. EPA600/P–99/002bF. Washington, DC: U.S. Environmental Protection Agency. Retrieved on March 18, 2009 from *http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=87903.*

[40] U.S. EPA (2009). Integrated Science Assessment for Particulate Matter (Final Report). U.S. Environmental Protection Agency, Washington, DC, EPA/600/R–08/139F, 2009. A copy of this document is in docket number EPA–HQ–OAR–2010–0687.

[41] U.S. EPA (2010). Our Nation's Air: Status and Trends through 2008. Office of Air Quality Planning and Standards, Research Triangle Park, NC. Publication No. EPA 454/R–09–002. This document can be accessed electronically at: *http://www.epa.gov/airtrends/2010/.*

[42] U.S. EPA (2010). Our Nation's Air: Status and Trends through 2008. Office of Air Quality Planning and Standards, Research Triangle Park, NC. Publication No. EPA 454/R–09–002. This document can be accessed electronically at *http://www.epa.gov/airtrends/2010/.*

[43] U.S. EPA (2010). Fact Sheet Revisions to Ozone Standards. This document can be accessed electronically at: *http://www.epa.gov/groundlevelozone/pdfs/fs20100106std.pdf.*

nonattainment areas will be required to attain the 2006 24-hour $PM_{2.5}$ NAAQS in the 2014 to 2019 time frame and then be required to maintain the 2006 24-hour $PM_{2.5}$ NAAQS thereafter.

The aircraft engine emission standards being proposed today were approved by ICAO/CAEP and would have an implementation date of 2013. Therefore, the aircraft engine emission reductions that are being proposed today should be useful to states in attaining or maintaining the ozone and $PM_{2.5}$ NAAQS.

EPA has already adopted many emission control programs that are expected to reduce ambient ozone and $PM_{2.5}$ levels and which will assist in reducing the number of areas that fail to achieve the NAAQS. Even so, our air quality modeling projects that in 2030 as many as 16 counties with a population of almost 35 million may not attain the 2008 ozone standard of 0.075 ppm (75 ppb).[44] In addition, our air quality modeling projects that in 2030 at least 9 counties with a population of almost 28 million may not attain the 1997 annual $PM_{2.5}$ standard of 15 $\mu g/m^3$ and 26 counties with a population of over 41 million may not attain the 2006 24-hour $PM_{2.5}$ standard of 35 $\mu g/m^3$.[45] These numbers do not account for those areas that are close to (*e.g.,* within 10 percent of) the standards. These areas, although not violating the standards, would also benefit from any reductions in NO_X ensuring long-term maintenance of the NAAQS.

There are currently no NO_2 nonattainment areas. However, the NO_2 standards were recently revised and a new 1-hour NO_2 standard was promulgated.[46] Nonattainment area designations for the 1-hour NO_2 standard are expected to be finalized in 2012. These proposed aircraft NO_X reductions would be useful to states in attaining or maintaining the NO_2 standards.

III. Details of the Proposed Rule

We are proposing two different levels or tiers of increasingly more stringent NO_X emission standards for gas turbofan engines with maximum rated thrusts greater than 26.7 kilonewtons (kN).[47] Each of the tiers would potentially apply to newly-certified engines. Newly-certified aircraft engines are those that would receive a new type certificate after the effective date of the applicable standards. Such engine types or models would not have begun production prior to the effective date of the new requirement.[48]

We are also proposing to apply the first tier of the two tiers of standards to newly-manufactured engines. Newly-manufactured aircraft engines are those that have been previously certified and manufactured in compliance with preexisting standards, and will continue to be produced after the effective date of a new applicable standard. Normally, these newly-manufactured engines would need to comply with the same NO_X limits as newly-certified engines, but at a later date or cease production.[49] The end of this ''phase-in'' period for the newly-manufactured engine standards is sometimes referred to a ''production cutoff,'' for obvious reasons. Again, we are proposing only the first of the two new tiers of NO_X standards for newly-manufactured engines. These provisions are described in detail below.

Five other regulatory features are being proposed in today's action. First, we are proposing to revise provisions addressing certain time-limited flexibilities, *i.e.,* potential exemptions, for newly-manufactured engines that may not be able to comply with the first tier of the proposed new NO_X standards because of specific technical or economic reasons.[50] Similarly, the proposal includes exception provisions for spare engines. Second, we are proposing to define a derivative engine for emissions certification purposes. The intent of this definition is to distinguish when the emission characteristics of a new turbofan engine model vary substantially from its existing parent engine design, and must show compliance with the emission standards for a newly-certificated engine. Third, we are proposing new CO and NO_X standards for turbofan engines that are used to propel supersonic aircraft. These standards were adopted by ICAO in the 1980s, but were not previously added to our HC emission standard for these engines. The proposed standards would meet our treaty obligation under the Convention on International Civil Aviation as previously described in section I.B. Fourth, we are proposing several amendments to the emission testing and measurement procedures in our regulations that are intended to implement ICAO's Annex 16 and to incorporate the entire annex in our regulations by reference. Finally, as described in section IV., we are proposing amendments to current regulatory provisions addressing definitions, acronyms and abbreviations, general applicability and requirements, exemptions, and incorporation by reference. These amendments are intended to clarify requirements, make them more consistent with other parts of the program, update the text to be consistent with current standard language conventions, or remove obsolete provisions.

As discussed further below, with the exception of the annual reporting requirement described in section III.D., the proposed amendments reflect those changes that were previously adopted by ICAO or that CAEP has recommended for adoption by ICAO in the near future. In this latter case, we are proposing these standards and recommended practices at this time rather than wait until ICAO takes final action to help ensure that our standards, and the FAA's implementing regulations, are adopted in a timely manner once ICAO completes its process. We anticipate that our final standards would generally conform to ICAO's final standards, once adopted.

[44] U.S. EPA (2010). Regulatory Impact Analysis: Final Rulemaking To Establish Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards. Chapter 7: Environmental and Health Impacts. EPA420–R–10–009.

[45] U.S. EPA (2010). Regulatory Impact Analysis: Final Rulemaking To Establish Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards. Chapter 7: Environmental and Health Impacts. EPA 420–R–10–009.

[46] U.S. EPA, ''Primary National Ambient Air Quality Standards for Nitrogen Dioxide;'' Final Rule, 75 FR 6474, February 9, 2010.

[47] The proposed standards would apply to engines used in commercial and noncommercial aviation for which the FAA issues airworthiness certificates, *e.g.,* non-revenue, general aviation service. The vast majority of these engines are used in commercial applications. See section IV.A.2. for more information regarding noncommercial applications.

[48] ICAO standards describe newly-certified engines as ''* * * engines of a type or model for which the date of manufacture of the first individual production model was after * * *.'' the effective date of the emission standards. See ICAO, ''Aircraft Engine Emissions,'' Annex 16, Volume II, Third Edition, July 2008, Amendment 4 effective on July 20, 2008. A copy of this document is in docket number EPA–HQ–OAR–2010–0687.

[49] The standards for newly-manufactured engines are described in general regulatory terms as the date that the type or model was first certified and produced in conformance with specific emission standards, and the date beyond which an individual engine meeting those same requirements cannot be made. So ICAO standards describe newly-manufactured engines as ''* * * engines of a type or model for which the date of manufacture of the first individual production model was after * * *.'' the effective date of the applicable standards, and ''* * * for which the date of manufacture of the individual engine was on or before * * *'' a specific date that is later than the first effective date of the standards. See ICAO, ''Aircraft Engine Emissions,'' Annex 16, Volume II, Third Edition, July 2008, Amendment 4 effective on July 20, 2008. Copies of this document can be obtained from the ICAO Web site at *http://www.icao.int.*

[50] These apply only to the Tier 6 NO_X standards. We are not yet proposing a production cutoff for the Tier 8 NO_X standard.

This would better enable the regulated industry to respond to new, globally harmonized requirements in an orderly manner, which is important given the international nature of the market for the aircraft engines that would be affected by today's proposed rule. It would also avoid continuing the significant lag time that has sometimes occurred between ICAO's adoption of international standards and our adoption of corresponding standards under U.S. law. To the extent ICAO adopts standards that differ from those recommended by CAEP before we issue our final rule, we would then consider whether to make conforming amendments in our final standards, or to issue a supplemental proposal reflecting the amended ICAO standards, if appropriate.

This proposal also is consistent with our authority and obligations under the CAA as described in section I.B. More specifically, the technical feasibility and cost of the proposed emission standards were well documented by our own analyses and CAEP as described later in this section and in section V., Technical Feasibility, Costs, and Emission Benefits. We think that the proposal would provide adequate lead time for the development and application of the requisite technology with appropriate consideration to the cost of compliance. We have consulted with the Department of Transportation through the FAA regarding lead time, noise, safety, and the technical feasibility of the proposed standards. Today's proposal is also consistent with U.S. treaty obligations under the Chicago Convention as described in section I.C., because the proposed requirements are consistent with current ICAO standards or those that we expect ICAO to adopt prior to the promulgation of any final rule.

Except to the extent needed to make our standards conform to ICAO's standards by making them applicable to both commercial and non-commercial engines, we are not proposing revised exhaust emission standards for HC, CO, or smoke, which would remain in effect as currently promulgated. All engines subject to the proposed new NO_X standards would also continue to be subject to the existing HC, CO, and smoke standards. It is worth emphasizing that although we are proposing to include these existing HC, CO, and smoke standards in a new section 87.23, which would also contain the proposed Tier 6 and Tier 8 NO_X standards, we are not actually proposing new standards, since under the current form of part 87 these HC, CO and smoke standards would already continue to apply to new engine types subject to future revised NO_X standards.

We are proposing to adopt a new naming convention in this preamble and the regulatory text to more easily distinguish between the proposed tiers of increasingly more stringent NO_X emission standards. This convention is also consistent with the numeric identifier that CAEP uses to differentiate the CAEP work cycle that produces new NO_X standards. (The CAEP naming convention is described in section I.E.) As a result, the first tier of proposed NO_X standards, which are consistent with CAEP/6, will be referred to as Tier 6 in the remainder of today's notice. The second tier of proposed standards will be referred to as Tier 8, which is consistent with CAEP/8. We are also incorporating the new naming convention in the regulations for the existing NO_X emission standards, *i.e.,* Tier 0, Tier 2, and Tier 4. There is no material change to the existing NO_X standards themselves, except to the extent that upon the effectiveness of a final rule reflecting today's proposal the existing NO_X standards would be superseded by Tier 6 standards.

We acknowledge that this new naming convention is a change from the past practice of not describing aircraft engine emission standards as tiers. However, we believe the new naming scheme is a valuable tool that makes referring to individual NO_X standards much easier. It is also similar to the terminology we use for other mobile source sectors that are subject to environmental regulation and for which standards have become more stringent or have otherwise been amended over time.

A. NO_X Standards for Newly-Certified Engines

We are proposing two different tiers of increasingly stringent NO_X standards. These standards would apply for all for newly-certified turbofan aircraft engines with maximum rated thrusts greater than 26.7 kN.[51] (See section III.B. for a discussion of how these standards would apply for newly-manufactured engines that are not considered to be newly certified.) The numerical value of the applicable standard for an individual engine model is defined by the engine's thrust level and pressure ratio. Simply stated, the pressure ratio is a ratio of the air pressure entering the engine to the air pressure at the entrance to the combustor, *i.e.,* after the air has passed through the compressor section of the engine. Each of the proposed tiers is described separately below.

1. Tier 6 NO_X Standards for Newly-Certified Engines

This first tier of proposed standards is equivalent to the CAEP/6 NO_X limits that were already adopted by ICAO and became internationally effective after December 31, 2007. Given that aircraft turbofan engines are international commodities, engine manufacturers have already introduced engine models after that date that demonstrate compliance with these international standards, or are already planning to do so for upcoming engine designs. Based on this, and on our evaluation of the necessary lead time, we are proposing that this tier of standards take effect immediately upon the effective date of our final regulations.

The basic form of the NO_X standards for turbofan engines is different for higher- and lower-rated thrust engines. Higher output engines are defined as having rated thrusts equal to or greater than 89 kN, while lower output engines are defined as having rated thrusts less than 89 kN but greater than 26.7 kN. The proposed Tier 6 NO_X standards for each of these power grouping are described separately below.

a. Numerical Emission Limits for Higher Thrust Engines

The proposed Tier 6 NO_X standards for newly-certified gas turbine engines with rated thrusts of 89 kN or more are differentiated by pressure ratio as shown below.

- For engines with a pressure ratio of 30 or less: g/kN rated output = 16.72 + (1.4080 * engine pressure ratio).
- For engines with a pressure ratio of more than 30 but less than 82.6: g/kN rated output = −1.04 + (2.0 * engine pressure ratio).
- For engines with a pressure ratio of 82.6 or more: g/kN rated output = 32 + (1.6 * engine pressure ratio).

The corresponding CAEP/6 standards were derived by CAEP using the following methodology:

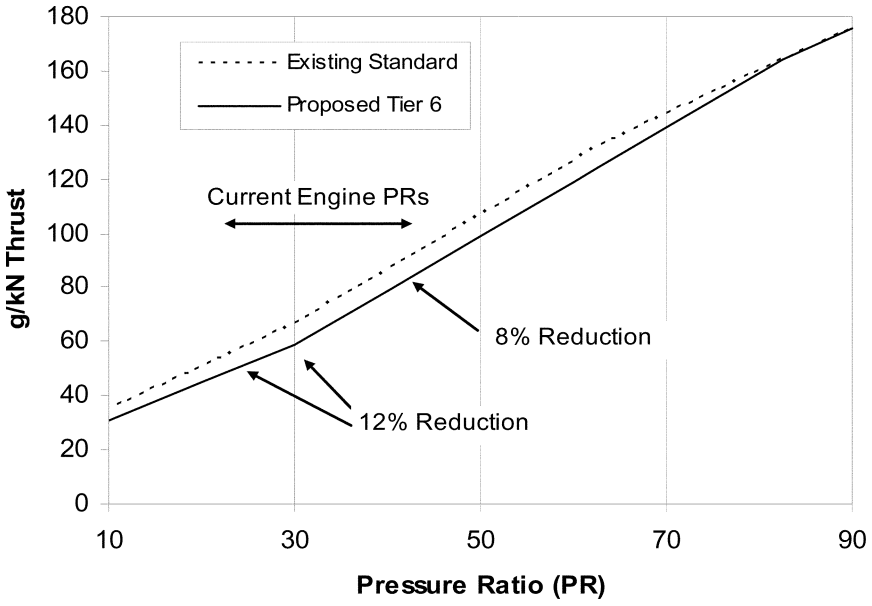
- Make the CAEP/6 standard 12 percent more stringent than the CAEP/4 requirement at a pressure ratio of 30;
- Retain the same percent reduction, *i.e.,* 12 percent, for pressure ratios below 30;
- Retain the slope of the CAEP/4 standard for pressure ratios of 30 to 62.5 for the CAEP/6 pressure ratios of 30 to 82.6;
- Retain the slope of the CAEP/4 standard for pressure ratios equal to or

[51] There are no gaseous emission standards, *e.g.,* NO_X, for gas turbine engines with maximum rated thrusts equal to or less than 26.7 kN. These engines are, however, subject to smoke and fuel venting standards.

greater than 62.5 for the CAEP/6 pressure ratios at or above 82.6.[52]

The resulting proposed Tier 6 NO_X standards for these higher thrust engines are presented in Figure 1 along with the most recently adopted existing EPA NO_X standards, which were based on CAEP/4, for comparison.

Figure 1: Proposed Tier 6 NOx Standards for Higher Thrust Engines



As a matter of convention, the relative stringency from one CAEP standard to another is expressed relative to a pressure ratio of 30, because the percentage reduction is usually inconsistent across all of the possible pressure ratios, which otherwise makes a simple comparison difficult. Using that convention, the proposed Tier 6 standards (CAEP/6) are referred to as being 12 percent more stringent than the existing EPA NO_X Tier 4 standards (CAEP/4). The relative stringency can also be illustrated at other pressure ratios. At pressure ratios less than 30 the reductions are also 12 percent. At pressure ratios above 30, however, the percent reduction decreases as the pressure ratio is increased. Based on the figure, the percent reduction for current technology engines ranges from about 8 to 12 percent.

b. Numerical Emission Limits for Lower Thrust Engines

The proposed Tier 6 NO_X standards for newly-certified gas turbine engines with rated thrusts between 26.7 and less than 89.0 kN are differentiated by both pressure ratio and rated thrust as shown below.

- For engines with a pressure ratio of 30 or less:

g/kN rated output = 38.5486 + (1.6823 * engine pressure ratio) − (0.2453 * kN rated thrust) − (0.00308 * engine pressure ratio * kN rated thrust).

- For engines with a pressure ratio of more than 30 but less than 82.6:

g/kN rated output = 46.1504 + (1.4285 * engine pressure ratio) − (0.5298 * kN rated thrust) + (0.00642 * engine pressure ratio * kN rated thrust).

In developing the corresponding NO_X standards for low thrust engines, CAEP recognized the technical challenges that physically smaller-sized engines represent relative to incorporating some of the lowest NO_X technology, which is otherwise available to their larger counterparts. These technical difficulties are well documented and increase progressively as size is reduced (from around 89 kN).[53] For example, the relatively small combustor[54] space and section height of these engines creates constraints on the use of low NO_X fuel-staged combustor concepts which inherently require the availability of greater flow path cross-sectional area than conventional combustors. Also, fuel-staged combustors need more fuel injectors, and this need is not compatible with the relatively smaller total fuel flows of lower thrust engines. (Reductions in fuel flow per nozzle are difficult to attain without having clogging problems due to the small sizes of the fuel metering ports.) In addition, lower thrust engine combustors have an inherently greater liner surface-to-combustion volume ratio, and this requires increased wall cooling air flow. Thus, less air will be available to obtain acceptable turbine inlet temperature distribution and for emissions control.[55] With these technological constraints in mind, CAEP fashioned the CAEP/6 NO_X standards across the range of thrusts represented by low-thrust engines to become comparatively less stringent,

[52] Reverting to the CAEP/4 slope at a pressure ratio of 82.6 prevents the CAEP/6 standard from otherwise intersecting the older CAEP/2 standard at this point and thereby actually making CAEP/6 less stringent than CAEP/2. It has no practical effect because current engines or anticipated engine designs do not utilize such high pressure ratios. Presently, there are no current engines with pressure ratios above approximately 42.

[53] ICAO/CAEP, ''Report of Third Meeting, Montreal, Quebec, December 5–15, 1995,'' Document 9675, CAEP/3. A copy of this paper can be found in Docket EPA–HQ–OAR–2010–0687.

[54] The combustor is a chamber where a mixture of fuel and air is burned to form very hot, expanding gases. As these gases move through the combustion chamber, the walls of the combustor are cooled with dilution air to prevent thermal damage. Dilution air is also used to tailor the gas' temperature profile as it exits the combustor so that the final temperatures will not exceed the allowable limit at the turbine inlet.

[55] ICAO, ''Combined Report of the Certification and Technology Subgroups,'' section 2.3.6.1, CAEP Working Group 3 (Emissions). Presented by the Chairman of the Technology Subgroup, Third Meeting, Bonn, Germany, June 1995. A copy of this paper can be found in Docket EPA–HQ–OAR–2010–0687.

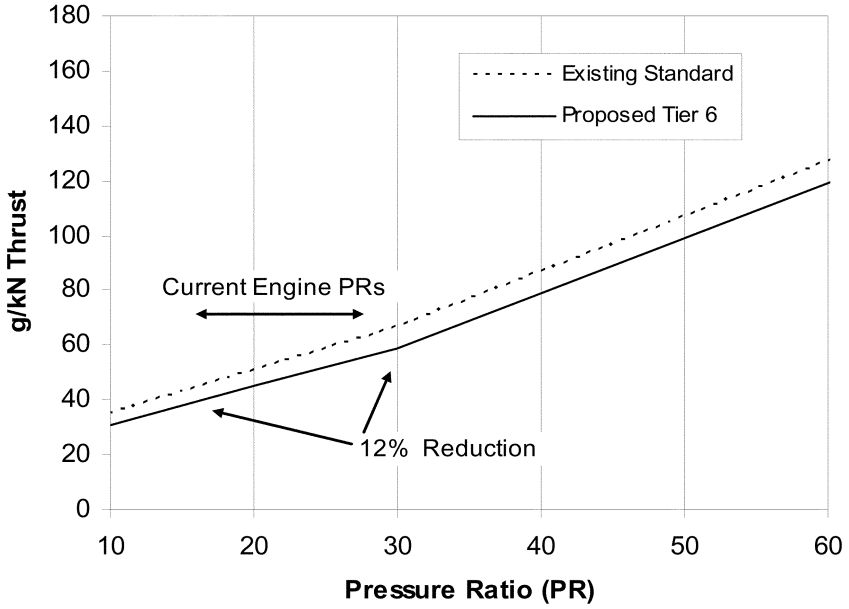
i.e., CAEP/6 relative to CAEP/4, as the rated output and physical size of the engines decrease. We agree with this approach.

As mentioned, the proposed Tier 6 standards depend on an individual engine's rated thrust and pressure ratio. With two variables in the calculation, the standards cannot be represented in a simple figure, *i.e.,* no single line graph showing the standards for all engines within the thrust range is possible as it was for higher thrust engines. Regardless of this complexity, however, some general observations are useful to characterize the proposed Tier 6 NO_X standards for lower thrust engines based on the engine size versus technological challenge described in the previous paragraph.

Comparing the proposed lower and higher thrust standards at 89 kN, which is the demarcation point between the two sets of standards, shows that the standards for lower thrust engines are numerically equivalent to the limit for higher thrust engines at each pressure ratio. This is as expected because the engine sizes and ability to incorporate low-NO_X technologies are the same at 89.0 kN delineation point.

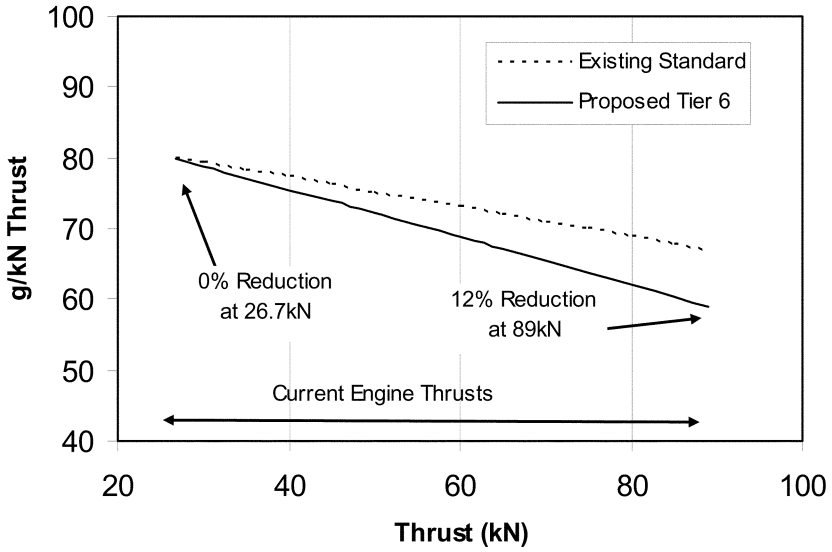
Again focusing only on 89 kN engines, the proposed Tier 6 standards represent a 12 percent reduction from the existing EPA Tier 4 (CAEP/4 based standards) for pressure ratios of 30 or less as shown below in Figure 2. This includes the region represented by almost all current engine designs. At higher pressure ratios, the relative numerical reduction is progressively less because the slope of the two standards is essentially the same.

Figure 2: Proposed Tier 6 NOx Standards for Lower Thrust Engines Rated at 89.0 kN



At other thrust ratings the percent reduction between the proposed Tier 6 and existing EPA NO_X standards at any pressure ratio becomes progressively smaller as thrust decreases. This is illustrated in Figure 3 for a pressure ratio of 30. This pressure ratio was chosen for the example because, as before, the relative stringency of CAEP NO_X standards is generally compared at this point as a matter of convention. As shown in the figure for current engines, the reduction ranges from 12 percent at the upper end of the thrust range to 0 percent at the lower end of the range. The pattern is similar for the other pressure ratios. Only the actual numerical value for percentage reduction at 89 kN, as shown on the far right of the figure, may vary by pressure ratio, as described at the beginning of this paragraph. However, in the region of pressure ratios represented by today's engines, the results are identical to those shown in the figure, *i.e.,* a 12 percent reduction at 89 kN decreasing to 0 percent at 26.7 kN.

Figure 3: Proposed Tier 6 NOx Standards for Lower Thrust Engines At Pressure Ratio 30



2. Tier 8 NO_X Standards for Newly-Certified Engines

The second tier of proposed standards, *i.e.,* Tier 8, are equivalent to the NO_X limits that were most recently recommended at CAEP/8 in February 2010 for adoption by ICAO.[56] The CAEP/8 recommended standards have a recommended effective date after December 31, 2013. As discussed further in section V. of today's notice, we agree with CAEP that this provides engine manufacturers with adequate lead time to respond to these more stringent NO_X standards considering the technical feasibility and cost associated with the requirements. Therefore, we are proposing that this tier of proposed standards would take effect on January 1, 2014, provided ICAO adopts CAEP/8's recommended standards and effective date. If ICAO adopts different standards or a different effective date, we would evaluate whether to similarly adopt correspondingly different standards and effective dates, or seek further public comment before doing so.

As with the Tier 6 NO_X standards, the basic form of the Tier 8 standards for turbofan engines is different for higher- and lower-rated thrust engines. Higher output engines are defined as having rated thrusts equal to or greater than 89 kN, while lower output engines are defined as having rated thrusts less than 89 kN but greater than 26.7 kN. The longer-term standards for each of these power grouping are described separately below.

a. Numerical Emission Limits for Higher Thrust Engines

The proposed Tier 8 NO_X standards for newly-certified turbofan engines with rated thrusts of 89 N or more are differentiated by pressure ratio as shown below.

- For engines with a pressure ratio of 30 or less: g/kN rated output = 7.88 + (1.4080* engine pressure ratio).
- For engines with a pressure ratio of more than 30 but less than 104.7: g/kN rated output = − 9.88+ (2.0 * engine pressure ratio).
- For engines with a pressure ratio of 104.7 or more: g/kN rated output = 32 + (1.6 * engine pressure ratio).

The corresponding CAEP/8 standards were derived by CAEP using the following methodology:

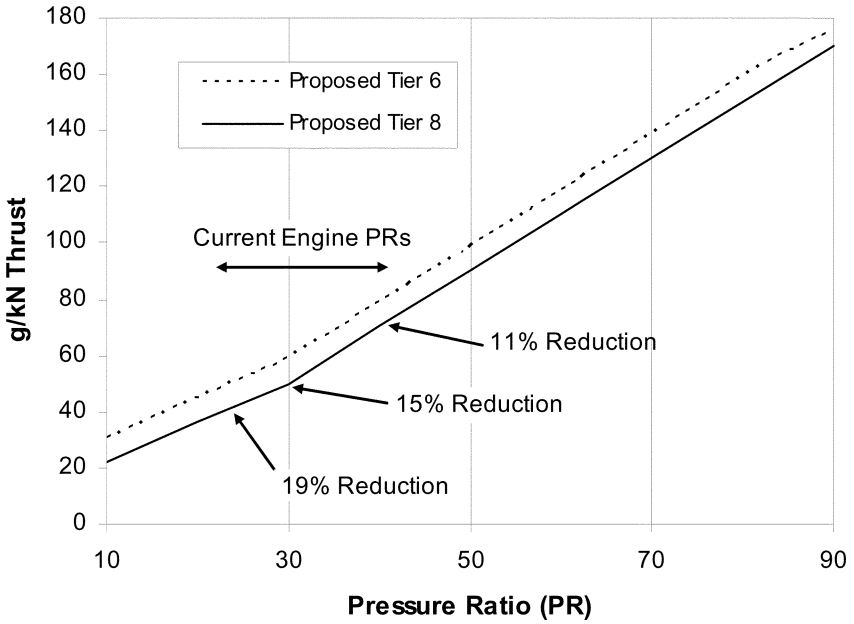
- Make the CAEP/8 standard 15 percent more stringent than the CAEP/6 requirement at a pressure ratio of 30;
- Retain the slope of the CAEP/6 standard for pressure ratios below 30;
- Retain the slope of the CAEP/6 standard for pressure ratios of 30 to 82.6 for the CAEP/8 pressure ratios of 30 to 104.7;
- Retain the slope of the CAEP/6 standard for pressure ratios above 82.6 for the CAEP/8 pressure ratios equal to or greater than 104.7.[57]

The resulting proposed Tier 8 NO_X standards for these higher thrust engines are presented in Figure 4 along with the proposed Tier 6 standards for comparison.

[56] CAEP/7 did not adopt new aircraft engine NO_X standards.

[57] Reverting to the CAEP/6 slope at a pressure ratio of 104.7 prevents the CAEP/8 standard from otherwise intersecting the older CAEP/2 standard at this point and thereby actually making CAEP/8 less stringent than CAEP/2. It has no practical value because current engines or anticipated engine designs do not utilize such high pressure ratios. Presently, there are no current engines with pressure ratios above approximately 42.

Figure 4: Proposed Tier 8 NOx Standards for Higher Thrust Engines



As noted previously, as a matter of convention the relative stringency from one CAEP standard to another is generally expressed relative to a pressure ratio of 30. Using that convention, the proposed Tier 8 standards (CAEP/8) are referred to as being 15 percent more stringent than the proposed Tier 6 NO_X standards (CAEP/6). The relative stringency can also be illustrated at other pressure ratios. At pressure ratios less than 30 the reductions increase. At pressure ratios above 30, however, the percent reduction decreases. Based on the figure, the percent reduction for current technology engines ranges from about 11 to 19 percent.

b. Numerical Emission Limits for Lower Thrust Engines

The proposed Tier 8 NO_X standards for newly-certified gas turbine engines with rated thrusts between 26.7 but less than 89.0 kN are differentiated by both pressure ratio and rated thrust as shown below.

- For engines with a pressure ratio of 30 or less:

g/kN rated output = 40.052 + (1.5681 * engine pressure ratio) − (0.3615 * kN rated thrust) − (0.0018 * engine pressure ratio * kN rated thrust).

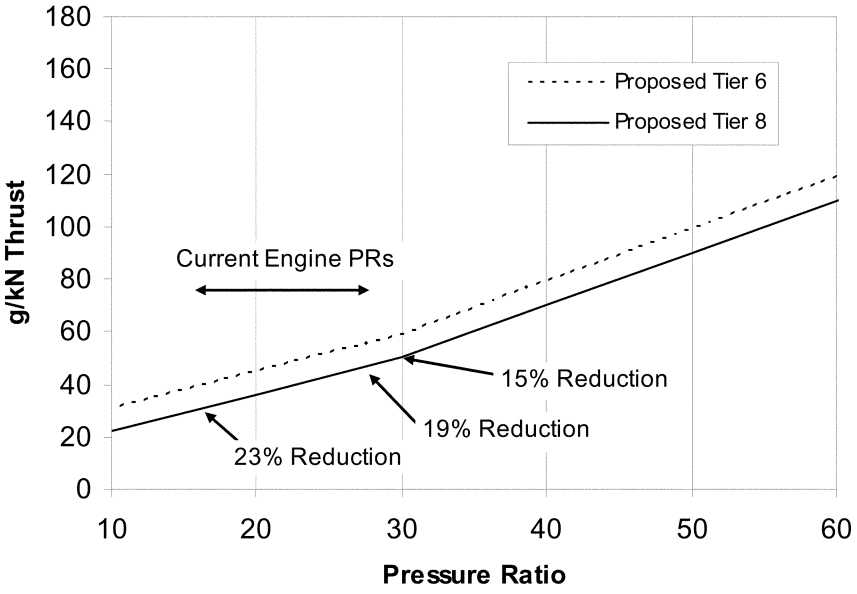
- For engines with a pressure ratio of more than 30 but less than 104.7:

g/kN rated output = 41.9435 + (1.505 * engine pressure ratio) − (0.55823 * kN rated thrust) + (0.005562 * engine pressure ratio * kN rated thrust).

In developing the corresponding CAEP/8 NO_X standards for low thrust engines, CAEP recognized the technical challenges that physically smaller-sized engines represent relative to incorporating some of the lowest NO_X technology, which is otherwise available to their larger counterparts. These technical difficulties were described in the previous section for the proposed Tier 6 low-thrust engine standards.

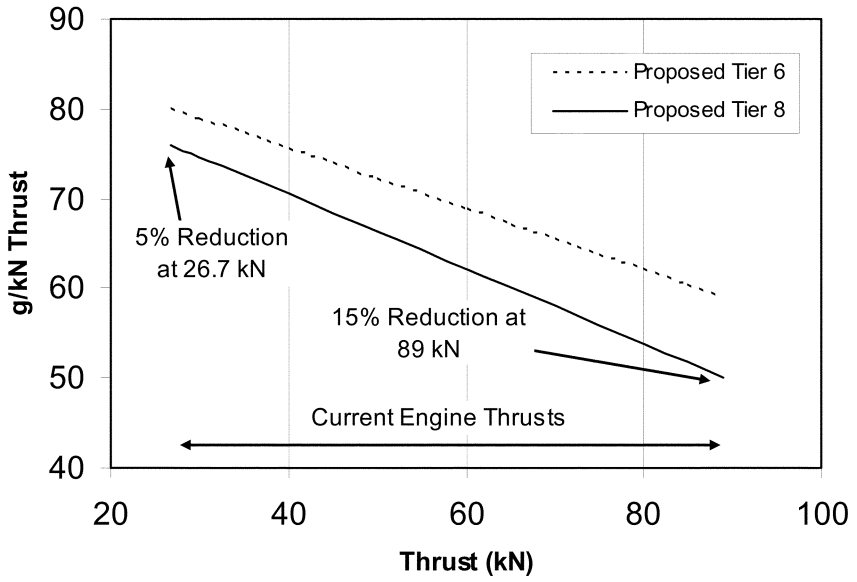
Also as previously described, no single line graph showing the standards for all engines within the thrust range is possible as it was for higher thrust engines, because the equations have two variables. However, some general observations are useful to characterize the proposed Tier 8 NO_X standards for lower thrust engines based on the engine size versus technological challenge described in the previous paragraph. First, the proposed Tier 8 NO_X standards for lower thrust engines are numerically equivalent to the limit for higher thrust engines across all pressure ratios at the highest rating of 89 kN, where the engine sizes and ability to incorporated low-NO_X technologies are comparable. This same characteristic was observed for the proposed Tier 6 standards. Second, as shown below in Figure 5 for 89 kN engines, at this thrust rating the proposed Tier 8 standards represents a 15 percent reduction from the proposed Tier 6 standards for a pressure ratio of 30. However, within the region of pressure ratios for all current engine designs, the reductions range from 19 to 23 percent.

Figure 5: Proposed Tier 8 NOx Standards for Lower Thrust Engines Rated at 89.0 kN



Third, at other thrust ratings the percent reduction between the proposed Tier 6 and Tier 8 standards at any pressure ratio becomes progressively smaller as thrust decreases. This is illustrated in Figure 6 for a pressure ratio of 30, following the convention described above. Also as shown in the figure for current engines, the reduction ranges from 15 percent at the upper end of the thrust range to 5 percent at the lower end of the range. While not depicted in a figure, the pattern is similar for the other pressure ratios. However, the actual numerical values for percentage reductions at both ends of the thrust range, *i.e.,* 26.7 to 89 kN, may vary by pressure ratio. In the region of pressure ratios represented by today's engines, the results are identical to those shown in Figure 6 at 26.7 kN, *i.e.,* a 5 percent reduction at all pressure ratios for that thrust rating. However, percent reductions increase linearly up to a maximum 23 percent reduction for 89 kN engines with pressure ratios of about 15.

Figure 6: Proposed Tier 8 NOx Standards for Lower Thrust Engines at Pressure Ratio 30



B. Application of the Tier 6 NO_X Standards to Newly-Manufactured Engines

This section describes our proposal to apply the proposed Tier 6 NO_X standards to newly-manufactured engines, and our proposed amended temporary flexibilities for newly-manufactured engines that may have significant problems complying with these requirements. Also, consistent with CAEP/8, we are not proposing to apply the Tier 8 NO_X standards to newly-manufactured engines at this time. This section concludes with a description of future efforts to examine such a possibility.

1. Phase-In of the Tier 6 NO_X Standards for Newly-Manufactured Engines

As described above, the proposed Tier 6 NO_X standards would apply to all engine types or models that receive a *new* type certificate after the effective date of the final rule. We are also proposing to phase-in these same NO_X limits for newly-manufactured engines for engine models (and their derivatives for emissions certification purposes) that were originally certified to less stringent requirements (*i.e.,* Tier 2 or Tier 4) and were already being produced for installation on new aircraft prior to the effective date of the final rule.[58] As a result, manufacturers would need to bring newly-manufactured engines of these previously certified models into compliance with the applicable Tier 6 standards by a future date or cease production of those engine models.[59] As we discussed and described in our analysis of the need for a CAEP 6 production cutoff during the CAEP process, establishing a date certain for compliance with any emission standard is foundational to its basic design and purpose and helps to ensure that the full benefits of newer, more stringent requirements will be achieved in a reasonable time.[60] We are, however, proposing certain limited flexibilities for engines that cannot be made compliant because of specific technical or economic reasons, as discussed later in this section.

The proposed effective date of January 1, 2013[61] for the newly-manufactured engine standards is consistent with the expected market demand for these previously certified engine types. Historically, engine manufacturers have often responded to the adoption of more stringent NO_X standards by bringing older engine types into compliance with the newer requirements well before the required date in anticipation of the likely market demand, or planning for the orderly withdrawal of these engines from the marketplace. Information developed during the ICAO process in 2008 and 2009[62] [63] [64] and our more recent discussions with manufacturers indicate that: (1) All but a few models are already compliant with CAEP/6 standards, (2) nearly without exception, all current production models will meet the CAEP/6 requirements by the 2011 time frame, and (3) any noncompliant models will be phased out of production because of low market demand.

We think that the proposed five-year phase-in period from ICAO's effective date of the CAEP/6 standards (corresponding to our proposed Tier 6 NO_X standards) for newly-certified engines is adequate for manufacturers and their customers to respond to the new requirements without disrupting their future planning and purchasing decisions.[65] [66] This phase-in period for applying the Tier 6 NO_X standards to newly-manufactured engines is identical to the date for this same requirement that CAEP/8 has recommended to ICAO for adoption.[67] Therefore, we are proposing that all engines newly-manufactured after December 31, 2012 must comply with the Tier 6 NO_X standards. Again, if ICAO ultimately adopts a production cutoff date that differs from this proposed date, we would evaluate whether to adopt a correspondingly different date in the final rule or to seek further public comment on the change.

2. Exemption and Exceptions From the Tier 6 Production Cutoff

In conjunction with the implementation of the proposed Tier 6 NO_X standards, we are proposing provisions which would allow engine manufacturers to request an exemption exception from meeting the Tier 6 NO_X standards for newly-manufactured engines. These proposed provisions would replace existing provisions addressing exemptions, currently promulgated in section 87.7 of our aircraft engine regulations. (Any exemptions previously issued under section 87.7 would not be affected by the proposed revisions.) This section of the preamble describes these proposed exemption and exception provisions, *i.e.,* exemptions for engines installed in new aircraft and exceptions for spare engines used in existing aircraft for maintenance purposes. These provisions have largely been crafted to be consistent with exemption provisions in the ICAO Environmental Technical Manual (ETM).[68] [69] The provisions of the ETM guidance were developed in the context of the CAEP/6 NO_X

[58] The requirement that newly-manufactured engines must meet the CAEP 6 NO_X standard by a date certain applies only to engines that are intended to be installed on all new airframes. It would not apply to engines produced as ''spares,'' which are intended to be installed on existing airframes as replacements for maintenance or other reasons. See section III.B.2. for more information about new and spare engines.

[59] After this date the production of any noncompliant engines would cease because the FAA would discontinue issuing an airworthiness approval tag (FAA Form 8130–3) to these engines.

[60] ICAO, Committee on Aviation Environmental Protection (CAEP), Eight Meeting, Montreal, 1 to 12 February 2010, Agenda 2: Review of Technical Proposals Relating to Aircraft Engine Emissions, Adoption of Production Cutoff for Emission Standards, WP/56, Presented by the United States, December 12, 2009. A copy of this document is in docket number EPA–HQ–OAR–2010–0687.

[61] The proposed regulatory text specifies that engine models certified at or below the Tier 4 NO_X standards may be produced through December 31, 2012 without meeting the Tier 6 NO_X standards. Therefore, the effective date of the proposed standards for newly-manufactured engines is effectively January 1, 2013.

[62] ICAO, Committee on Aviation Environmental Protection (CAEP), Steering Group Meeting, Salvador, Brazil, 22 to 26 June 2009, Agenda 6: Emissions Technical-WG3, Production Cutoffs and Associated Flexibilities for ICAO Engine Emission Standards, WP/39, Presented by U.S. Representative, August 6, 2009. A copy of this document is in docket number EPA–HQ–OAR–2010–0687.

[63] ICAO, Committee on Aviation Environmental Protection (CAEP), Steering Group Meeting, Salvador, Brazil, 22 to 26 June 2009, Agenda Item 3: Forecasting and Economic Analysis Support Group (FESG), CAEP/6 NO_X Production Cutoff Cost Analysis, WP/39, Presented by the FESG NO_X Stringency Task Group, February 6, 2009. A copy of this document is in docket number EPA–HQ–OAR–2010–0687.

[64] ICAO, Committee on Aviation Environmental Protection (CAEP), Steering Group Meeting, Seattle, 22 to 26 September 2008, Agenda Item 3: Forecasting and Economic Analysis Support Group (FESG), Production Cutoff for NO_X Standards, WP/6, Presented by the FESG Rapporteurs, April 9, 2008. A copy of this document is in docket number EPA–HQ–OAR–2010–0687.

[65] The ICAO CAEP/6 NO_X standards became effective after December 31, 2007.

[66] This period of time is also consistent with the phase-in period associated with previous ICAO standards. CAEP's predecessor, the Committee on Aircraft Engines Emissions, established the first international emission standards with an effective date four years after adoption, *i.e.,* effectively a four year phase-in. CAEP2 included a phase-in period of 4 years for newly-manufactured engines.

[67] We expect that ICAO will formally adopt the CAEP/8 recommendations with an effective date in November 2011, which is well before the projected effective date of our final rule.

[68] ICAO, ''Committee on Aviation Environmental Protection (CAEP), Report of the Eighth Meeting, Montreal, February 1–12, 2010,'' CAEP/8–WP/80. A copy of this document is in docket number EPA–HQ–OAR–2010–0687.

[69] Note that EPA has submitted a paper to amend the exemption provisions included in this ETM to be consistent with this proposed rule. See ICAO, ''Newly Produced Engine Exemptions for CAEP/6 NO_X Production Cutoff,'' CAEP9_WG3–CTG–2_IP01, September 23, 2010. A copy of this document is in docket number EPA–HQ–OAR–2010–0687.

production cutoff deliberations leading up to the CAEP/8 meeting in February 2010.

While we are proposing to revise our regulations, the process for evaluating any request for an exemption, *i.e.,* petition, and any final decision on its disposition would be unchanged. In this regard, the FAA is the process owner under its enforcement authority contained in section 232 of the Clean Air Act.[70] The FAA must consult with EPA in evaluating the merits of the request, and the EPA must formally concur with any decision regarding the granting or denial of the request.

Under the existing regulations, the FAA, with EPA concurrence, may exempt low-production volume engines from being fully compliant with the emission standards. Several such short-term exemptions were granted in the 1980s when emission standards were first applied. These exemptions have since expired, and requests for new exemptions under those provisions have not been submitted. We have determined that these provisions, which were adopted in conjunction with revised emission standards in 1982, are no longer of any utility.[71] Therefore, we are proposing to delete these provisions to avoid confusion.

We are also proposing to delete the existing provisions for temporary exemptions based on flights for short durations and infrequent intervals. These provisions are not necessary because our standards apply to aircraft certificated by the FAA, and the FAA does not address in the certification process whether an aircraft will be used for short durations or infrequent intervals. Hence, the provisions are of no utility.

The current regulations also provide for permanent exemptions based on consideration of the certain factors specified in section 87.7(c). We are proposing to replace these provisions with new regulatory text consistent with the ETM that would provide for two separate types of permanent exemptions: Exceptions for spare engines and exemptions for engines on new aircraft. These are summarized below. (See § 87.50 of the proposed regulations for additional details on these exemptions.)

[70] EPA formally transferred the responsibility and authority for the evaluation of requests for exemptions from the emission standards to the Secretary of Transportation (DOT). See ''Control of Air Pollution from Aircraft and Aircraft Engines; Emission Standards and Test Procedures;'' Final Rule, 47 FR 58462, December 30, 1982.

[71] U.S.EPA, ''Control of Air Pollution from Aircraft and Aircraft Engines; Emission Standards and Test Procedures,'' Final Rule, 47 FR 58462, December 30, 1982.

Finally, we are deleting the time-limited exemption provisions for in-use engines that are contained in section 87.7(d). These provisions, which were intended for when the standards of sections 87.11(a), 87.31(a), and 87.31(c) first took effect, are now obsolete.

a. New Provisions for Spare Engines

This proposed allowance, which is an exception to the standards as described below, is intended to allow the production and sale of a newly-manufactured engine for installation on an in-service aircraft, *i.e.,* a ''spare engine.'' It would *not* allow for installing such an engine on a new aircraft. Spare engines are produced from time to time in order to keep an aircraft in revenue service when the existing in-service engine must be removed for maintenance or replacement purposes as needed. Otherwise removing these aircraft from active service would be very expensive and logistically difficult. Also, under our proposed regulations, there would be no adverse environmental effect from allowing the use of a spare engine as a direct replacement for an existing engine, because a spare could be used only when the emissions of the spare engine are equal to or lower than those of the engine it is replacing, for all pollutants. Manufacturers would not be required to obtain FAA or EPA approval before producing spare engines. However, they would have to submit information about the production of spare engines in an annual report to the EPA. Because manufacturers would not be required to seek or obtain formal approval to produce spare engines, this allowance is being referred to as an ''exception'' rather than an ''exemption''. This terminology would be consistent with current FAA regulations. The permanent record for each engine excepted under this provision would need to indicate that the engine is an excepted spare engine and the engine itself would need to be labeled as ''EXCEPTED SPARE.'' in accordance with FAA marking requirements of 14 CFR.

Exceptions for spare engines are not addressed in the existing regulations because there is no production cutoff for the current Tier 4 NO_X standards. Thus manufacturers have been allowed to continue production of older engine designs under type certificates first issued before the Tier 4 standards took effect (*e.g.,* Tier 2). However, our proposal to apply a Tier 6 NO_X production cutoff to all newly-manufactured engines means that if we did not also propose this exception process, manufacturers would be prohibited from producing Tier 4 spare engines under the existing type certificates. We see no reason to change our policy of allowing manufacturers to produce new engines for use as spares. The proposed regulatory provisions would allow this practice to continue.

Under the proposed regulations, engines meeting the requirements for spare engines could be produced and enter into commerce without prior approval from EPA or FAA. (This allowance would also need to be promulgated by the FAA.) It is important to note that while spare engines would be excepted from the Tier 6 NO_X standards being proposed today, they would still need to be produced under an FAA type certificate. (This FAA oversight would serve the same role as the exemption approval step envisioned by ICAO in its ETM language for spare engines.) We would expect little or no additional burden for manufacturers, since we are not proposing new restrictions, monitoring, recordkeeping, or reporting requirements other than the end of year report. When combined with the proposed prohibition against using spare engines to replace lower emitting engines, this program will ensure that using a spare engine would not increase emissions, but would at the same time allow the availability of spares for maintenance or replacement as needed.

b. New Provisions for Engines Installed in New Aircraft

The primary purpose of allowing limited continued production of Tier 4 engines is to provide for an orderly implementation of the Tier 6 NO_X production cutoff. It addresses engines reaching the end of their production cycles in the time frame when new emission standards take effect. The typical production cycle would have annual production volumes ramp up quickly, remain at relatively large volumes for several or many years, and then fall off over a few more years. When new emission standards are adopted in the middle of a production cycle to take effect a few years later, manufacturers generally devote technical resources to bring into compliance those engine models expected to be produced in large numbers in the time frame when the new standards are in effect. In contrast, they may plan not to invest in upgrading the emissions of engine models that would be very near the end of their normal production cycles when compliance with the new standards becomes required. The actual length and shape of this tail of production volumes can be affected by factors not fully

within the engine manufacturers' control, *e.g.,* unexpected market demand. Thus, exemptions may be justified if a manufacturer does not complete the production cycle before the production cutoff date and projected production volumes are not adequate to justify investing the necessary resources to reduce emissions or there are other technological issues.

Furthermore, in certain exceptional circumstances exemptions may also be appropriate. These are ''hardship'' situations that may arise as a result of unforeseen technical or economic circumstances or events beyond control of the manufacturer. For example, this could vary from unexpected problems with technology upgrade programs to labor disruptions or natural events disrupting production or parts availability.

Our regulations currently address these kinds of situations in section 87.7(c), entitled ''Exemptions for New Engines in Other Categories.'' Today's proposed amendments would replace this provision with a new set of provisions addressing exemptions for new engines. We invite public comment on any other ways to address the need for flexibilities in the above circumstances.

i. Time Frame and Scope

The proposed regulations would allow manufacturers to request an exemption for engines not meeting the Tier 6 NO_X standards so they may be installed in new aircraft. If granted, the exemption would allow manufacturers to produce a limited number of newly-manufactured engines, in a time period beginning after December 31, 2012 and going through December 31, 2016. The time period for any given approved exemption could be shorter depending on the specifics of the application but could not be longer. This exemption would be limited to NO_X emissions from engines that are covered by a valid type certificate issued by FAA. The engines would be required to meet all other applicable requirements. More specifically, an engine exempted from the Tier 6 NO_X standards would need to be covered by a previously issued type certificate showing compliance with the Tier 4 NO_X standards,[72] as well as the current HC, CO, fuel venting, and smoke standards.

ii. Production Limit

In the proposed new regulatory language for exemptions, we are proposing to use the general exemption language for exhaust emission standards contained in part 87.7(c) of the current regulations. That language states that the Secretary of the Department of Transportation determines, with the EPA Administrator's concurrence, when the emission standards do not apply to engines based on a number of specific considerations such as adverse economic impact on the engine manufacturer, aircraft manufacturer, or airline industry; in addition to the effects on public health and welfare. We are also proposing to make this language applicable only to the Tier 6 production cutoff, which is consistent with the ETM guidance. No need has been identified to apply such exemption language to the other regulated exhaust pollutants, *i.e.,* hydrocarbons and carbon monoxide. The emission standards for those pollutant species have remained unchanged for nearly three decades and present no technical issues for modern turbofan engines.[73] If new emission standards for these pollutants are considered in the future, the potential need for exemption provisions will also be assessed at that time.

Each request for exemption would be evaluated on a case-by-case basis, using the information provided by the applicant and any other relevant information that is available to FAA and EPA at the time. Any approved exemption would include a specific limit on the number of such engines based on that information and is not defined on a basis such as type certificate. (See section III.B.b.iii. for a description of what the request must contain.) The intent, of course, would be to exempt the minimum number of engines that can be clearly justified, including a consideration of the public health and welfare effects associated with the exemptions.

We acknowledge that our proposal differs from the language contained in the current ICAO ETM guidance, which would nominally allow up to 75 engines per type certificate.[74] To understand why we find that a deviation from the ETM is appropriate in this instance, the following explanation regarding the historical perspective on the development of the ETM provision is helpful.

Prior to the CAEP/8 meeting in February 2010, ICAO had no specific provisions regarding exemptions. The only language regarding exemptions was contained in Annex 16 Volume II section 2.1.1 which rather generically stated that:

> In considering exemptions, certificating authorities should take into account the probable number of such engines that will be produced and their impact on the environment. When such an exemption is granted, the certificating authority should consider imposing a time limit on the production of such engines for installation on new aircraft or on existing aircraft as spares.

When ICAO/CAEP began considering a production cut-off for the CAEP/6 NO_X standard, there was a consensus among the participants in the technical working group that more specific provisions were needed with respect to potential exemptions from that requirement.[75] The provisions would help support an orderly transition in the implementation of the production cut-off. Toward that end, the group consulted periodically over several months to craft provisions addressing number, time limit, and emission levels (impact on the environment). The deliberations were complicated by the fact that the language in Annex 16 simultaneously addressed both engines for new production aircraft and spare engines for existing aircraft.[76]

For new production engines, agreement was reached relatively quickly that exemptions should be available for up to four years after the production cut-off becomes effective, and that any engine model for which an exemption was requested should at a minimum comply with the emission standards for all other regulated pollutants, including the CAEP/4 NO_X requirements. Similarly, it was readily agreed in the technical working group that there would be no limit on the number of spare engines because these units would essentially be installed in

[72] Engines certified only for compliance with earlier NO_X standards would not be eligible for exemptions. This is also consistent with the exemption language in the ICAO ETM. Note that where such engines have emissions actually meeting the Tier 4 NO_X standard, they may be recertified to the Tier 4 standards, but only before the effective date of the proposed regulations.

[73] For example, the hydrocarbon exhaust emission standards were adopted on December 30, 1982. See 47 FR 58462.

[74] CAEP/8—WP/18, *Environmental Technical Manual (ETM), Vol II on the Use of Procedures in the Emission Certification of Aircraft Engines,* Appendix ''ICAO Emissions Environmental Technical Manual''.

[75] ICAO, ''Committee on Aviation Environmental Protection (CAEP), Report of the 6th Meeting,'' CAEP/8–WG3–WP7–03, Presented by the Rapporteurs, London, UK, April 1–3, 2009. A copy of this document is in docket number EPA–HQ–OAR–2010–0687.

[76] ICAO, ''Committee on Aviation Environmental Protection (CAEP), Draft Minutes of ETM/Annex 16 Ad-Hoc Group Telecon,'' May 26, 2009. A copy of this document is in docket number EPA–HQ–OAR–2010–0687.

place of in-use engines that are removed for maintenance or other reasons.[77]

However, discussions and deliberations were more difficult with regard to the number of potential exemptions for engines for new production aircraft. This difficulty stemmed from the fact that the ICAO Emissions Data Bank identified 20 unique engine models/sub models that could have been affected by the production cutoff. Those models had valid type certificates and, therefore, were considered to be ''in production.'' [78] During further discussions the engine manufacturers clarified that most of these 20 were not in active production because the airlines normally purchase new aircraft with engines meeting the latest emission standards. Nonetheless, it was stated that if the demand existed, 14 of these 20 models could potentially be produced under the exemption provisions since they had valid type certificates and met the previously mentioned exemption emission requirements.[79] [80] [81] [82] After much deliberation, the technical working group settled on a value of 75 engines per type certificate over the four years for the ICAO ETM guidance based on the information available at the time.[83]

This value and the maximum number of engines it could represent were of immediate concern to EPA. First, in a hypothetical worst case, it represented the potential for over 1000 exempt engines (500 aircraft) to enter the fleet over this time period based on the information above. Assuming two engines per aircraft, this is essentially equivalent to the number of civil aircraft shipped in a single year.[84] Second, it was unclear to us if that number of potential exemptions, *i.e.,* 75 per type certificate, was necessary. Third, from a broader perspective, while EPA regulations normally include hardship type provisions, it is not normal for EPA to include specific transitional exemptions of this magnitude in our regulations.

As we continued efforts to identify how many exemptions might potentially be needed for the CAEP/6 production cutoff, three new pieces of information became available during the development of this proposed rule that were not considered during the deliberations leading up to the ICAO decision for the ETM guidance. First, a review of previously unavailable information on past exemption requests to FAA under the previous less specific ICAO language indicated that of the eight requests were granted since 1983, only three involved exemptions during standards transition (two related to smoke for turboprop engines and one related to NO_X for a turbofan engine). These three exemption petitions in combination ultimately affected less than 50 engines.[85] Second, engine manufacturers indicated individually that the potential need for exemptions was not as large as EPA understood during the technical working group deliberations, and that absent unforeseen events, a much smaller value was workable on a per manufacturer basis as opposed to a per type certificate basis.[86] [87] [88] Third, our most recent discussions with the engine manufacturers that are directly affected by the proposed Tier 6 NO_X standards, *i.e.,* CAEP/6 standards, concluded that only one or two engine models may be candidates for exemptions. Those discussions also concluded that the likely potential number of justifiable exemptions would be less than 75 in total.[89] Considering all of these factors and the basic intent of the CAEP ETM exemption provisions, we are proposing to adopt in our new regulatory text addressing exemptions, language that reflects the essence of the general exemption language for exhaust emission standards that is embodied in current section 87.7(c) of the regulations. That provision generally states that the FAA, with EPA's concurrence, may grant exemptions to exhaust emission standards based on factors such as adverse economic impact on the engine manufacturer, aircraft manufacturer, or airline industry; in addition to the effects on public health and welfare. We are also proposing include in this new regulatory provision the key elements of the current 87.7(c) and additional facets of the ETM language not captured in existing 87.7(c). Like the ETM, we are proposing to apply this provision only to the Tier 6 production cutoff for four years, but importantly we are not proposing a specific basis for the exemption, *i.e.,* type certification or type certificate holder, or numerical limit. We believe the proposed approach addresses the intent of the ICAO guidance in addition to the potential needs of the engine manufacturers, while minimizing the potential for adverse environmental impacts from exemptions and aligning with EPA's general approach with regard to exemptions and hardship provisions.

We acknowledge that our proposal in this respect differs from the ETM guidance and that this, on its face, may be of concern to some. To the extent this may occur, we point out that the ETM is guidance material; not an ICAO standard or regulation of any type. So as a general matter, consistency is not compelled when a deviation is justified, and we are comfortable with our proposed exemption provision for those reasons.

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[77] ICAO, ''Committee on Aviation Environmental Protection (CAEP), Report of the Eighth Meeting, Montreal, February 1–12, 2010,'' CAEP/8–WP/80. A copy of this document is in docket number EPA–HQ–OAR–2010–0687.

[78] U.S. EPA, ''Simplified Working Copy of ICAO EDB, Issue 16A,'' memorandum from Glenn Passavant, Assessment and Standards Division, Office of Air Quality and Transportation, March 25, 2010. A copy of this document is in docket number EPA–HQ–OAR–2010–0687.

[79] ICAO, ''Committee on Aviation Environmental Protection (CAEP), Response to EPA Paper 14 and 16,'' WG–3 Flimsy 6–2, ICCAIA, London, UK, April 13, 2009. A copy of this document is in docket number EPA–HQ–OAR–2010–0687.

[80] ICAO, ''Committee on Aviation Environmental Protection (CAEP), Production Cut-Off for Engine NO_X Standards,'' CAEP–SG/20082–WP/6, Presented by FESG, September 4, 2008. A copy of this document is in docket number EPA–HQ–OAR–2010–0687.

[81] ICAO, ''Committee on Aviation Environmental Protection (CAEP), CAEP/6 NO_X Productin Cut-Off Analysis,'' CAEP–SB/20093–IP/19, Presented by FESG NO_X Stringency Task Group, June 2, 2009. A copy of this document is in docket number EPA–HQ–OAR–2010–0687.

[82] ICAO, ''Committee on Aviation Environmental Protection (CAEP), Production Cut-Off and Associated Flexibilities for ICAO Engine Emission Standards,'' CAEP–SG/20093–WP/39, U.S. EPA, June 8, 2009. A copy of this document is in docket number EPA–HQ–OAR–2010–0687.

[83] ICAO, ''Committee on Aviation Environmental Protection (CAEP), Report of the Eighth Meeting, Montreal, February 1–12, 2010,'' CAEP/8–WP–80, Appendix B. A copy of this document is in docket number EPA–HQ–OAR–2010–0687.

[84] See Table 5 of the most recent AIA statistical report available at *http://www.aia-aerospace.org/assets/Table* 5.pdf.

[85] U.S. EPA, ''Historical Exemptions from Gas Turbine Aircraft Emission Standards,'' memorandum from Glenn Passavant, Assessment and Standards Division, Office of Air Quality and Transportation, March 28, 2011. A copy of this document is in docket number EPA–HQ–OAR–2010–0687.

[86] ICAO, ''Committee on Aviation Environmental Protection (CAEP), Response to EPA Paper 14 and 16,'' WG–3 Flimsy 6–2, ICCAIA, London, UK, April 13, 2009. A copy of this document is in docket number EPA–HQ–OAR–2010–0687.

[87] ICAO, ''Committee on Aviation Environmental Protection (CAEP), Production Cut-Off for Engine NO_X Standards,'' CAEP–SG/20082–WP/6, Presented by FESG, September 4, 2008. A copy of this document is in docket number EPA–HQ–OAR–2010–0687.

[88] ICAO, ''Committee on Aviation Environmental Protection (CAEP), CAEP/6 NO_X Production Cut-Off Analysis,'' CAEP–SB/20093–IP/19, Presented by FESG NO_X Stringency Task Group, June 2, 2009. A copy of this document is in docket number EPA–HQ–OAR–2010–0687.

[89] U.S. EPA, ''Results of Discussions with Aviation Gas Turbine Manufactures on the Potential Number of Exemptions from the Tier 6 Production Cutoff for the Proposed Rulemaking on Aircraft Engine Emission Standards,'' memorandum from Richard S. Wilcox, Assessment and Standards Division, Office of Air Quality and Transportation, May 19, 2011. A copy of this document is in docket number EPA–HQ–OAR–2010–0687.

Even if the ETM guidance were wrongly considered an ICAO standard of some kind, a justified deviation from such a provision is allowable under the Chicago Convention (the basis of ICAO) and the World Trade Organization's (WTO) Technical Barriers to Trade Agreement, Annex 3.[90, 91] The Chicago Convention allows nations to adopt their own unique standards that differ from the language in ICAO Annex 16, Standards and Recommended Practices, as previously described in section I.C. The WTO Annex 3 also allows for exceptions '' * * * where such international standards or relevant parts would be ineffective or inappropriate, for instance, because of an insufficient level of protection * * *.'' We believe our proposed deviation from the ETM, assuming for argument's sake that it is a deviation from international standards as contemplated by ICAO and the WTO Annex 3, is justified for the reasons explained above.

We also note that the proposed exemption provision has no cost associated with it for the government or industry, and there is no difference in potential cost savings under either approach. Both are designed to provide manufacturers with an opportunity to reduce costs or other adverse effects should the need for exemptions arise.

Finally, we believe the current ETM guidance provision should be revised to align with our proposed approach, and we will work through the ICAO/CAEP process to amend the ETM guidance as appropriate.

iii. Exemption Requests

We are proposing a process for requesting exemptions (for engines used on new aircraft) that would be more formal and structured than the current process. We are proposing that manufacturers be required to submit their request to the FAA, as currently required. The FAA will then share the submittal with EPA and execute the consultation process.

To ensure that we have the information necessary to evaluate exemption requests in this specific manner, the requests would need to include the following details to describe the specific engine model for which the manufacturer is requesting the exemption. The proposed provisions contained in § 87.50, which are summarized below, are consistent with and in some areas expand on the provisions in the ETM:

General Information

- Corporate name and an authorized representative's contact information (including a signed statement verifying the information);
- Description of the engines for which you are requesting the exemption, including the engine model and sub-model names;
- The number of engines that you would produce under the exemption and the period during which you would produce them;
- Identify the authorizing type certificate (type certificate number and date);
- Information about the aircraft in which the engines will be installed, including the airframe models and expected first purchasers/users of the aircraft, and the countries in which you expect the aircraft to be registered (including an estimate of how many will be registered in the U.S.); and
- List of other certificating authorities from which you have requested (or expect to request) exemptions, and a summary of each request.

Justification and Impacts Assessment

- A detailed description and assessment of the environmental impact of granting the exemption;
- Technical issues, from an environmental and airworthiness perspective, which may have caused a delay in compliance with a production cutoff, if any;
- Any economic impacts on the manufacturer, operator(s), and aviation industry at large; and
- Projected future production volumes and plans for producing a compliant version of the engine model in question.

Other Factors

- Hardship: Impact of unforeseen technical circumstances, business events, or other natural or manmade calamities beyond your control, and
- Equity issues in administering the production cutoff among economically competing parties.

It is important that any action on a potential exemption request be in the public interest; the fairly comprehensive list of application information in the proposed regulations is intended to gather the information needed for this assessment. We would expect to take a broad perspective in evaluating what is or is not in the public interest. This is why the manufacturer justifications would need to include a quantified description of the environmental effects of granting the exemption, as well as discussion of economic and technical issues related to bringing the engine into compliance. The analysis of environmental impacts would need to specify by how much the exempted engines would exceed the standards, the in-use effects in terms of lifetime tons of NO_X, and estimate the emissions rates of engines/aircraft that could potentially be used if the exemption was not granted. Since exemptions granted under the proposed regulations would apply only for NO_X emissions, the analysis could also include possible benefits regarding noise levels or reduced emissions of pollutants other than NO_X. Relevant economic impacts could include effects on the engine manufacturer, airframe manufacturer, airline(s), and the general public.

In the past, some manufacturers have requested exemptions based on the largest number of engines they hoped to continue producing without knowing how many they would actually be able to produce or who would purchase them. The new exemption language calls for manufacturers to target their requests more specifically based on likely production needs and time periods. At any time before approval, manufacturers could revise their requests to justify covering additional engines. We would then review the revised request. For exemptions that have already been approved, manufacturers could also request that additional engines be added after providing the justification for the increase. Manufacturers also would be required to notify the FAA if they determine after submitting a request that the information is not accurate, either from an error or from changing circumstances.

While we expect a manufacturer to have this specific information when they submit a request, the regulations would allow us to process exemption requests with somewhat less specific information. However, we would expect this to apply only for unusual circumstances.

If, after consulting with FAA, we determine that the exemption request is fully documented and approval would be in the public interest, we would concur with approving the request if the FAA also concluded that the request should be granted. Note that we could approve the exemption for a smaller number of engines than the manufacturer requested, or we could include certain other conditions.

In order to allow us to oversee these exempted engines, manufacturers would

[90] ICAO, ''Convention on International Civil Aviation,'' Article 38, Ninth Edition, Document 7300/9, 2006. Copies of this document can be obtained from the ICAO Web site located at *http://www.icao.int/icaonet/arch/doc/7300/7300_9ed.pdf.*

[91] WTO, ''Agreement on Technical Barriers to Trade,'' Uruguay Round of Multilateral Trade Negotiations, April 15, 1994, pp. 117–137. Copies of this document can be obtained from the WTO Web site located at *http://www.wto.org/english/docs_e/legal_e/17-tbt_e.htm.*

also be required to provide an annual report to EPA on exempt engines similar to the information about spare exempt engines. The permanent record for each engine exempted under this provision would need to indicate that the engine is an exempted engine and the engine itself would need to be labeled as ''EXEMPT NEW'' in accordance with FAA marking requirements of 14 CFR.

iv. Coordination of Exemption Requests

The limit on the number of potentially exempt engines as described in the ETM is intended to apply to overall worldwide production. Toward that end, the ETM envisions collaboration and consultation among certificating authorities and member states whenever any authority receives an exemption request. Specifically, the ETM states:

> Exemptions for new engines should be processed and approved by the competent authorities for both the manufacture of the exempted engines and the initial operator of the aircraft to which they are to be fitted. Given the international nature of the aviation enterprise, civil aviation authorities of member states should attempt to collaborate and consult on the details of exemptions. In the case where engine type certification is done through a reciprocity agreement between or among member states, the states involved should coordinate on the processing of exemptions and concur before approval is granted.[92]

Working with the FAA, we would expect to conduct such collaboration and consultation among the competent authorities whenever we receive an exemption request. This would include consultation with other certificating authorities as well as coordination with the competent civil aviation authority of any country where the aircraft with the exempted engines will be registered.

To facilitate this consultation and coordination we are proposing that manufacturers also include in their requests a list of countries in which the aircraft are expected to be registered. While not specifically listed in the ETM, we believe that this information is consistent with the ETM as it would be necessary to ensure proper coordination. The ETM appears to presume that each member country will recognize exemptions granted by other countries. This presumption seems reasonable assuming that the exemption being granted is generally consistent with the guidelines of the ETM and that the collaboration, consultation and coordination called for in the ETM were conducted in good faith. However, there should be no presumption that EPA would agree to an exemption for an engine model if the aforementioned collaboration, consultation, and coordination were not conducted. The Clean Air Act (which provides EPA with its authority to establish emission standards) includes no provisions that would allow any foreign country or other certificating authority to exempt subject aircraft engines, over the objection of FAA and EPA, from the applicable standards EPA promulgates. Nevertheless, because our proposed exemptions provisions are generally consistent with the procedures called for in the ETM, assuming appropriate consultation and coordination in accordance with the ETM and absent unforeseen complications, it is reasonable to believe that FAA and EPA would not object to exemptions for engines properly exempted by other countries under those procedures. The FAA would still need to take the certification action as called out in 14 CFR 91.203 and 14 CFR 21.183.

This, however, raises the question as to how we would respond to an exemption request when another certificating authority did not consult or coordinate on a previous request for the same engine model. A related concern arises if a type certificate is sought under a reciprocity agreement and the original exemption was not coordinated with the United States. Such requests would likely be viewed as new exemption requests if the anticipated collaboration, consultation, and coordination had not occurred.

Thus to avoid these issues, in most cases, manufacturers may want to work with all relevant certificating authorities at the same time as well as the civil aviation authority of nation(s) where the aircraft will be initially registered or operated if that nation requires a type certificate issued under its own regulations to operate in its air space consistent with international agreements.

c. Voluntary Emission Offsets

We are requesting comment on establishing a voluntary EPA program by which manufacturers could receive emission credits for producing cleaner engines, which they could use to offset higher emissions from exempted engines. An example of such a program is summarized in a memorandum to the docket,[93] and a basic overview of how credits might be generated is presented in the following paragraph. The types of programs being considered would be developed, promulgated, and administered solely by EPA.

We would expect manufacturers to be interested in generating offsets for one of three purposes. First, manufacturers might choose to generate offsets as part of their justifications for exemptions. For example, where we determine that an exemption would not be in the public interest because it would have an undue adverse effect on air quality, a manufacturer might use offsets so that the combination of the exemption and offsets would be more emission neutral. Second, manufacturers might choose to generate offsets as part of a justification for being allowed to exceed the numerical limit that FAA and EPA are willing to approve in an exemption request. We are asking for comment on this option, and could include it in the final rule based on the comments and our assessment of the inputs and issues. Third, provided a standard is promulgated to allow this, a manufacturer might also be interested in generating offsets to bank for use for exemptions of engines to be produced after the credit generating engines are produced, or possibly against a future production cutoff. This would also require a change to the proposed regulations, as well as record support for such banking being appropriate under the relevant standard.

Under this approach, generation of offsets would be voluntary and would be open to all certifying engine manufacturers. One concept would be to allow credits to be generated only from engine models that are introduced after this rule and that had characteristic levels significantly below the otherwise applicable standard (*e.g.,* at least 10 percent below). It is a separate question, however, how to calculate the credit. If we adopted a 10 percent threshold for eligibility, we would probably also allow credits only to the degree which the NO_X characteristic level was more than 10 percent below the standard. For example, an engine that was 15 percent below the standard would generate credits equivalent to 5 percent of the standard. This would ensure a net improvement in emissions. If we were to finalize such a program, we could reserve the right to restrict the use of credits so that they were used in a manner that ensured there was no net adverse impact on air quality. Such a program would need to ensure that

[92] ICAO, ''Committee on Aviation Environmental Protection (CAEP), Eighth Meeting, Montreal, 1 to 12 February 2010,'' CAEP/8–WP/80, Agenda Item 2: Review of Technical Proposals Relating to Aircraft Emissions, April 2, 2010. A copy of this document is in docket number EPA–HQ–OAR–2010–0687.

[93] U.S. EPA, ''Draft Regulatory Text for Voluntary Offset Program,'' Memorandum from Charles Moulis, Assessment and Standards Division, Office of Air Quality and Transportation, June 2011. A copy of this document is in docket number EPA–HQ–OAR–2010–0687.

emission benefits from one aircraft model truly offset the higher emissions from another model. For example, emissions from regional aircraft may not be directly equivalent to emissions from aircraft designed for longer cross-country or international flights. Equivalency factors could be developed to account for differences in the number of LTOs per year, the lifetime of the aircraft, and the number of LTOs per mile. These factors could be developed based on the operation characteristics from existing sources of information and would not require the collection new operational data. Commenters are encouraged to review additional information contained in the memorandum to the public docket and provide input on the ideas, concepts, and options presented therein in addition to those discussed above.

3. Potential Phase-In of New Tier 8 NO_X Standards for Newly-Manufactured Engines

We are not proposing to phase-in the proposed Tier 8 NO_X standards for newly-manufactured engines at this time, since such a feature is not included in the CAEP/8 recommendation to ICAO. This means that engine manufacturers may continue to produce Tier 6 compliant engines within already certified models after the proposed Tier 8 standards become effective for newly-certified engine models. As noted elsewhere, EPA is working within the ICAO/CAEP framework to develop harmonized international standards for aircraft turbine engines. At the February 2010 meeting of CAEP, where the CAEP/8 NO_X standards were approved for recommendation to ICAO, the committee decided to continue considering a related newly-manufactured engine standard as a future work item at CAEP, pending new information on technology and market responses.

We will continue our efforts to evaluate a newly-manufactured engine standard as a complement to the Tier 8 NO_X standards as part of the future CAEP work programs. We believe that such a requirement is a necessary component of any effective NO_X control strategy for aircraft turbine engines. It provides an orderly, stable transition between emission requirements that is helpful for product planning by engine and airframe manufacturers, and in making purchasing decisions by their customers. It also ensures compliance with any new emission standard in a reasonable period of time, thereby providing the public with all the environmental benefits that a new emission standard can provide. However, in order to maximize consistency with the CAEP/8 NO_X standard as currently recommended to ICAO, our proposed Tier 8 standard does not contain a production cutoff.

Assuming a CAEP/8 production cutoff is adopted at some time in the future, we will re-examine the permanent exemption provisions to ensure a timely and orderly phase-out of engine models that do not meet the CAEP/8 NO_X standards. We would expect this to be done as part of future CAEP deliberations and through a notice and comment rulemaking process to amend our own regulations.

C. Application of Standards for Derivative Engines

It is very common for a manufacturer to make changes to an originally type certificated engine model that is in production while keeping the same basic engine core and combustor design. In some cases these modifications may affect emissions. As a result, the certificating authority must decide whether the emission characteristics of the modified design were significant enough from the parent engine's certification basis that a demonstration of compliance with newer emission standards is necessary, or if the changes were minor relative to the parent engine's emission certification basis so that it is considered a derivative version of the original model with no emissions changes. This may be further complicated because of the common practice of making iterative changes over time, that leaves open the question as to when the cumulative changes reach a point where a new demonstration of compliance is warranted.

In the past, these determinations were made for turbofan engines by an engineering evaluation that was performed by the engine manufacturer and then approved by the FAA. As part of the ICAO/CAEP deliberations leading up to the February 2010 CAEP/8 meeting, a new standardized guidance was agreed upon as described in the ETM. The guidance, which the U.S. fully supported, includes specific criteria that can be used to determine when a design modification requires a new demonstration of compliance with newer emission standards, or when a modification was simple enough to be considered a no emissions change.

We are proposing to include the ETM language in our regulations. This addresses a longstanding need to provide consistent standards for the decision process regarding derivative engines and applicable emission standards. The definition of ''derivative engines for emissions certification purposes,'' along with the criteria for making this determination, will provide engine manufacturers and the regulators with more certainty regarding emission standard requirements for future modifications made to certificated models. Finally, it will make the decision criteria enforceable. To ensure that the numerical decision criteria can be administered to allow for the consideration of unusual circumstances or special information, we are also proposing that the FAA have some flexibility to make adjustments to the specific criteria based on good engineering judgment. In summary, if the FAA determines that an engine model is sufficiently similar to its parent engine so as to meet the criteria established in the proposed part 87.48, the manufacturer may demonstrate certification compliance and continue production of the engine model to the same extent as allowed for the original engine model. However, if the FAA determines that an engine model is not a derivative for emission certification purposes, the manufacturer would be required to demonstrate compliance with the most recent emissions standards. This determination will be made using numerical criteria consistent with ICAO provisions, and will apply to modified engine models if it is: (1) Derived from an original engine that had received a U.S. certification, (2) the original engine was certified under title 14 of the CFR, and (3) one of the following conditions is met:

(1) The FAA determined that a safety issue exists that requires an engine modification; or

(2) Emissions from the derivative engines are equivalent to or lower than the original engine.

The proposed regulations specify that to show emissions equivalency, the engine manufacturer must demonstrate that the difference between emission rates of a derivative engine and the original engine are within the following allowable ranges, unless otherwise adjusted using good engineering judgment as determined by the FAA:

$\pm$ 3.0 g/kN for NO_X.
$\pm$ 1.0 g/kN for HC.
$\pm$ 5.0 g/kN for CO.
$\pm$ 2.0 SN for smoke.

Engine models represented by characteristic levels at least five percent below all applicable standards would be allowed to demonstrate equivalency by engineering analysis. In all other cases, the manufacturer would be required to test the new engine model to show that its emissions met the equivalency criteria.

D. Annual Reporting Requirements

In May of 1980, ICAO's Committee on Aircraft Engine Emissions (CAEE) recognized that certain information relating to environmental aspects of aviation should be organized into one document. This document became ICAO's ''Annex 16 to the Convention on International Civil Aviation, International Standards and Recommended Practices, Environmental Protection'' and was split into two volumes—*Volume I* addressing Aircraft Noise topics and *Volume II* addressing Aircraft Engine Emissions. Annex 16 has continued to grow and today Annex 16 *Volume II* includes a list of mandatory requirements to be satisfied in order for an aircraft engine to meet the ICAO emission standards.[94] These requirements include information relating to engine identification and characteristics, fuel usage, data from engine testing, data analysis, and the results derived from the test data. Additionally, this list of aircraft engine requirements is supplemented with voluntarily reported information which has been assembled into an electronic spreadsheet entitled ''Emissions Databank'' (EDB)[95] for turbofan engines with maximum thrust ratings greater than 26.7 kN in order to aid with emission calculations and analysis as well as help inform the general public.

In order to understand how current gaseous emission standards are affecting the current fleet, we need to have access to timely, representative emissions data of the engine fleet at the requisite model level. The EDB is a useful tool for providing a general overview of the aircraft fleet, as it contains information on engine exhaust emissions and performance tests. However, it is not updated on a consistent basis, it contains a varying amount of voluntarily reported data from each manufacturer, and it does not specifically list every engine sub-model.[96] It also does not contain information on smaller thrust category turbofans or turboprops, and contains no information on past or recent engine production volumes. We need this data to conduct accurate emission inventories and develop appropriate policy. Accordingly, we do not consider the EBD to be a sufficient tool upon which to base policy decisions or adopt future standards. Furthermore, in the context of EPA's standards-setting role under the Clean Air Act with regard to aircraft engine emissions, it is consistent with our policy and practice to ask for timely and reasonable reporting of emission certification testing and other information that is relevant to our mission.[97] Under the Clean Air Act, we are authorized to require manufacturers to establish and maintain necessary records, make reports, and provide such other information as we may reasonably require discharge our functions under the Act. (See 42 U.S.C. 7414(a)(1).)

Therefore, we are proposing to require that any engine manufacturer submit a production report directly to EPA[98] with specific information for each individual engine sub-model that: (1) Is designed to propel subsonic aircraft, (2) is subject to our exhaust emission standards, and (3) has received a U.S. type certificate. More specifically, the scope of the proposed production report would include turbofan engines as described above with maximum rated thrusts greater than 26.7 kN, *i.e.,* those subject to gaseous emission and smoke standards. In addition, it would include turbofans with maximum rated thrusts less than or equal to 26.7 kN and all turboprop engines, *i.e.,* those only subject to smoke standards. We are also proposing that this specific exhaust emission related information be reported to us in a timely manner, which will allow us to conduct proper emissions inventory analyses of the existing fleet and to ensure that any public policy we create based on this information will be well informed.

We are proposing to have each affected engine manufacturer report a reduced number of specific data elements to us as compared to those already reported voluntarily and periodically by most engine manufacturers to the EDB. We feel that this minimizes the reporting burden for each manufacturer while still providing us with sufficient information to perform our job. All of the specific reporting items we are proposing are the same as requested for the EDB, with the exception of total annual engine production volumes, information on type certificates, and the emission standards to which the engine sub-model was certified.

This information will be used in conjunction with the NO_X and CO_2 emission data already required to be submitted to us under part 87.64 for purposes of greenhouse gas (GHG) reporting to establish our own independent engine exhaust emissions database. We would expect most manufacturers generally to add the proposed information items to the annual GHG report. We want to clarify, however, that comments are invited only on the proposed incremental data reporting elements that comprise the production report. No changes are being proposed to the contents of the GHG report.

The proposed incremental reporting elements for each affected gas turbine engine sub-model are listed below. The reporting elements of the existing GHG report are also identified for completeness.

- Company corporate name as listed on the engine type certificate (GHG);
- Calendar year for which reporting (GHG);
- Complete sub-model name (This will generally include the model name and the sub-model identifier, but may also include an engine type certificate family identifier) (GHG);
- The type certificate number, as issued by the FAA (Specify if the sub-model also has a type certificate issued by a certificating authority other than the FAA) (GHG);
- Date of issue of type certificate and/or exemption, *i.e.* month and year (GHG);
- Emission standards to which the engine is certified, *i.e.,* the specific Annex 16, Volume II, edition number and publication date in which the numerical standards first appeared.
- If this is a derivative engine for emissions certification purposes, identify the original certificated engine model.
- Engine sub-model that received the original type certificate for the engine type certificate family;
- Production volume of the sub-model for the previous calendar year, or if zero, state that the engine model is not in production and list the date of manufacture (month and year) of the last engine produced;
- Regarding the above production volume report, specify (if known) the number of engines that are intended for use on new aircraft and the number

[94] ICAO, ''Annex 16 to the Convention on International Civil Aviation, Environmental Protection, Volume II, Aircraft Engine Emissions,'' Part III, Chapter 2, Section 2.4. A copy of this document is in docket number EPA–HQ–OAR–2010–0687.

[95] United Kingdom, Civil Aviation Authority, ''ICAO Emissions Databank.'' Available at the Civil Aviation Authority Web site *http://www.caa.co.uk/default.aspx?catid=702.*

[96] Under the proposed regulations, a grouping of engines with an essentially identical emission-related design would be defined to be an ''engine sub-model''. Engines with slightly different designs would be defined to be an ''engine model''.

[97] The FAA already requires much of the information EPA is seeking through the certification process, but is unable to share it because of confidentiality agreements with engine manufacturers. Also, that information is part of a much larger submission, making it difficult to extract the specific reporting elements for EPA.

[98] The proposed report would be submitted only to EPA. No separate submission or communication of any kind is required for the FAA.

intended for use as certified (non-exempt) spare engines on in-use aircraft;

- Reference pressure ratio (GHG);
- Combustor description (type of combustor where more than one type available on an engine);
- Engine maximum rated thrust output, in kilonewtons (kN)) or kilowatts (kW) (depending on engine type) (GHG);
- Unburned hydrocarbon (HC) mass (g) total (weighted) and over each segment of the Landing and Take-off Cycle (LTO), *i.e.* Take-off, Climb, Approach, Taxi/Ground Idle; [99]
- Unburned hydrocarbon (HC) characteristic level (*i.e.* mass of hydrocarbons over LTO cycle/Rated Thrust (Dp/Foo)); [100]
- Carbon monoxide (CO) mass (g) total (weighted) and over each segment of the entire Landing and Take-off Cycle (LTO) (*i.e.* Take-off, Climb, Approach, Taxi/Ground Idle);
- Carbon monoxide (CO) characteristic level (*i.e.* mass of CO over LTO cycle/Rated Thrust (Dp/Foo));
- Nitrogen oxides (NO_X) mass (g) total (weighted) and over each segment of the entire Landing and Take-off Cycle (LTO) (*i.e.* Take-off, Climb, Approach, Taxi/Ground Idle) (GHG);
- Nitrogen oxides (NO_X) characteristic level (*i.e.* mass of NO_X over LTO cycle/Rated Thrust (Dp/Foo)) (GHG);
- Smoke number total and over each segment of the entire Landing and Take-off Cycle (LTO) (*i.e.* Take-off, Climb, Approach, Taxi/Ground Idle);
- Smoke number characteristic level;
- Carbon dioxide (CO_2) mass (g) total (weighted) and over each segment of the entire Landing and Take-off Cycle (LTO), (*i.e.* Take-off, Climb, Approach, Taxi/Ground Idle (GHG));
- Number of tests run per sub-model (GHG);
- Number of engines tested per sub-model (GHG);
- Fuel flow (grams/second) total (weighted) and over each segment of the Landing and Take-off Cycle (LTO) (*i.e.* Take-off, Climb, Approach, Taxi/Ground Idle) (GHG); and
- Any additional remarks to the EPA.

The proposed annual report would be submitted for each calendar year in which a manufacturer produces any turbofan engine subject to emission standards as previously described. These reports would be due by February 28 of each year, starting with the 2014 calendar year, and cover the previous calendar year. This report would be sent to the Designated EPA Program Officer. Where information provided for any previous year remains valid and complete, the engine manufacturer may report the production figures and state that there are no changes instead of resubmitting the original information. To facilitate and standardize reporting, we expect to specify a particular format for this reporting in the form of a spreadsheet or database template that we provide to each manufacturer. As noted previously, we intend to use the proposed reports to help inform any further public policy approaches regarding aircraft engine emissions that we consider, including possible future emissions standards, as well as help provide transparency to the general public. Subject to the applicable requirements of 42 U.S.C. 7414(c), 18 U.S.C. 1905, and 40 CFR part 2, all data received by the Administrator that is not confidential business information may be posted on our Web site and would be updated annually. By collecting and publically posting this information on EPA's Web site, we will be able to calculate turbine exhaust emission rates and demonstrate to the public how the fleet meets the current emission requirements. We believe that this information will also be useful to the general public to help inform public knowledge regarding aircraft exhaust emissions. We ask for comment on our proposed plan to post this information on our Web site and whether any of it should be omitted as confidential business information. Such confidential information would be retained by EPA. For guidance on how to preserve a claim of confidentiality and on how EPA would treat submitted information covered by such a claim, please see our earlier discussion in section VII. of this notice regarding how a public commenter on the proposed rule should submit information that the submitter considers to be confidential business information. We have assessed the potential reporting burden associated with the proposed annual reporting requirement. That assessment is presented in sections V. and IX.B. of this notice.

E. Proposed Standards for Supersonic Aircraft Turbine Engines

We are proposing CO and NO_X emission standards for turbine engines that are used to propel aircraft at sustained supersonic speeds, *i.e.,* supersonic aircraft to complement our existing HC standard for these engines. These proposed standards were originally adopted by ICAO in the 1980s, and our adoption of NO_X and CO standards for commercial engines in 1997 omitted coverage of these pollutants for supersonic commercial engines that were then in use. The lack of EPA CO and NO_X standards for engines used by supersonic aircraft has had no practical effect, because no such engines have been certified by the FAA. Also, none of the engines used on these aircraft are currently in production. (See section III.G. for a brief discussion of potential revised emission standards for future engine designs that may be used on supersonic aircraft.) However, to meet U.S. treaty obligations under the Convention on International Civil Aviation as previously described in section I.C., we believe it is necessary and appropriate to propose these conforming standards. Therefore, the proposed standard simply aligns EPA standards with the rest of the world.

F. Amendments to Test and Measurement Procedures

We are proposing to incorporate by reference into the 40 CFR 87.60 regulatory text, amendments to ICAO's International Standards and Recommended Practices for aircraft engine emissions testing and certification. These amendments to Annex 16, Volume II are mainly intended to ensure that the provisions reflect current certification practices. The amendments make clarifications or add flexibilities for engine manufacturers. They are described separately below for the amendments that have already been adopted by ICAO [101] [102] and those that have been recommended by CAEP for adoption by ICAO.[103]

The amendments that have already been adopted by ICAO are:

- Standardizing of the terminology relating to engine thrust/power;

[99] See Regulation Part 87-*Control of Air Pollution from Aircraft and Aircraft Engines,* Subpart E, § 87.42 *Certification report to EPA* for definitions.

[100] Dp/Foo: total gross emissions of each gaseous pollutant (mass)/rated thrust (g/kN).

[101] A strikeout and highlighted version of the amendments is contained in Attachment A to ICAO state letter AN 1/61.2, AN 1/62.2–07/32 entitled, ''Proposed Amendment to International Standards and Recommended Practices, Environmental Protection, Annex 16 to the Convention on International Civil Aviation, Volume II Aircraft Engine Emissions, May 27, 2007. A copy of this document is in docket number EPA–HQ–OAR–2010–0687.

[102] ICAO, ''International Standards and Recommended Practices, Annex 16 to the Convention on International Civil Aviation, Environmental Protection, Volume II Aircraft Engine Emissions,'' Third Edition, July 2008, International Civil Aviation Organization. This document contains the full text of ICAO standards and practices and is in docket number EPA–HQ–OAR–2010–0687.

[103] ICAO, ''Committee on Aviation Environmental Protection (CAEP), Report of the Eighth Meeting, Montreal, February 1–12, 2010,'' CAEP/8–WP/80. A copy of this document is in docket number EPA–HQ–OAR–2010–0687.

• Clarifying the need to correct measured results to standard reference day and reference engine conditions;
• Allowing a certificating authority to approve the use of test fuels other than those specified during certification testing;
• Allowing materials other than stainless steel in the sample collection equipment; and
• Clarifying the appropriate value of fuel flow to be used at each LTO test point.

The amendments that have been recommended for adoption by ICAO are:
• Clarifying exhaust nozzle terminology for exhaust emissions sampling; and
• Allowing an equivalent procedure for gaseous emission and smoke measurement if approved by the certificating authority.

The test procedure amendments that ICAO has already adopted became applicable on November 20, 2008. The amendments that have been recommended to ICAO are expected to be adopted prior to the date of the final action on today's proposed rule. Manufacturers are either already voluntarily complying with these changes or will be even in the absence of a final rule. Our adoption of these test procedure amendments is, therefore, unlikely to require new action by manufacturers beyond what they are already undertaking to meet ICAO's adopted and recommended amendments.

G. Possible Future Revisions to Emission Standards for New Technology Turbine Engines and Supersonic Aircraft Turbine Engines

As a general matter, emission standards not only apply to all conventional turbofan aircraft engines greater than 26.7 kNs, but also to all aircraft engines designed for applications that otherwise would have been fulfilled by turbofan aircraft engines. The high price of jet fuel, current emphasis on fuel economy, and need to reduce emissions have renewed interest in open rotor propulsion designs for future aircraft gas turbine engines. Essentially, the fan of an open rotor engine is not contained within an engine nacelle as it is with a conventional turbofan engine. This design has also been referred to as an unducted fan, propfan, or ultra-high bypass engine. At least two engine manufacturers are actively pursuing such designs for certification in the later part of this decade.

It now appears that certain aspects of EPA's gas turbine engine emission standards may be incompatible with these new designs. For example, the current landing and takeoff cycle for emissions certification is based on conventional engine designs where a significant amount of thrust is generated by an idling engine. Specifically, idle emissions are measured and calculated at seven percent of the engine's rated thrust. However, the fan/prop blades of an open rotor engine may be variable in pitch and this may allow the blades to be ''feathered'' at idle. In that position, the blades are rotated so very little thrust is generated as the engine idles and generates emissions. Also, future aircraft using these engine designs may fly at somewhat slower speeds. This might affect the time these aircraft spend during the climbout mode of the landing and takeoff cycle. Therefore, the traditional landing and takeoff cycle used in turbofan engine emissions certification may need to be revised in the future to accommodate open rotor engines.

We will be working within CAEP to evaluate the differences between conventional turbine engine and open rotor engine technologies, and to revise the emission standards and test procedures as appropriate for these latter engines. If any changes are required, EPA will undertake rulemaking to revise our regulations accordingly.

There may also be changes in the emission standards and test procedures for engines used to power future supersonic transport aircraft designs. The emission standards for these engines were originally developed in the early 1970s in response to the Aerospatiale-BAC Concorde. Since that time, there have been varying levels of interest in developing a new generation of supersonic transport. As a result, the current CAEP work program is evaluating the status of supersonic aircraft engine development and the potential need for new emission standards and test procedures.[104] Our recent discussions with engine manufacturers indicate that no substantive work is being undertaken at this time, however. We will continue to work within CAEP on this issue and undertake rulemaking to revise the regulations for supersonic aircraft engines as appropriate.

We request comments on the status and timing of open rotor and future engine designs for supersonic aircraft, and how the aircraft engine emission standards and test procedures may need to be modified to accommodate these types of engines.

IV. Description of Other Revisions to the Regulatory Text

In addition to the proposed changes discussed above, we are proposing a number of other changes to the regulatory program. Most of these changes are designed to bring the program into conformity with current technology and current technical or policy practice. Each of these is discussed below.

A. Applicability Issues

This section discusses how the proposed rule relates to engines used in military and noncommercial civilian aircraft. We do not believe the proposed changes would have practical significance for current engine models because the changes align with manufacturers' current practice in certifying their engines.

1. Military Engines

We do not intend our proposal to have any impact on engines installed on military aircraft. Military aircraft are not required to have FAA standard airworthiness certificates and our 1997 endangerment finding for NO_X and CO emissions and resulting standards did not cover military aircraft (see 62 FR at 25359). As such, engines used in military aircraft are not required to meet EPA emission standards, since our current regulations define ''aircraft'' subject to our rules as any airplane for which a U.S. standard airworthiness certificate (or foreign equivalent) is issued. (See 40 CFR 87.1(a) of the existing regulations.) Currently, manufacturers certificate some engine models used in military aircraft with the FAA (with respect to emissions), because these engine models also have commercial applications and have to be certificated for such use. Our proposed new standards and requirements would continue to apply only to engines for which standard airworthiness certificates are issued, and it is not our intent to interfere with current practice with regard to engine models with joint commercial/military applications to the extent such engines are used in military aircraft. Although civilian aircraft applications of all such engines would be subject to the new standards and production cutoff, we are proposing to include a statement in the regulations to clarify that the proposed production

[104] The CAEP Working Group 3 has taken the position that engine development programs for future supersonic aircraft applications should be focused on achieving the emission standards that are applicable to subsonic aircraft engines. Past supersonic aircraft engines required the use of afterburner technology to achieve supersonic speeds. Future supersonic aircraft are expected to use engines without that technology, making them more similar to their subsonic counterparts.

cutoff would not apply for previously certificated engines that are installed and used in military aircraft.

2. Noncommercial Engines

The current section 87.21(d) specifies that gaseous emission standards apply to engines used in commercial applications with rated thrusts greater than 26.7 kN. These are engines intended for use by an air carrier or a commercial operator as defined in the Chapter I, Title 49 of the United States Code and Title 14 of the Code of Federal Regulations. Therefore, engines of equivalent thrust ratings that are used in aircraft certificated by the FAA that are used in non-revenue, general aviation service are not required to comply with our current HC, CO, and NO_X exhaust emission standards in § 87.21(d). They are subject, however, to the current standards for smoke and fuel venting.

We are proposing to apply the proposed gaseous emission standards for commercial engines to their noncommercial civilian counterparts that are required to obtain standard airworthiness certificates. There are a couple of reasons for this proposed action. First, the ICAO Annex 16 standards and recommended practices apply equally to commercial and noncommercial engines, and our rules' current failure to reflect this means that our requirements do not fully conform to ICAO's standards. Second, manufacturers already emissions certify engines that are used in non-revenue, general aviation service to these standards. Therefore, this proposal simply incorporates the status quo.

In order to make EPA standards conform to ICAO's, we need to, in addition to promulgating the necessary regulatory amendments, update the underlying finding regarding the need to limit gaseous emissions from commercial and non-commercial civilian aircraft, pursuant to CAA section 231(a)(2)(A). In 1997, our analysis and finding, and hence our regulations, were limited to commercial aircraft emissions. (See 62 FR at 25358.) Today, we are proposing to expand that analysis and finding to include gaseous emissions from both commercial and non-commercial civilian aircraft engines with rated thrusts greater than 26.7 kN.

These noncommercial and commercial engines have a great deal in common. First, they each use the same thermodynamic engine cycle (*i.e.,* a gas (air) compressor, fuel combustor, and expansion turbine), engine design, and technology. That means they emit the same pollutants, *i.e.,* HC, CO, and NO_X. Second, they are each used in the same manner, *i.e.,* landing and takeoff operations from airports in the U.S., including commercial airports in ozone and CO nonattainment areas. That means their emissions are geographically, spatially, and temporally similar, and that they collectively contribute to ozone and CO air pollution in nonattainment areas and are projected to continue to do so. Third, noncommercial engines are usually the same engine model and sometimes sub-model as engines used in commercial operations, which makes distinguishing between commercial and noncommercial engines somewhat artificial. These attributes, taken together, demonstrate that engines used in noncommercial service have the same effect on the environment as their commercial counterparts. Therefore, the Administrator is proposing to find that commercial and noncommercial applications for turbofan and turbojet engines with rated thrusts greater than 26.7 kN collectively cause or contribute to the same air pollution as their commercial counterparts. Our emissions assessment supporting this conclusion is contained in the docket for this proposed rulemaking.[105]

B. Non-Substantive Revisions

We are also taking the opportunity to revisit the clarity of other regulatory provisions in part 87. Many of these provisions were first written 30 or 40 years ago with little or no change since then. We are proposing changes to the text related to some of these provisions to better organize, clarify, and update the regulations. Our goal is to revise the regulations in part 87 to properly organize the content of the regulation, use clearer language to describe the applicable requirements, clarify some definitions, and clear up a variety of terms and current practices that have not been adequately addressed.

Except as discussed in previous sections, the proposed changes to part 87 are not intended to significantly change the certification and compliance program. We are not reopening for comment the substance of any part of the program that remains unchanged substantively. Specifically, for those instances where we propose to move a provision to a different section or reword a provision in clearer language, we do not consider those changes to be substantive. It is also important to note that the changes to the regulation apply starting with the date that the final rule takes effect.

In particular, it is worth emphasizing that while we are restating the HC, CO, and smoke standards, as they would apply to Tier 6 and later NO_X standard-subject engines, in a new part 87.23, we are not proposing them as new standards or otherwise reopening them for comment. The HC, CO, and smoke standards in the proposed part 87.23 are identical to the existing standards of part 87.21 and are being copied into the new section merely for clarity to readers.

The proposed rule includes the following definitions and other minor changes in addition to those changes described earlier in this section or in section III.:

The definition of the term ''aircraft'' is being revised to be consistent with its meaning under FAA regulations in 14 CFR 1.1. The existing part 87 definition limits ''aircraft'' to be only those craft issued an airworthiness certificate. This was done as a way to specify the applicability of the standards. However, this can cause confusion in a variety of ways. For example, this departs from the plain meaning of ''aircraft,'' as well as from the meaning given under the Clean Air Act and Title 49 of the United States Code. The proposed definition aligns with these statutory definitions. The changed wording is intended to clarify the existing policy without changing it.

Text specifying general applicability is being added to part 87.3 to be consistent with the new definition of ''aircraft'' and maintain the effective applicability of the existing regulations, which uses narrow definitions to limit applicability. For example, the existing regulations limit the applicability of the standards by defining ''aircraft'' to only include fixed-wing airplanes with airworthiness certificates. They exclude non-propulsion engines from the definition of ''aircraft engine'' and turboshaft engines from the definition of ''aircraft gas turbine engine.'' We believe it is more appropriate to explicitly exclude these engines in an applicability section than to rely on readers finding these exclusions in the definitions section. We are also renaming part 87.3 as ''General applicability and requirements'' and reorganizing the content for clarity. Finally, we are replacing the existing regulatory text related to Federal preemption for exempted engines in part 87.7(f) with a codification of the statutory preemption language in part 87.3 and an explanatory note that the statutory preemption applies to

[105] U.S. EPA, ''Proposed Finding for Commercial and Noncommercial Turbofan and Turbojet Aircraft Emissions,'' memorandum from John Mueller, Assessment and Standards Division, Office of Transportation and Air Quality, May 2011. A copy of this document is in docket EPA–HQ–OAR–2010–0687.

exempted engines because they are certified to prior-tier standards.

ICAO Annex 16 is being incorporated by reference for test procedures. This involves a broader reference to Annex 16, with less content repeated in part 87. However, this does not substantively change the test procedures that apply since the existing procedures are based directly on Annex 16. As part of this change, we are adding the ICAO definition of ''characteristic level'' to properly describe how manufacturers demonstrate that they meet applicable standards.

Definitions are being added for ''date of introduction,'' ''date of manufacture,'' and ''derivative engine for emissions certification purposes,'' and the definition of ''engine model'' is being revised, to more carefully describe when new emission standards apply to specific aircraft engines. These definitions are generally consistent with the most common understandings of these terms by industry and FAA, and with the CAEP/8 recommendation for adoption by ICAO. Except for engines subject to exemptions, there will be no more engines required to be certified to the standards specified in part 87.21, so changing the definition of ''engine model'' will not change the requirements for engines certified to the Tier 4 or earlier standards. For the benefit of the reader, we are also reprinting the following definitions that remain unchanged, without requesting comment on those definitions:

- Aircraft engine
- Aircraft gas turbine engine
- Class TP
- Class TF
- Class T3
- Class T8
- Class TSS
- Commercial aircraft gas turbine engine
- Fuel venting emissions

Specific provisions are being added to define and require the use of ''good engineering judgment.'' This applies for instances where the regulation cannot spell out every technical detail of how a manufacturer should comply with the regulation. For example, the proposed regulations would rely on good engineering judgment being used on the engineering analysis of emissions equivalency for derivative engines (part 87.48(b)(2)), and for applying the turbofan test procedures to turboprop engines (part 87.60(a)). The general approach for implementing good engineering judgment is to allow manufacturers to exercise well substantiated and explained technical judgment subject to potential EPA and FAA review (as appropriate). The consequences of disagreements with a manufacturer's decision would depend on whether we believe the manufacturer made the decision in good faith. Where the manufacturer makes its decision in good faith, EPA or FAA could require a different approach for future work if we believe it would represent better engineering judgment. We believe these provisions reflect the spirit of the approach being used today to interpret the applicable regulations.

Provisions are being added specifying rounding practices for rated output, rated pressure ratio, and calculated emission standards; generally specifying that they be expressed to at least three significant figures. These specifications are consistent with how manufacturers are generally certifying engines today. Defining how to round these values would prevent manufacturers in the future from effecting small changes in the level of the emission standards to which they certify their engines. This is because standards are calculated using the numerical values of the rated output and rated pressure ratio. Without these specifications, manufacturers could subject themselves to a slightly less stringent standard by selectively rounding or truncating an engine model's rated output to be low and its rated pressure ratio to be high, or by strategically rounding the calculated standard itself. While this has not been an issue in the past, it is important to maintain a level playing field for all manufacturers as standards become more stringent. We do not expect any more engines type-certificated to the standards specified in part 87.21, so the specified procedures for rounding these values will not change the requirements for engines certified to the Tier 4 or earlier standards.

Definitions are being added for ''turbofan engine,'' ''turbojet engine,'' ''turboprop engine,'' ''turboshaft engine,'' ''supersonic,'' and ''subsonic'' to avoid any uncertainty about how the standards apply to different types of engines. The proposed definitions are intended to reflect the plain meaning of these terms.

The proposed regulations include the following additional amendments:

Regulation cite	Description of amendment	Notes
87.1	Add definition of ''characteristic level''.	The characteristic level is established by ICAO Annex 16 as a means of calculating a statistical adjustment to measured emission results to take into account the level of uncertainty corresponding to the number of tests run for a given pollutant.
87.1	Remove definitions for ''emission measurement system'', ''power setting'', ''sample system'', ''shaft power'', ''taxi/idle (in)'', and ''taxi/idle (out)''.	These terms will no longer be used in part 87. There will be no more engines certified to the standards specified in § 87.21, so removing these definitions will not change the requirements for engines certified to the Tier 4 or earlier standards.
87.1	Revise definition of ''exhaust emissions'' and ''smoke''.	The new language references the emission testing procedures, since that is the practical meaning of these terms in part 87. This clarifies, for example, that emissions from the nozzle of an aircraft or aircraft engine count as exhaust emissions only if they are measured using the specified test procedures. There will be no more engines certified to the standards specified in § 87.21, so revising these definitions will not change the requirements for engines certified to the Tier 4 or earlier standards.
87.1	Define ''new'' instead of defining ''new aircraft turbine engine''.	The regulations also refer to new turboprop engines and new engines used for supersonic aircraft, so it is appropriate to define the adjective as it relates to these different kinds of engines. This approach does not change the meaning of the applicable terms and therefore has no bearing on the requirements that applied under the standards specified in § 87.21.

Regulation cite	Description of amendment	Notes
87.1	Revise the definition of ''standard day condition'': (1) remove the reference to the 1976 U.S. Standard Atmosphere, (2) correct a typographical error in the humidity specification, and (3) change the atmospheric pressure units from Pa to kPa.	The editorial changes do not involve any substantive change in the specified conditions.
87.2	Remove FAA from the list of acronyms in § 87.2 and add it to the set of defined terms in § 87.1.	This is intended to not involve a change in emission standards or implementation.
87.3	Add provisions describing the scope of applicability of part 87.	The broad statement in § 87.3 is not intended to conflict with the applicability statements in individual subparts, since those additional statements indicate that certain requirements in part 87 apply more narrowly. All applicability statements in the proposed rule are intended to be consistent with current policy.
87.3	Remove the provision related to preemption of state standards for exempted aircraft and replace it with the preemption provision in the Clean Air Act.	This change more carefully tracks the statutory provisions related to preemption.
87.5	Move the provisions related to special test procedures to § 87.60.	This provision, and the similar provision from § 87.3(a), should be described together in the context of the testing requirements in subpart G.
87.21	Identify the specific date when the smoke standard started to apply for turbofan engines with rated output less than 26.7 kilonewtons.	This corrects a typographical error from the FEDERAL REGISTER.
87.21	Revise paragraph (f) to correctly reference the regulatory sections that describe the applicable test procedures.	This change is strictly editorial.
87.60	Revise the description of test procedures to rely broadly on the procedures specified in ICAO Annex 16. This includes a variety of recent changes to the Annex 16 procedures.	There will be no more engines certified to the standards specified in § 87.21, so any changes to the test procedures will not change the requirements for engines certified to the Tier 4 or earlier standards. Moreover, engine manufacturers are expected to perform all their testing based on the current test procedures from ICAO Annex 16, regardless of the standards that apply.

C. Clarifying Language for Regulatory Text

The proposed regulations incorporate the changes described in this preamble. The following table highlights and clarifies several provisions that may not be obvious to the reader.

Regulation cite	Note
87.1, Definition of ''aircraft''	This definition would revert to the normal FAA definition of aircraft, rather than the much narrower current definition in part 87. To understand this change, the proposed definition needs to be considered along with the proposed changes to applicability in 87.3(a).
87.1, Definition of ''date of manufacture''	This is generally the same definition as given in ICAO Annex 16. However, our definition addresses certain specific circumstances that could possibly occur, but that are not addressed by the Annex. For example, our definition would provide a date of manufacture for an engine not previously documented by a manufacturer.
87.1, Definition of ''derivative engine for emissions certification purposes''.	It is important to consider this definition in combination with the definition of ''engine type certificate family''.
87.1 Definition of ''engine model''	A manufacturer or FAA may further divide an engine model into sub-models. Engines from an engine model must be contained within a single engine type certificate family. Where FAA determines that engines are not sufficiently similar to be included under a single type certificate, they will not be considered to be the same engine model for purposes of part 87.
87.1, Definition of ''military aircraft'' and 87.23(d).	In § 87.23(d) we clarify that the production cutoff does not apply for military aircraft engines (even if they have been certificated). In § 87.1, we define military aircraft to mean ''aircraft owned by, operated by, or produced for sale to the armed forces or other agency of the Federal government responsible for national security (including but not limited to the Department of Defense).'' For example, aircraft owned by the U.S. Coast Guard would be military aircraft.
87.1, Definition of ''production cutoff date''	The production cutoff date for the Tier 6 NO_X standards is December 31, 2012.
87.1, Definition of ''spare engine''	Newly manufactured spare engines may be excepted under § 87.50.
87.1, Definitions of tiers	As specified in the definitions of ''Tier 0'' through ''Tier 8'', tiers apply only for NO_X standards. Tiers do not apply for HC, CO, and smoke standards because these continue to apply, independent of the NO_X standards.
87.23(d)(2)	The allowance to continue production of Tier 6 engines after the Tier 8 standards start to apply is not necessary for engines with rated pressure ratio at or above 104.7 because the Tier 6 and Tier 8 standards are numerically identical at these thrust levels.

Regulation cite	Note
87.42(c)(1)	§ 87.42 requires that a manufacturer report the engines it produces by sub-model. The manufacturer must specify the manufacturer's unique sub-model name, which will generally include a model name and a sub-model name. It may also include a family name.
87.50	This provision specifies that EPA must provide written concurrence for exemptions.
87.50(a)(1)(iv)(F)	This provision states that manufacturers requesting exemptions should describe equity issues. As an example of equity issues related to an exemption request, a manufacturer might provide a rationale for granting the exemption when another manufacturer has a compliant engine and does not need an exemption, taking into account the implications for operator fleet composition, commonality, and related issues in the absence of the engine model in question.
87.50(a)(6)	This provision requires manufacturers to promptly notify the FAA if new or changed information could have affected approval of an exemption. For corrections to an exemption request that would not affect the approval of the exemption, manufacturers may include the updated information in the annual report described in § 87.50(e).

V. Technical Feasibility, Cost Impacts, Emission Benefits

During the CAEP process, the technical feasibility and cost of compliance of the CAEP/6 and CAEP/8 NO_X standards were thoroughly assessed and documented.[106] [107] EPA participated in these analyses and supported the results. Generally, CAEP considered certain factors as pertinent to the cost estimates of a technology level for engine changes, and these factors or technology levels are described below. The first technology level was regarded as a minor change, and it could include modeling work, minor design changes, and additional testing and re-certification of emissions. The second technology level was considered a scaled proven technology. At this level an engine manufacturer applies its best-proven, combustion technology that was already certified in at least one other engine type to another engine type. This second technology level would include substantial modeling, design, combustion rig testing, modification and testing of development engines, and flight testing. The third technology level was regarded as new technology or current industry best practice, and it was considered where a manufacturer has no proven technology that can be scaled to provide a solution and some technology acquisition activity is required. (One or more manufacturers have demonstrated the necessary technology, while the remaining manufacturers would need to acquire the technology to catch up.) Since the effective date for the CAEP/6 NO_X standard was January 1, 2008 and nearly all in-production engines currently meet this standard, we will limit our discussion below of applying these technology levels to engines that need to comply with the CAEP/8 NO_X standard.

At the time of the CAEP reports, the CAEP/8 NO_X standard for higher thrust engines, *i.e.,* 89.0 kN or more would apply to a total of 15 engine types. For these types the following technology level response was anticipated: six types would require no change, one type would need the first technology level change, five would require the second technology level, and three would need the third technology level. For lower thrust engines, *i.e.,* greater than 26.7 but less than 89.0 kN, CAEP listed a total of 13 engine types in their analysis of the CAEP/8 NO_X standard. The following technology level response was estimated for these types: 11 types would require no change, 1 type would need the first technology level change, and 1 type would require a second technology.

Regarding the costs of this specific proposal, aircraft turbofan engines are designed and built for use on aircraft that are sold and operated throughout the world. As a result, engine manufacturers respond to this market reality by designing and building engines that conform to ICAO international standards and practices. This normal business practice means that engine manufacturers are compelled to make the necessary business decisions and investments to maximize their international markets even in the absence of U.S. regulations that would otherwise codify ICAO standards and practices. Indeed, engine manufacturers have developed or are already developing improved technology in response to ICAO standards that match the standards proposed here. Also, the proposed recommended practices, *e.g.,* test procedures, needed to demonstrate compliance are being adhered to by manufacturers during current engine certification tests, or will be even in the absence a final rule. Therefore, EPA believes that today's proposed standards and practices that conform with ICAO standards and practices will impose no real additional burden on engine manufacturers. This finding regarding no incremental burden, is also consistent with past EPA rulemakings that adopted ICAO requirements. ((See 62 FR 25356 (May 8, 1997) and 70 FR 69664 (November 11, 2005)).

In fact, engine manufacturers have suggested that certain benefits accrue for compliant products when the U.S. adopts ICAO standards and practices, but have not provided detailed information regarding these benefits. Primarily, such action makes FAA certification more straightforward and transparent. That in turn is advantageous when marketing their products to potential customers, because compliance with ICAO standards is an important consideration in purchasing decisions. It simply removes any question that their engines comply with international requirements. There will be some cost, however, associated with our proposed annual reporting requirement for emission related information. (See section III.D. for a description of the proposed reports.) There are a total of 10 engine manufacturers that would be affected. Eight of these produce turbofan engines with rated thrusts greater than 26.7 kN, which are already voluntarily reported to the ICAO-related Emissions Databank (EDB). We expect the incremental reporting burden for these

[106] CAEP/6 NO_X standards: CAEP Forecasting and Economic Analysis Support Group, *Economic Analysis of NO_X Emissions Stringency Options,* CAEP/6–IP/13 (Information Paper 13), January 15, 2004. A copy of this document is in docket number EPA–HQ–OAR–2010–0687.

[107] CAEP/8 NO_X standards: CAEP Working Group 3, *NO_X Stringency Technology Response Assessment,* CAEP–SG/20082–WP/18 (Working Paper 18), September 25, 2008. CAEP Forecasting and Economic Analysis Support Group, *Economic Assessment of the NO_X Stringency Scenarios,* CAEP/8–IP/14, November 30, 2009. Modeling Task Force, *MODTF NO_X Stringency Assessment,* CAEP/8–IP/13, December 11, 2009. United States, *Aviation Environmental Portfolio Management Tool for Economics (APMT–Economics) and Its Application in the CAEP/8 NO_X Stringency Analysis,* CAEP/8–IP/29, January 6, 2010. A copy of these documents are in docket number EPA–HQ–OAR–2010–0687.

manufacturers to be very small because we: (1) Have significantly reduced the number of reporting elements from those requested in the EDB, and (2) are adding only three basic reporting categories to those already requested by the EDB. Also, four of the eight manufacturers make smaller turbofan and turboprop engines that will be reporting for the first time. This will add a small incremental burden for these four manufacturers that otherwise already voluntarily report to the EDB. There are also two engine manufacturers that only produce turbofan engines with rated thrusts less than or equal to 26.7 kN and they will be reporting for the first time. For these two manufacturers we believe that the reporting burden will be small because all of the information we are proposing to require should be readily available, and these manufacturers have a very limited number of engine models.

We have estimated the annual burden and cost to be six hours and $365 per manufacturer. With 10 manufacturers submitting reports, the total burden of this reporting requirement is estimated to be 60 hours, for a total cost of $3,646.

Turning to emission benefits, CAEP's assessments indicated that the CAEP/8 NO_X standards would provide global NO_X reductions, which would translate to emission reductions in the U.S. The global LTO NO_X reductions were estimated to be about 5.5 percent in 2026 and 7 percent in 2036 relative to the baseline.[108] According to an analysis conducted for comparable percent NO_X reductions in the U.S., it was estimated that this would translate to LTO NO_X reductions in the U.S. of about 5,200 tons in 2020 and 8,700 tons in 2030,[109] and the cumulative LTO NO_X reductions from 2014 to 2030 (2014 is the implementation date of the CAEP/8 NO_X standards) were projected to be about 100,000 NO_X tons.

VI. Coordination With FAA

The requirements contained in this action are being proposed after consultation with the Federal Aviation Administration (FAA). Section 231(a)(2)(B)(i) of the CAA requires EPA to ''consult with the Administrator of the [FAA] on aircraft engine emission standards'' 42 U.S.C. 7571(a)(2)(B)(i), and section 231(a)(2)(B)(ii) indicates that EPA ''shall not change the aircraft engine emission standards if such change would significantly increase noise. * * *'' 42 U.S.C. 7571(a)(2)(B)(ii). Section 231(b) of the CAA states that ''[a]ny regulation prescribed under this section (and any revision thereof) shall take effect after such period as the Administrator finds necessary (after consultation with the Secretary of Transportation) to permit the development and application of the requisite technology, giving appropriate consideration to the cost of compliance within such period.'' 42 U.S.C. 7571(b). Section 231(c) provides that any regulation under section 231 ''shall not apply if disapproved by the President * * * on the basis of a finding by the Secretary of Transportation that any such regulation would create a hazard to aircraft safety.'' 42 U.S.C. 7571(c). Under section 232 of the CAA, the Department of Transportation (DOT) has the responsibility to enforce the aircraft emission standards established by EPA under section 231.[110] As in past rulemakings and pursuant to the above referenced sections of the CAA, EPA has coordinated with the FAA, *i.e.,* DOT, with respect to today's action.

Moreover, FAA is the official U.S. delegate to ICAO. FAA agreed to the amendments at ICAO's Sixth and Eighth Meetings of the Committee on Aviation Environmental Protection (CAEP/6) after advisement from EPA.[111] FAA and EPA were both members of the CAEP's Working Group 3 (among others), whose objective was to evaluate emissions technical issues and develop recommendations on such issues for CAEP/6 and CAEP/8. After assessing emissions test procedure amendments and new NO_X standards, Working Group 3 made recommendations to CAEP on these elements. These recommendations were approved by CAEP/6 meetings prior to their adoption by ICAO in 2004. Similarly, the more recent Working Group 3 recommendations were approved by CAEP/8 and subsequently recommended to ICAO for adoption.

In addition, as discussed above, FAA will have the duty to enforce today's requirements. As a part of these duties, the FAA witnesses the emission tests or delegates aspects of that responsibility to the engine manufacturer, which is then monitored by the FAA.

VII. Public Participation

We request comment on this proposal, however, we are not reopening for comment the substance of any part of the program that remains substantially unchanged as described in section IV.B. The remainder of this section describes how you can participate in this process.

How do I submit comments?

We are opening a formal comment period by publishing this document. We will accept comments during the period indicated in the **DATES** section at the beginning of this document. If you have an interest in the proposed emission control program described in this document, we encourage you to comment on any aspect of this rulemaking.

Your comments will be most useful if you include appropriate and detailed supporting rationale, data, and analysis. Commenters are especially encouraged to provide specific suggestions for any changes to any aspect of the regulations that they believe need to be modified or improved. You should send all comments, except those containing proprietary information, to our Air Docket (see **ADDRESSES** located at the beginning of this document) before the end of the comment period.

You may submit comments electronically, by mail, or through hand delivery/courier. To ensure proper receipt by EPA, identify the appropriate docket identification number in the subject line on the first page of your comment. Please ensure that your comments are submitted within the specified comment period. Comments received after the close of the comment period will be marked ''late.'' EPA is not required to consider these late comments. If you wish to submit Confidential Business Information (CBI) or information that is otherwise protected by statute, please follow the instructions in section VIII.B.

How should I submit CBI to the agency?

Do not submit information that you consider to be CBI electronically through the electronic public docket, *http://www.regulations.gov,* or by e-mail. Send or deliver information identified as CBI only to the following address: U.S. Environmental Protection Agency, Assessment and Standards Division, 2000 Traverwood Drive, Ann Arbor, MI 48105, Attention Docket ID EPA–HQ–OAR–2010–0687. You may claim information that you submit to EPA as CBI by marking any part or all of that information as CBI (if you submit CBI on disk or CD ROM, mark the outside of the disk or CD ROM as CBI

[108] CAEP Rapporteurs of Modeling Task Force and Forecasting and Economic Analysis Support Group, *Environmental and Economic Assessment of the NO_X Stringency Scenarios,* CAEP/8–WP/15, December 2, 2009.

[109] ''Historical Assessment of Aircraft Landing and Take-off Emissions (1986–2008),'' Eastern Research Group, May 2011. A copy of this document can be found in public docket EPA–HQ–OAR–2010–0687.

[110] The functions of the Secretary of Transportation under part B of title II of the Clean Air Act (§§ 231–234, 42 U.S.C. 7571–7574) have been delegated to the Administrator of the FAA. 49 CFR 1.47(g).

[111] The Sixth Meeting of CAEP (CAEP/6) occurred in Montreal, Quebec from February 2 through 12 in 2004.

and then identify electronically within the disk or CD ROM the specific information that is CBI). Information so marked will not be disclosed except in accordance with procedures set forth in 40 CFR part 2.

In addition to one complete version of the comment that includes any information claimed as CBI, a copy of the comment that does not contain the information claimed as CBI must be submitted for inclusion in the public docket. If you submit the copy that does not contain CBI on disk or CD ROM, mark the outside of the disk or CD ROM clearly that it does not contain CBI. Information not marked as CBI will be included in the public docket without prior notice. If you have any questions about CBI or the procedures for claiming CBI, please consult the person identified in the **FOR FURTHER INFORMATION CONTACT** section at the beginning of this document.

Will there be a public hearing?

We will hold a public hearing on August 11, 2011. The hearing will start at 9:30 am local time and continue until everyone has had a chance to speak.

If you would like to present testimony at the public hearing, we ask that you notify the contact person listed under **FOR FURTHER INFORMATION CONTACT** at least ten days before the hearing. You should estimate the time you will need for your presentation and identify any needed audio/visual equipment. We suggest that you bring copies of your statement or other material for the EPA panel and the audience. It would also be helpful if you send us a copy of your statement or other materials before the hearing.

We will make a tentative schedule for the order of testimony based on the notifications we receive. This schedule will be available on the morning of the hearing. In addition, we will reserve a block of time for anyone else in the audience who wants to give testimony.

We will conduct the hearing informally, and technical rules of evidence won't apply. We will arrange for a written transcript of the hearing and keep the official record of the hearing open for 30 days to allow you to submit supplementary information. You may make arrangements for copies of the transcript directly with the court reporter.

Comment Period

The comment period for this rule will end on September 26, 2011.

What should I consider as I prepare my comments for EPA?

You may find the following suggestions helpful for preparing your comments:

Explain your views as clearly as possible.

Describe any assumptions that you used.

Provide any technical information and/or data you used that support your views.

If you estimate potential burden or costs, explain how you arrived at your estimate.

Provide specific examples to illustrate your concerns.

Offer alternatives.

Make sure to submit your comments by the comment period deadline identified.

To ensure proper receipt by EPA, identify the appropriate docket identification number in the subject line on the first page of your response. It would also be helpful if you provided the name, date, and **Federal Register** citation related to your comments.

VIII. Statutory Provisions and Legal Authority

The statutory authority for today's proposal is provided by sections 114, 231–234 and 301(a) of the Clean Air Act, as amended, 42 U.S.C. 7414, 7571–7574 and 7601(a). See section II. of today's rule for discussion of how EPA meets the CAA's statutory requirements.

IX. Statutory and Executive Order Reviews

A. Executive Order 12866: Regulatory Planning and Review

Under Executive Order (EO) 12866 (58 FR 51735, October 4, 1993), this action is a ''significant regulatory action.'' This action proposes the adoption of new aircraft engine emissions regulations and as such, requires consultation and coordination with the Federal Aviation Administration (FAA). OMB has determined that this action raises '' * * * novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in the EO.'' Accordingly, EPA submitted this action to the Office of Management and Budget (OMB) for review under EO 12866 and any changes made in response to OMB recommendations have been documented in the docket for this action.

As discussed further in section V., we do not attribute any costs to the compliance with today's proposed regulations that conform with ICAO standards and recommended practices. Aircraft turbofan engines are international commodities. As a result, engine manufacturers respond to this market reality by designing and building engines that conform to ICAO international standards and practices. Therefore, engine manufacturers are compelled to make the necessary business decisions and investments to maximize their international markets even in the absence of U.S. action. Indeed, engine manufacturers have or are already responding, or will in the future, to ICAO requirements that match the standards and practices proposed here. Therefore, EPA believes that today's proposed requirements that conform with ICAO standards and practices will impose no real additional burden on engine manufacturers. This finding is also consistent with past EPA rulemakings that adopted ICAO requirements.

There is, nonetheless, a small burden associated with the proposed reporting requirements, as discussed in section IX.B.

B. Paperwork Reduction Act

The information collection requirements in this proposed rule have been submitted for approval to the Office of Management and Budget (OMB) under the Paperwork Reduction Act, 44 U.S.C. 3501 *et seq.* The Information Collection Request (ICR) document prepared by EPA has been assigned EPA ICR Number 2427.01.

Manufacturers keep substantial records to document their compliance with emission standards. We need to be able to access this data to conduct accurate emission inventories, understand how emission standards affect the current fleet, and develop appropriate policy in the form of future emission standards. Most manufacturers are already accustomed to reporting much of this information to ICAO. We are, therefore, proposing to require that engine manufacturers send this information to EPA on an annual basis. We also propose to require manufacturers to send us their annual production volumes, which is the only item we would treat as confidential business information. Under the Clean Air Act, we are authorized to require manufacturers to establish and maintain necessary records, make reports, and provide such other information as we may reasonably require to execute our functions under the Act. See 42 U.S.C. 7414(a)(1). We would expect most manufacturers generally to add the proposed information items to the annual report they are already required to submit with information about NO_X

and CO_2 emission levels. See section III.D. for a more complete description of the proposed annual reporting requirement.

We have estimated the total annual burden of the proposed reporting requirement to be 60 hours, and the total cost to be $3,646. The annual burden and cost per respondent is estimated to be 6 hours and $365. Burden is defined at 5 CFR 1320.3(b). An agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number. The OMB control numbers for EPA's regulations in 40 CFR are listed in 40 CFR part 9. To comment on the Agency's need for this information, the accuracy of the provided burden estimates, and any suggested methods for minimizing respondent burden, EPA has established a public docket for this rule, which includes this ICR, under Docket ID EPA–HQ–OAR–2010–0687. Submit any comments related to the ICR to EPA and OMB. See the **ADDRESSES** section at the beginning of this notice for where to submit comments to EPA. Send comments to OMB at the Office of Information and Regulatory Affairs, Office of Management and Budget, 725 17th Street, NW., Washington, DC 20503, Attention: Desk Office for EPA. Since OMB is required to make a decision concerning the ICR between 30 and 60 days after July 27, 2011, a comment to OMB is best assured of having its full effect if OMB receives it by August 26, 2011. The final rule will respond to any OMB or public comments on the information collection requirements contained in this proposal.

C. Regulatory Flexibility Analysis

The Regulatory Flexibility Act (RFA) generally requires an agency to prepare a regulatory flexibility analysis of any rule subject to notice and comment rulemaking requirements under the Administrative Procedure Act or any other statute unless the agency certifies that the rule will not have a significant economic impact on a substantial number of small entities. Small entities include small businesses, small organizations, and small governmental jurisdictions.

For purposes of assessing the impacts of today's rule on small entities, small entity is defined as: (1) A small business as defined by SBA size standards; (2) a small governmental jurisdiction that is a government of a city, county, town, school district or special district with a population of less than 50,000; and (3) a small organization that is any not-for-profit enterprise which is independently owned and operated and is not dominant in its field. The following Table 4 provides an overview of the primary SBA small business categories potentially affected by this regulation.

TABLE 4—PRIMARY POTENTIALLY AFFECTED SBA SMALL BUSINESS CATEGORIES

Industry	NAICS [a] codes	Defined by SBA as a small business if: [b]
Manufacturers of new aircraft engines	336412	< 1,000 employees.
Manufacturers of new aircraft	336411	< 1,500 employees.

[a] North American Industry Classification System (NAICS).
[b] According to SBA's regulations (13 CFR part 121), businesses with no more than the listed number of employees or dollars in annual receipts are considered "small entities" for purposes of a regulatory flexibility analysis.

After considering the economic impacts of today's proposed rule on small entities, I certify that this action will not have a significant economic impact on a substantial number of small entities. Small governmental jurisdictions and small organizations as described above will not be impacted. We have determined that the estimated effect of the proposed rule's reporting requirement is to affect one small entity turbofan engine manufacturer with costs less than one percent of revenues. This one company represents all of the small businesses impacted by the proposed regulations. An analysis of the impacts of the proposed rule on small businesses has been prepared and placed in the docket for this rulemaking.[112]

We continue to be interested in the potential impacts of the proposed rule on small entities and welcome comments on issues related to such impacts.

[112] "Small Business Impact Memo, Proposed Aircraft Engine Emission Standards—Determination of No SISNOSE," EPA memo from Solveig Irvine to Alexander Cristofaro, November, 2010.

D. Unfunded Mandates Reform Act

This rule does not contain a Federal mandate that may result in expenditures of $100 million or more for State, local, and Tribal governments, in the aggregate, or the private sector in any one year. As discussed in section IV, today's proposed action will establish consistency between U.S. and existing international emission standards. The engine manufacturers are already developing the technology to meet the existing ICAO standards, and we do not believe it is appropriate to attribute the costs of that technology to this proposed action. Thus, this rule is not subject to the requirements of sections 202 or 205 of UMRA.

This rule is also not subject to the requirements of section 203 of UMRA because it contains no regulatory requirements that might significantly or uniquely affect small governments. The provisions of this proposal apply to the manufacturers of aircraft and aircraft engines, and as such would not affect small governments.

E. Executive Order 13132: Federalism

This action does not have federalism implications. It will not have substantial direct effects on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government, as specified in Executive Order 13132. As discussed earlier, section 233 of the CAA preempts states from adopting or enforcing aircraft engine emission standards that are not identical to our standards. This rule proposes to revise the Code of Federal Regulations to more accurately reflect the statutory preemption established by the Clean Air Act. This rule does not impose any new preemption of State and local law. Thus, Executive Order 13132 does not apply to this action.

In the spirit of Executive Order 13132, and consistent with EPA policy to promote communications between EPA and State and local governments, EPA specifically solicits comment on this proposed action from State and local officials.

F. Executive Order 13175: Consultation and Coordination With Indian Tribal Governments

These rules regulate aircraft manufacturers and aircraft engine

manufacturers. We do not believe that Tribes own any of these businesses nor are there other implications for Tribes. Thus, Executive Order 13175 does not apply to this action.

EPA specifically solicits additional comment on this proposed action from Tribal officials.

G. Executive Order 13045: Protection of Children From Environmental Health & Safety Risks

This rule is not subject to Executive Order 13045 (62 FR 19885, April 23, 1997) because the Agency does not believe the environmental health risks or safety risks addressed by this action present a disproportionate risk to children. See section II.B.2. for a discussion of the health impacts of NO_X emissions.

The public is invited to submit comments or identify peer-reviewed studies and data that assess effects of early life exposure to aircraft emissions.

H. Executive Order 13211: Actions That Significantly Affect Energy Supply, Distribution, or Use

This action is not a ''significant energy action'' as defined in Executive Order 13211 (66 FR 28355 (May 22, 2001)), because it is not likely to have a significant adverse effect on the supply, distribution, or use of energy. These proposed aircraft engine emissions regulations are not expected to result in any changes to aircraft fuel consumption.

I. National Technology Transfer Advancement Act

Section 12(d) of the National Technology Transfer and Advancement Act of 1995 (''NTTAA''), Public Law 104–113 (15 U.S.C. 272 note) directs EPA to use voluntary consensus standards in its regulatory activities unless to do so would be inconsistent with applicable law or otherwise impractical. Voluntary consensus standards are technical standards (*e.g.,* materials specifications, test methods, sampling procedures, and business practices) that are developed or adopted by voluntary consensus standards bodies. NTTAA directs EPA to provide Congress, through OMB, explanations when the Agency decides not to use available and applicable voluntary consensus standards.

This proposed rulemaking involves technical standards for testing emissions for aircraft gas turbine engines. EPA proposes to use test procedures contained in ICAO's International Standards and Recommended Practices Environmental Protection, Annex 16, along with the modifications contained in this rulemaking.[113] These procedures are currently used by all manufacturers of aircraft gas turbine engines (with thrust greater than 26.7 kN) to demonstrate compliance with ICAO emissions standards.

EPA welcomes comments on this aspect of the proposed rulemaking and, specifically, invites the public to identify potentially-applicable voluntary consensus standards and to explain why such standards should be used in this regulation.

J. EO 12898: Federal Actions To Address Environmental Justice in Minority Populations and Low-Income Populations

Executive Order (EO) 12898 (59 FR 7629 (Feb. 16, 1994)) establishes Federal executive policy on environmental justice. Its main provision directs Federal agencies, to the greatest extent practicable and permitted by law, to make environmental justice part of their mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority populations and low-income populations in the United States.

EPA has determined that this proposed rule will not have disproportionately high and adverse human health or environmental effects on minority or low-income populations because it increases the level of environmental protection for all affected populations without having any disproportionately high and adverse human health or environmental effects on any population, including any minority or low-income population.

List of Subjects

40 CFR Part 87

Environmental protection, Air pollution control, Aircraft, Incorporation by reference.

40 CFR Part 1068

Environmental protection, Administrative practice and procedure, Confidential business information, Imports, Incorporation by reference, Motor vehicle pollution, Penalties, Reporting and recordkeeping requirements, Warranties.

[113] ICAO International Standards and Recommended Practices Environmental Protection, Annex 16, Volume II, ''Aircraft Engine Emissions,'' Second Edition, July 1993—Amendment 3, March 20, 1997. Copies of this document can be obtained from ICAO (*http://www.icao.int*).

Dated: July 6, 2011.

Lisa P. Jackson,

Administrator.

For the reasons stated in the preamble title 40, chapter I of the Code of Federal Regulations is proposed to be amended as follows:

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

1. The authority citation for part 87 is revised to read as follows:

Authority: 42 U.S.C. 7401 *et seq.*

Subpart A—[Amended]

2. Revise § 87.1 to read as follows:

§ 87.1 Definitions.

The definitions in this section apply to this part. The definitions apply to all subparts. Any terms not defined in this section have the meaning given in the Clean Air Act. The definitions follow:

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 has the meaning given in 14 CFR 1.1, which defines aircraft to mean a device used or intended to be used for flight in the air. Note that under § 87.3, the requirements of this part generally apply only to propulsion engines used on certain airplanes for which U.S. airworthiness certificates are required.

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). 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 subtitle 7 of 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 introduction or *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. This does not include test engines or other engines not placed into service.

Date of manufacture means the date on which a manufacturer is issued documentation by FAA (or other competent authority for engines certificated outside the United States) attesting than the given engine conforms to all applicable requirements. This date may not be earlier that the date on which assembly of the engine is complete. Where the manufacturer does not obtain such documentation from FAA (or other competent authority for engines certificated outside the United States), *date of manufacture* means the date of final assembly of the engine.

Derivative engine for emissions certification purposes means an engine that has the same or similar emissions characteristics as an engine covered by a U.S. type certificate issued under 14 CFR part 33. These characteristics are specified in § 87.48.

Designated EPA Program Officer means the Director of the Assessment and Standards Division, 2000 Traverwood Drive, Ann Arbor, Michigan 48105.

DOT Secretary means the Secretary of the Transportation and any other officer or employee of the Department of Transportation to whom the authority involved may be delegated.

Engine means an individual engine. A group of identical engines together make up an engine model or sub-model.

Engine model means an engine manufacturer's designation for an engine grouping of engines and/or engine sub-models within a single engine type certificate family, where such engines have similar design, including being similar with respect to the core engine and combustor designs.

Engine sub-model means a designation for a grouping of engines with essentially identical design, especially with respect to the core engine and combustor designs and other emission-related features. Engines from an engine sub-model must be contained within a single engine model. For purposes of this part, an original engine model configuration is considered a sub-model. For example, if a manufacturer initially produces an engine model designated ABC and later introduces a new sub-model ABC–1, the engine model consists of two sub-models: ABC and ABC–1.

Engine type certificate family means a group of engines (comprising one or more engine models, including sub-models and derivative engines for emissions certification purposes of those engine models) determined by FAA to have a sufficiently common design to be grouped together under a type certificate.

EPA means the U.S. Environmental Protection Agency.

Except means to routinely allow engines to be produced and sold that do not meet (or do not fully meet) otherwise applicable standards. (Note that this definition applies only with respect to spare engines and that the term ''except'' has its plain meaning in other contexts.) Excepted engines must conform to regulatory conditions specified for an exception in this part and other applicable regulations. Excepted engines are deemed to be ''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 excepted.

Exempt means to allow (through a formal case-by-case process) engines to be produced and sold that do not meet (or do not fully meet) otherwise applicable standards. Exempted engines must conform to regulatory conditions specified for an exemption in this part and other applicable regulations. Exempted engines are deemed to be ''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 to the atmosphere from exhaust discharge nozzles, as measured by the test procedures specified in subpart G of this part.

FAA means the U.S. Department of Transportation, Federal Aviation Administration.

Fuel venting emissions means raw fuel, exclusive of hydrocarbons in the exhaust emissions, discharged from aircraft gas turbine engines during all normal ground and flight operations.

Good engineering judgment involves making decisions consistent with generally accepted scientific and engineering principles and all relevant information, subject to the provisions of 40 CFR 1068.5.

ICAO Annex 16 means Volume II of Annex 16 to the Convention on International Civil Aviation (incorporated by reference in § 87.8).

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

Military aircraft means aircraft owned by, operated by, or produced for sale to the armed forces or other agency of the Federal government responsible for national security (including but not limited to the Department of Defense).

New means relating to an aircraft or aircraft engine that has never been placed into service.

Operator means any person or company that owns or operates an aircraft.

Production cutoff date or *date of the production cutoff* means the date on which interim phase-out allowances end.

Rated output (rO) means the maximum power/thrust available for takeoff at standard day conditions as approved for the engine by FAA, including reheat contribution where applicable, but excluding any contribution due to water injection, expressed in kilowatts or kilonewtons (as applicable) and 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 operating at rated output, rounded to at least three significant figures.

Round means to round numbers according to NIST SP 811 (March 2008), unless otherwise specified.

Smoke means the matter in exhaust emissions that obscures the transmission of light, as measured by the test procedures specified in subpart G of this part.

Smoke number means a dimensionless value quantifying smoke emissions calculated in accordance with ICAO Annex 16.

Spare engine means an engine installed (or intended to be installed) on an in-service aircraft to replace an existing engine and that is excepted as described in § 87.50(c).

Standard day conditions means the following ambient conditions: temperature = 15 °C, specific humidity = 0.00 kg H_2O/kg dry air, and pressure = 101.325 kPa.

Subsonic means relating to aircraft that are not supersonic aircraft.

Supersonic means relating to aircraft that are certificated to fly faster than the speed of sound.

Tier 0 means relating to an engine that is subject to the Tier 0 NO_X standards specified in § 87.21.

Tier 2 means relating to an engine that is subject to the Tier 2 NO_X standards specified in § 87.21.

Tier 4 means relating to an engine that is subject to the Tier 4 NO_X standards specified in § 87.21.

Tier 6 means relating to an engine that is subject to the Tier 6 NO_X standards specified in § 87.23.

Tier 8 means relating to an engine that is subject to the Tier 8 NO_X standards specified in § 87.23.

Turbofan engine means a gas turbine engine designed to create its propulsion from exhaust gases and from air that bypasses the combustion process and is accelerated in a ducted space between the inner (core) engine case and the outer engine fan casing.

Turbojet engine means a gas turbine engine that is designed to create all of its propulsion from exhaust gases.

Turboprop engine means a gas turbine engine that is designed to create most of its propulsion from a propeller driven by a turbine, usually through a gearbox.

Turboshaft engine means a gas turbine engine that is designed to drive a rotor transmission system or a gas turbine engine not used for propulsion.

U.S.-registered aircraft means an aircraft that is on the U.S. Registry.

We (us, our) means the Administrator of the Environmental Protection Agency and any authorized representatives.

3. Revise § 87.2 to read as follows:

§ 87.2 Abbreviations.

The abbreviations used in this part have the following meanings:

% percent
° degree
CO carbon monoxide
CO_2 carbon dioxide
G gram
HC hydrocarbon(s)
kN kilonewton
kW kilowatt
LTO landing and takeoff
NO_X oxides of nitrogen
rO rated output
rPR rated pressure ratio
SN smoke number

4. Revise § 87.3 to read as follows:

§ 87.3 General applicability and requirements.

(a) The regulations of this part apply to engines on all aircraft that are required to be certificated by FAA under 14 CFR part 33 except as specified in this paragraph (a). These regulations do not apply to the following aircraft engines:

(1) Reciprocating engines (including engines used in ultralight aircraft).

(2) Turboshaft engines such as those used in helicopters.

(3) Engines used only in aircraft that are not airplanes. For purposes of this paragraph (a)(4), ''airplane'' means a fixed-wing aircraft that is heavier than air.

(4) Engines not used for propulsion.

(b) Under section 232 of the Act, the Secretary of Transportation issues regulations to ensure compliance with the standards and related requirements of this part (42 U.S.C. 7572).

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

(d) No State or political subdivision of a State may adopt or attempt to enforce any aircraft or aircraft engine standard respecting emissions unless the standard is identical to a standard applicable to such aircraft under this part (including prior-tier standards applicable to exempt engines).

§ 87.5—[Removed]

5. Remove § 87.5.

6. Revise § 87.6 to read as follows:

§ 87.6 Aircraft safety.

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

§ 87.7—[Removed]

7. Remove § 87.7.

8. Revise § 87.8 to read as follows:

§ 87.8 Incorporation by reference.

(a) 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. To enforce any edition other than that specified in this section, the Environmental Protection Agency must publish notice of change in the **Federal Register** and the material must be available to the public. All approved material is available for inspection at U.S. EPA, Air and Radiation Docket and Information Center, 1301 Constitution Ave., NW., Room B102, EPA West Building, Washington, DC 20460, (202) 202–1744, and is available from the sources listed below. It is also available for inspection at the National Archives and Records Administration (NARA). For information on the availability of this material at NARA, call 202–741–6030 or go to *http://www.archives.gov/federal_register/code_of_federal_regulations/ibr_locations.html.*

(b) International Civil Aviation Organization, Document Sales Unit, 999 University Street, Montreal, Quebec, Canada H3C 5H7, (514) 954–8022, *http://www.icao.int,* or *sales@icao.int.*

(1) Annex 16 to the Convention on International Civil Aviation, Environmental Protection, Volume II—Aircraft Engine Emissions, Third Edition, July 2008. [Update for CAEP8 changes]; IBR approved for §§ 87.2, 87.40, 87.42(d) and (f), and 87.60(a) and (b).

(2) [Reserved]

(c) National Institute of Standards and Technology, 100 Bureau Drive, Stop 1070, Gaithersburg, MD 20899–1070, (301) 975–6478, *http://www.nist.gov,* or *inquiries@nist.gov.* Anyone may also purchase copies of these materials from the Government Printing Office, Washington, DC 20402, (202) 512–0916, *http://www.gpo.gov,* or *prntproc@gpo.gov.*

(1) NIST Special Publication 811, 1995 Edition, Guide for the Use of the International System of Units (SI), Barry N. Taylor, Physics Laboratory; IBR approved for § 87.2.

(2) [Reserved]

Subpart C—[Amended]

9. Amend § 87.21 as follows:

a. By revising the section heading.

b. By adding introductory text.

c. By revising paragraphs (d)(1)(iii), (d)(1)(iv), (d)(1)(vi) introductory text, (e)(1), and (f).

§ 87.21 Exhaust emission standards for Tier 4 and earlier engines.

This section describes the emission standards that apply for Tier 4 and earlier engines that apply for aircraft engines manufactured before [INSERT EFFECTIVE DATE OF FINAL RULE] and certain engines exempted under § 87.50. Note that the tier of standards identified for an engine relates to NO_X emissions and that the specified standards for HC, CO, and smoke emissions apply independent of the changes to the NO_X emission standards.

(d) * * *

(1) * * *

(iii) The following Tier 0 emission standard applies for 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.

Oxides of Nitrogen: (40 + 2(rPR)) grams/kilonewton rO.

(iv) The following Tier 2 emission standard applies for 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:

Oxides of Nitrogen: (32 + 1.6(rPR)) grams/kilonewton rO.

* * * * *

(vi) The following Tier 4 emission standards apply for engines of a type or model of which the date of manufacture of the first individual production model was after December 31, 2003:

(e) * * *

(1) Class TF of rated output less than 26.7 kilonewtons manufactured on or after August 9, 1985:

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

* * * * *

(f) The standards in this section refer to a composite emission sample measured and calculated in accordance with the procedures described in subpart G of this part.

10. Add a new § 87.23 to read as follows:

§ 87.23 Exhaust emission standards for Tier 6 and Tier 8 engines.

This section describes the emission standards that apply for Tier 6 and Tier 8 engines. The standards of this section apply for aircraft engines manufactured on or after [INSERT EFFECTIVE DATE OF FINAL RULE], except where we specify that they apply differently by year, or where the engine is exempt from one or more standards of this section. Except as specified in paragraph (d) of this section, these standards apply based on the date the engine is manufactured. Where the 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). 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 § 87.60. The tier of standards identified for an engine relates to NO_X emissions and that the specified standards for HC, CO, and smoke emissions apply independent of the changes to the NO_X emission standards.

(a) New turboprop aircraft engines with rated output at or above 1,000 kilowatts must comply with a smoke standard of $187 \cdot rO^{-0.168}$.

(b) New supersonic engines must comply with the standards shown in the following table:

TABLE TO § 87.23(b)—SMOKE AND GASEOUS EMISSION STANDARDS FOR NEW SUPERSONIC ENGINES

Rated output	Smoke number	HC (g/kN rated output)	NO_X (g/kN rated output)	CO (g/kN rated output)
rO < 26.7 kN	.....	$140 \cdot 0.92^{rPR}$	36+2.42 · rPR	$4550 \cdot rPR^{-1.03}$
rO > 26.7 kN	$83.6 \cdot rO^{-0.274}$ or 50, whichever is smaller	$140 \cdot 0.92^{rPR}$	36+2.42 · rPR	$4550 \cdot rPR^{-1.03}$

(c) New turbofan or turbojet aircraft engines that are installed in subsonic aircraft must comply with the following standards:

(1) The applicable smoke, HC, and CO standards are shown in the following table:

TABLE TO § 87.23(c)(1)—SMOKE, HC, AND CO STANDARDS FOR NEW SUBSONIC TURBOFAN OR TURBOJET ENGINES

Rated output (kN)	Smoke standard	Gaseous emission standards (g/kN rated output)	
		HC	CO
rO < 26.7 kN	$83.6 \cdot rO^{-0.274}$ or 50, whichever is smaller.		
rO ≥ 260.7 kN ...	$83.6 \cdot rO^{-0.274}$ or 50, whichever is smaller	19.6	118.

(2) The Tier 6 NO_X standards apply as described in this paragraph (c)(2). See paragraph (d) of this section for provisions related to models introduced before these standards started to apply and engines determined to be derivative engines for emissions certification purposes under the requirements of this part.

TABLE TO § 87.23(c)(2)—TIER 6 NO_X STANDARDS FOR NEW SUBSONIC TURBOFAN OR TURBOJET ENGINES WITH RATED OUTPUT ABOVE 26.7 KN

If the rated pressure ratio is . . .	and the rated output (in kN) is . . .	The NO_X emission standard (in g/kN rated output) is . . .
rPR ≤ 30	26.7 < rO ≤ 89	$38.5486 + 1.6823 \cdot rPR - 0.2453 \cdot rO - 0.00308 \cdot rPR \cdot rO$
	rO > 89	$16.72 + 1.4080 \cdot rPR$
30 < rPR < 82.6	26.7 < rO ≤ 89	$46.1600 + 1.4286 \cdot rPR - 0.5303 \cdot rO + 0.00642 \cdot rPR \cdot rO$
	rO > 89	$-1.04 + 2.0 \cdot rPR$
rPR ≥ 82.6	all	$32 + 1.6 \cdot rPR$

(3) The Tier 8 NO_X standards apply as described in this paragraph (c)(3) beginning January 1, 2014. See paragraph (d) of this section for provisions related to models introduced before January 1, 2014 apply and engines determined to be derivative engines for emissions certification purposes under the requirements of this part.

TABLE TO § 87.23(c)(3)—TIER 8 NO_X STANDARDS FOR NEW SUBSONIC TURBOFAN OR TURBOJET ENGINES WITH RATED OUTPUT ABOVE 26.7 kN

If the rated pressure ratio is . . .	and the rated output (in kN) is . . .	The NO_X emission standard (in g/kN rated output) is . . .
rPR ≤ 30	26.7 < rO ≤ 89	40.052 + 1.5681 · rPR − 0.3615 · rO − 0.0018 · rPR · rO
	rO > 89	7.88 + 1.4080 · rPR
30 < rPR < 104.7	26.7 < rO ≤ 89	41.9435 + 1.505 · rPR − 0.5823 · rO + 0.005562 · rPR · rO
	rO > 89	−9.88 + 2.0 · rPR
rPR ≥ 104.7	all	32 + 1.6 · rPR

(d) This paragraph specifies phase-in provisions that allow continued production of certain engines after the Tier 6 and Tier 8 standards begin to apply.

(1) Engine type certificate families certificated with characteristic levels at or below the Tier 4 NO_X standards of § 87.21 (as applicable based on rated output and rated pressure ratio) and introduced before [INSERT EFFECTIVE DATE OF FINAL RULE] may be produced through December 31, 2012 without meeting the Tier 6 NO_X standards of paragraph (c)(2) of this section. This also applies for engines that are covered by the same type certificate and are determined to be derivative engines for emissions certification purposes under the requirements of this part. Note that after this production cutoff date for the Tier 6 NO_X standards, such engines may be produced only if they are covered by an exemption under § 87.50. This production cutoff does not apply to engines installed (or delivered for installation) on military aircraft.

(2) Engine type certificate families certificated with characteristic levels at or below the Tier 6 NO_X standards of paragraph (c)(2) of this section with an introduction date before January 1, 2014 may continue to be produced. This also applies for engines that are covered by the same type certificate and are determined to be derivative engines for emissions certification purposes under the requirements of this part.

11. Add a new subpart E containing §§ 87.40, 87.42, 87.46, and 87.48 to part 87 to read as follows:

Subpart E—Certification Provisions

Sec.

§ 87.40 General certification requirement.

Manufacturers of engines subject to this part must meet the requirements of title 14 of the Code of Federal Regulations as applicable.

§ 87.42 Production report to EPA.

Engine manufacturers must submit an annual production report as specified in this section. This requirement applies for engines produced on or after January 1, 2013.

(a) You must submit the report for each calendar year in which you produce any engines subject to emission standards under this part. The report is due by February 28 of the following calendar year. If you produce exempted engines, you may submit a single report with information on both exempted and non-exempted engines.

(b) Send the report to the Designated EPA Program Officer.

(c) In the report, specify your corporate name and the year for which you are reporting. Include information as described in this section for each engine sub-model subject to emission standards under this part. List each engine sub-model produced or certificated during the calendar year, including the following information for each sub-model:

(1) The complete sub-model name, including any applicable model name, sub-model identifier, and engine type certificate family identifier.

(2) The certificate under which it was produced. Identify all the following:

(i) The type certificate number. Specify if the sub-model also has a type certificate issued by a certificating authority other than FAA.

(ii) Your corporate name as listed in the certificate.

(iii) Emission standards to which the engine is certificated.

(iv) Date of issue of type certificate (month and year).

(v) Whether or not this is a derivative engine for emissions certification purposes. If so, identify the original certificated engine model.

(vi) The engine sub-model that received the original type certificate for an engine type certificate family.

(3) The calendar-year production volume of engines from the sub-model that are covered by an FAA type certificate, or state that the engine model is no longer in production and list the date of manufacture (month and year) of the last engine produced. Specify the number of these engines that are intended for use on new aircraft and the number that are intended for use as non-exempt engines on in-use aircraft.

(4) The number of engines tested and the number of test runs for the applicable type certificate.

(5) The applicable test data and related information specified in Part III, Section 2.4 of ICAO Annex 16 (incorporated by reference in § 87.8), except as otherwise allowed by this paragraph. Include the percent of standard for the applicable standard, and for NO_X include percent of standard for all the NO_X standards specified in §§ 87.21 and 87.23. Specify thrust in kW for turboprop engines. You may omit the following items specified in Part III, Section 2.4 of ICAO Annex 16:

(i) Fuel specifications including fuel specification reference and hydrogen/carbon ratio.

(ii) Methods used for data acquisition, correcting for ambient conditions, and data analysis.

(iii) Intermediate emission indices and rates, however you may not omit the final characteristic level for each regulated pollutant in units of g/kN or g/kW.

(d) [Reserved]

(e) Include the following signed statement and endorsement by an authorized representative of your company: ''We submit this report under 40 CFR 87.42. All the information in this report is true and accurate to the best of my knowledge.

(f) Where information provided for the previous year remains valid and complete, you may report your production volumes and state that there are no changes, without resubmitting the other information specified in this section.

§ 87.46 Recordkeeping.

(a) You must keep a copy of any reports or other information you submit to us for at least three years.

(b) Store these records in any format and on any media, as long as you can promptly send us organized, written records in English if we ask for them. You must keep these records readily

available. We may review them at any time.

§ 87.48 Derivative engines for emissions certification purposes.

(a) *General.* A type certificate holder may request from the FAA a determination that an engine model is considered a derivative engine for emissions certification purposes. This would mean that the engine model is determined to be similar in design to a previously certificated engine (the ''original'' engine) for purposes of compliance with exhaust emission standards (gaseous and smoke). In order for the engine model to be considered a derivative engine for emission purposes under this part, it must have been derived from an original engine that was certificated to the requirements of 14 CFR part 33, and one of the following conditions must be met:

(1) The FAA 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. FAA may adjust these criteria in unusual circumstances, consistent with good engineering judgment.

(b) *Emissions 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 only within the following ranges:

(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.

(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, you 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, then, you may use engineering analysis to demonstrate that the derivative engine will not exceed the applicable emission standards, consistent with good engineering judgment. The engineering analysis must address all modifications from the original engine, including those approved for previous derivative engines.

(c) *Continued production allowance.* Where we allow continued production of an engine model after new standards begin to apply, you may also produce engine derivatives if they 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.

12. Add a new subpart F containing § 87.50 to part 87 to read as follows:

Subpart F—Exemptions and Exceptions

§ 87.50 Exemptions and exceptions.

This section specifies provisions related to exempting/excepting engines from some or all of the standards and requirements of this part 87. Exempted/excepted engines must conform to regulatory conditions specified for an exemption in this section and other applicable regulations. Exempted/excepted engines are deemed to be ''subject to'' the standards of this part even though they are not required to comply with the otherwise applicable requirements. Engines exempted/excepted with respect to certain standards must comply with other standards. Exemption requests under this section must be approved by the FAA, with the written concurrence of EPA, to be effective. Exceptions do not require a case-by-case FAA approval.

(a) *Engines installed in new aircraft.* Type certificate holders may request an exemption to produce a limited number of newly manufactured engines through December 31, 2016, to be installed in new aircraft as specified in this paragraph (a). This exemption is limited to NO_X emissions from engines that are covered by a valid type certificate issued by FAA.

(1) Submit your request for an exemption before producing the engines to be exempted to the FAA who will provide a copy to the Designated EPA Program Officer. Exemption by an authority outside the United States does not satisfy this requirement. All requests must include the following:

(i) Your corporate name and an authorized representative's contact information.

(ii) A description of the engines for which you are requesting the exemption including the type certificate number and date it was issued by the FAA. Include in your description the engine model and sub-model names and the types of aircraft in which the engines are expected to be installed. Specify the number of engines that you would produce under the exemption and the period during which you would produce them.

(iii) Information about the aircraft in which the engines will be installed. Specify the airframe models and expected first purchasers/users of the aircraft. Identify all countries in which you expect the aircraft to be registered. Specify how many aircraft will be registered in the United States and how many will be registered in other countries; you may estimate this if it is not known.

(iv) A justification of why the exemption is appropriate. Justifications must include a description of the environmental impact of granting the exemption. Include other relevant information such as the following.

(A) Technical issues, from an environmental and airworthiness perspective, which may have caused a delay in compliance with a production cutoff.

(B) Economic impacts on the manufacturer, operator(s), and aviation industry at large.

(C) Environmental effects. This should consider the amount of additional air pollutant emissions that will result from the exemption. This could include consideration of items such as:

(*1*) The amount that the engine model exceeds the standard, taking into account any other engine models in the engine type certificate family covered by the same type certificate and their relation to the standard.

(*2*) The amount of the applicable air pollutant that would be emitted by an alternative engine for the same application.

(*3*) The impact of changes to reduce the applicable air pollutant on other environmental factors, including emission rates of other air pollutants, community noise, and fuel consumption.

(*4*) The degree to which the adverse impact would be offset by cleaner engines produced in the same time period (unless we decide to consider earlier engines).

(D) Impact of unforeseen circumstances and hardship due to business circumstances beyond your control (such as an employee strike, supplier disruption, or calamitous events).

(E) Projected future production volumes and plans for producing a

compliant version of the engine model in question.

(F) Equity issues in administering the production cutoff among economically competing parties.

(G) List of other certificating authorities from which you have requested (or expect to request) exemptions, and a summary of the request.

(H) Any other relevant factors.

(v) A statement signed by your authorized representative attesting that all information included in the request is accurate.

(2) In consultation with the EPA, the FAA may specify additional conditions for the exemption. The FAA may also require additional information pursuant to 14 CFR Parts 11 and 34, as applicable to exemption requests made to the FAA.

(3) You must submit the annual report specified in paragraph (d) of this section.

(4) The permanent record for each engine exempted under this paragraph (a) must indicate that the engine is an exempted new engine.

(5) Engines exempted under this paragraph (a) must be labeled with the following statement: ''EXEMPT NEW''.

(6) You must notify the FAA if you determine after submitting your request that the information is not accurate, either from an error or from changing circumstances. If you believe the new or changed information could have affected approval of your exemption (including information that could have affected the number of engines we exempt), you must notify the FAA promptly. The FAA will consult with EPA as needed to address any concerns related to this new or corrected information.

(b) [Reserved]

(c) *Spare engines.* Newly manufactured engines meeting the definition of ''spare engine'' are excepted as follows:

(1) This exception allows production of a newly manufactured engine for installation on an in-service aircraft. It does not allow for installation of a spare engine on a new aircraft.

(2) Each spare engine must be identical to a sub-model previously certificated to meet all requirements applicable to Tier 4 engines or later requirements.

(3) Spare engines excepted under this paragraph (c) may be used only where the emissions of the spare engines are equal to or lower than those of the engines they are replacing, for all pollutants.

(4) No prior approval is required to produce spare engines. Engine manufacturers must include information about their production of spare engines in the annual report specified in paragraph (d) of this section

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

(6) Engines excepted under this paragraph (c) must be labeled with the following statement: ''EXCEPTED SPARE''.

(d) *Annual reports.* If you produce engines with an exemption/exception under this section, you must submit an annual report with respect to such engines.

(1) You must send the Designated EPA Program Officer a report describing your production of exempted/excepted engines for each calendar year in which you produce such engines by February 28 of the following calendar year. You may include this information in the certification report described in § 87.42. Confirm that the information in your initial request is still accurate, or describe any relevant changes.

(2) Provide the information specified in this paragraph (d)(2). For purposes of this paragraph (d), treat spare engine exceptions separate from other new engine exemptions. Include the following for each exemption/exception and each engine model and sub-model:

(i) Engine model and sub-model names.

(ii) Serial number of each engine.

(iii) Use of each engine (for example, spare or new installation).

(iv) Types of aircraft in which the engines were installed (or are intended to be installed for spare engines).

(v) Serial number of the new aircraft in which engines are installed (if known), or the name of the air carriers (or other operators) using spare engines.

(3) Include information in the report only for engines having a date of manufacture within the specific calendar year.

Subpart G—Test Procedures

13. The heading for subpart G is revised as set forth above.

14. Revise § 87.60 to read as follows:

§ 87.60 Testing engines.

(a) Use the equipment and procedures specified in Appendix 3, Appendix 5, and Appendix 6 of ICAO Annex 16 (incorporated by reference in § 87.8), as applicable, to demonstrate whether engines meet the gaseous emission standards specified in subpart C of this part. Measure the emissions of all regulated gaseous pollutants. Similarly, use the equipment and procedures specified in Appendix 2 and Appendix 6 of ICAO Annex 16 to determine whether engines meet the smoke standard specified in subpart C of this part. The compliance demonstration consists of establishing a mean value from testing some 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 turbofan engines, consistent with good engineering judgment.

(b) Use a test fuel meeting the specifications described in Appendix 4 of ICAO Annex 16 (incorporated by reference in § 87.8). 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 alternate procedures for measuring emissions as specified in this paragraph (e). This might include testing and sampling methods, analytical techniques, and equipment specifications that differ from those specified in this part. Manufacturers and operators may request this approval by sending a written request with supporting justification to the FAA and to the Designated EPA Program Officer. Such a request may be approved only if one of the following conditions is met:

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

(2) The alternate procedure is shown to be equivalent to or better (*e.g.,* more accurate or precise) than the specified procedure.

(f) The following landing and take-off (LTO) cycles apply for emission testing and calculating weighted LTO values:

TABLE TO § 87.60(f)—LTO TEST CYCLES

Mode	Turboprop		Subsonic Turbofan		Supersonic Turbofan	
	Percent of rated output	Time in mode (minutes)	Percent of rated output	Time in mode (minutes)	Percent of rated output	Time in mode (minutes)
Take-off	100	0.5	100	0.7	100	1.2
Climb	90	2.5	85	2.2	65	2.0
Descent	.....	.....	.....	.....	15	1.2
Approach	30	4.5	30	4.0	34	2.3
Taxi/ground idle	7	26.0	7	26.0	5.8	26.0

(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 § 87.60.

§ 87.61 [Removed]

15. Remove § 87.61

§ 87.62 [Removed]

16. Remove § 87.62.

§ 87.64 [Revised]

17. Remove and reserve paragraph (a).

§ 87.71 [Removed]

18. Remove § 87.71.

Subpart H [Removed]

19. Remove subpart H.

PART 1068—GENERAL COMPLIANCE PROVISIONS FOR ENGINE PROGRAMS

20. The authority citation for part 1068 continues to read as follows:

Authority: 42 U.S.C. 7401–7671q.

Subpart A—[Amended]

21. Amend § 1068.1 by revising paragraph (b) to read as follows:

§ 1068.1 Does this part apply to me?

* * * * *

(b) This part does not apply to any of the following engine or vehicle categories:

(1) Light-duty motor vehicles (see 40 CFR part 86).

(2) Heavy-duty motor vehicles and motor vehicle engines, except as specified in 40 CFR part 86.

(3) Aircraft engines, except as specified in 40 CFR part 87.

(4) Land-based nonroad compression-ignition engines we regulate under 40 CFR part 89.

(5) Small nonroad spark-ignition engines we regulate under 40 CFR part 90.

(6) Marine spark-ignition engines we regulate under 40 CFR part 91.

(7) Locomotive engines we regulate under 40 CFR part 92.

(8) Marine compression-ignition engines we regulate under 40 CFR parts 89 or 94.

* * * * *

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