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Part II

## Environmental Protection Agency

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

**ENVIRONMENTAL PROTECTION AGENCY**

**40 CFR Parts 87 and 1068**

**[EPA–HQ–OAR–2010–0687; FRL–9678–1]**

**RIN 2060–AO70**

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

**AGENCY:** Environmental Protection Agency (EPA).

**ACTION:** Final rule.

**SUMMARY:** EPA is adopting several new aircraft engine emission standards for oxides of nitrogen ($NO_X$), compliance flexibilities, and other regulatory requirements for aircraft turbofan or turbojet engines with rated thrusts greater than 26.7 kilonewtons (kN). We also are adopting certain other requirements for gas turbine engines that are subject to exhaust emission standards as follows. First, we are clarifying 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 establishing 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 establishing amendments to aircraft engine test and emissions measurement procedures. EPA actively participated in the United Nations' International Civil Aviation Organization (ICAO) proceedings in which most of these requirements were first developed. These regulatory requirements have largely been adopted or are actively under consideration by its member states. By adopting such similar standards, therefore, the United States maintains consistency with these international efforts.

**DATES:** These final rules are effective on July 18, 2012. The incorporation by reference of certain publications listed in this regulation is approved by the Director of the Federal Register as of July 18, 2012.

**ADDRESSES:** EPA has established a docket for this action under Docket ID No. EPA–HQ–OAR–2010–0687. All documents in the docket are listed on the *http://www.regulations.gov* Web site. Although listed in the index, some information is not publicly available, e.g., confidential business information or other information whose disclosure is restricted by statute. Certain other material, such as copyrighted material, is not placed on the Internet and will be publicly available only in hard copy form. Publicly available docket materials are available electronically through *http://www.regulations.gov* or in hard copy at the 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 Air Docket 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; email 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 [b] Codes | 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. Executive Summary
II. Overview and Background
A. Contents of the Final Rule
B. EPA's Authority and Responsibilities Under the Clean Air Act
C. Interaction With the International Community
D. Brief History of EPA's Regulation of Aircraft Engine Emissions
E. Brief History of ICAO Regulation of Aircraft Engine Emissions
III. Why is EPA taking this action?
A. Inventory Contribution
B. Health, Environmental and Air Quality Impacts
1. Background on Ozone, PM and $NO_X$
a. What is ozone?
b. What is particulate matter?
c. What is $NO_X$?
2. Health Effects Associated With Exposure to Ozone, PM and $NO_X$
a. What are the health effects of ozone?
b. What are the health effects of PM?
c. What are the health effects of $NO_X$?
3. Environmental Effects Associated With Exposure to Ozone, PM and $NO_X$
a. Deposition of Nitrogen
b. Visibility Effects
c. Plant and Ecosystem Effects of Ozone
4. Impacts on Ambient Air Quality
IV. Details of the Final Rule
A. $NO_X$ Standards for Newly-Certified Engines
1. Tier 6 $NO_X$ Standards for Newly-Certified Engines
a. Numerical Emission Limits for Higher Thrust Engines
b. Numerical Emission Limits for Lower Thrust Engines
2. Tier 8 $NO_X$ Standards for Newly-Certified Engines
a. Numerical Emission Limits for Higher Thrust Engines
b. Numerical Emission Limits for Lower Thrust Engines
B. Application of $NO_X$ Standards for Newly-Manufactured Engines
1. Phase-In of the Tier 6 $NO_X$ Standards for Newly-Manufactured Engines
2. Carryover of Previously Generated Emission Data
3. Exemptions and Exceptions From the Tier 6 Production Cutoff
a. New Provisions for Spare Engines
b. New Provisions for Engines Installed in New Aircraft
i. Time-Frame and Scope
ii. Production Limit
iii. Exemption Requests
iv. Coordination of Exemption Requests
v. Low-Volume, Time-Limited Transitional Exception Program
c. Voluntary Emission Offsets
4. Potential Phase-In of New Tier 8 $NO_X$ Standards for Newly-Manufactured Engines

C. Application of Standards for Derivative Engines
D. Annual Reporting Requirement
E. Standards for Supersonic Aircraft Turbine Engines
F. Amendments to Test and Measurement Procedures
G. Possible Future Revisions to Emission Standards for New Technology Turbine Engines and Supersonic Aircraft Turbine Engines
V. Description of Other Revisions to the Regulatory Text
A. Applicability Issues
1. Military Engines
2. Noncommercial Engines
B. Non-Substantive Revisions
C. Clarifying Language for Regulatory Text
VI. Technical Feasibility and Cost Impacts
VII. Consultation With FAA
VIII. Public Participation
IX. Statutory Provisions and Legal Authority
X. Statutory and Executive Order Reviews
A. Executive Order 12866: Regulatory Planning and Review, and Executive Order 13563: Improving Regulation and Regulatory Review
B. Paperwork Reduction Act
C. Regulatory Flexibility Analysis
D. Unfunded Mandates Reform Act
E. Executive Order 13132: Federalism
F. Executive Order 13175: Consultation and Coordination With Indian Tribal Governments
G. Executive Order 13045: Protection of Children From Environmental Health & Safety Risks
H. Executive Order 13211: Actions That Significantly Affect Energy Supply, Distribution, or Use
I. National Technology Transfer Advancement Act
J. Executive Order 12898: Federal Actions To Address Environmental Justice in Minority Populations and Low Income Populations
K. Congressional Review Act
L. Executive Order 13609: Promoting International Regulatory Cooperation

## I. Executive Summary

### *A. Purpose of the Regulatory Action*

The primary purpose of this rule is to adopt new oxides of nitrogen ($NO_X$) emission standards for aircraft engines with rated thrusts greater than 26.7 kN thrust. These are mostly commercial passenger and freighter aircraft in common use at airports across the U.S. It does not include engines used on military aircraft. $NO_X$ is strongly correlated with $NO_2$, for which EPA has established National Ambient Air Quality Standards (NAAQS), i.e., a criteria pollutant, and it is an important precursor gas in the formation of tropospheric ozone and secondary particulate matter which are common air pollutants in urban areas where airports are located. Currently, approximately 154 million people live in areas designated nonattainment for one or more of the current NAAQS. This rule will allow us to enforce in the U.S. the emission standards adopted by ICAO, and will be useful to states in attaining or maintaining the ozone, $PM_{2.5}$, and $NO_2$ NAAQS standards. This rule also contains several provisions to facilitate the implementation of EPA's aircraft engine emission regulations and related requirements. It is also important to note that adoption of the provisions in this rule meets U.S. treaty obligations under the Chicago Convention of 1944 by aligning our regulations with those in the International Civil Aviation Organization Annex 16, Volume II (adopted in 2010) that the U.S. helped to develop and support as part of the international process. This rule is being implemented under the authority provided in section 231 of the Clean Air Act (42 U.S.C. 7571), which 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.

### *B. Summary of Major Provisions of the Regulatory Action*

The rule contains six major provisions. The first two provisions are new $NO_X$ emission standards for newly certified-engine models. The first standards, Tier 6, take effect when this rule becomes effective. These represent approximately a 12 percent reduction from current Tier 4 levels. They were actually adopted by ICAO in 2005 with an implementation date in 2008. The second standards, Tier 8, were adopted by ICAO in 2008 and take effect in 2014. These represent approximately a 15 percent reduction from Tier 6 levels. As noted above, both tiers of emission standards are needed to address local air quality concerns (NAAQS) and to meet U.S. treaty obligations under the Chicago Convention. The third major provision is a production cut-off for newly-manufactured engines (as opposed to newly-certified engines) which basically requires that after December 31, 2012 all newly-manufactured engines must meet at least Tier 6 $NO_X$ emission standards. This is also needed to meet our obligations under the Chicago Convention. The production cut-off is needed to ensure that the emission reductions envisioned by the emission standards are achieved on new production engines. The fourth major provision is related to potential exemptions or exceptions to the production cut-off requirement. These include revised provisions allowing manufacturers to request that FAA in consultation with EPA grant exemptions from the production cut-off for a designated number of engines within a prescribed time frame. These also include a low-volume, time-limited exception provision that will exclude several engines from the production cutoff. Both of these provisions help to assure an orderly transition to the new standards for engines needing more time to comply or for a few engines at the end of their production life. Finally, the rule includes a set of provisions which may be considered as minor if viewed separately, but collectively are important in upgrading EPA's regulations by incorporating some related agreements from our ICAO process and clarifying and improving existing provisions. Examples of this include special provisions for spare engines, provisions related to derivative engine models, test procedure specifications and reporting requirements. These changes are important for an effective implementation of the new requirements, and in many cases are also needed to meet our obligations under the Chicago Convention.

### *C. Costs and Benefits*

This is not an economically significant regulatory action. Aircraft engines are international commodities used on aircraft manufactured and sold around the world. When developing new engine models manufacturers not only consider current emission requirements but also try to anticipate the stringency of future standards and respond appropriately. Engine manufacturers participated in the deliberations leading up to ICAO decisions on the aircraft engine $NO_X$ emission standards and after the ICAO decisions they incorporated engine technology changes as needed to meet the new ICAO requirements. This helps to ensure the world wide acceptability of their products. Essentially all of these changes are now complete. Thus, while there is some cost to a manufacturer for responding to the new ICAO provisions, there is no significant further direct cost to the manufacturers created by EPA's adopting the requirements into U.S regulations. In fact, it is likely that our adopting these requirements facilitates the acceptance of U.S. type certificates by aircraft manufacturers and airlines around the world.

## II. Overview and Background

This section summarizes the major provisions of the final 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. Contents of the Final Rule*

We are adopting 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 establishing two new tiers of more stringent emission standards for oxides of nitrogen ($NO_X$).[2] The standards apply differently to two classes of these engines, i.e., ''newly-certified engines'' and ''newly-manufactured engines.'' The newly-certified engine standards 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 apply to aircraft engines that were previously certified and manufactured in compliance with preexisting standards, and they require manufacturers to either comply with the newer standards by a specified future date or cease production of the affected engine models. Newly-manufactured engine standards are also sometimes referred to as ''production cutoff'' standards. Second, we are adopting 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 $NO_X$ standards because of specific technical or economic reasons.[3]

We are also making a number of additional changes that would apply to a wider range of aircraft gas turbine engines [4] than those that would be subject to the new emission standards.[5] First, we are defining the meaning of 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 establishing new reporting requirements for manufacturers that produce gas turbine engines subject to any exhaust emission standard. This will provide us with timely and consistent emission data and other information that is necessary to conduct emission inventory and air quality analyses and develop appropriate public policy for the aviation sector. Specifically, reports are 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.[6] Third, we are adopting minor amendments to the test and measurement procedures for aircraft engines. Finally, as described in section IV, we are making minor amendments to regulator provisions addressing definitions, acronyms and abbreviations, general applicability and requirements, exemptions, and incorporation by reference.

Most of these new regulatory requirements have already been adopted by the United Nation's International Civil Aviation Organization (ICAO). The requirements contained in this final rule 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 D.C. 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 (D.C. 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 ensure 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 final rule further discusses our coordination with DOT through the FAA.[7] 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 air pollution 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

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

[2] As previously mentioned, these new $NO_X$ standards are identical to requirements established by ICAO. The stringency of any new emission standard is selected based on an assessment of the technical feasibility, cost, and environmental benefit of potential requirements. The $NO_X$ standards we are promulgating today will not affect fuel economy or have any practical effect on $CO_2$ emissions. (See International Civil Aviation Organization (ICAO), ''Committee on Aviation Environmental Protection (CAEP), Eighth Meeting, Montreal, 1 to 12 February 2010, CAEP/8 $NO_X$ Stringency Cost–Benefit Analysis Demonstration Using APMT–IMPACTS,'' CAEP/8–IP/30, December 1, 2010. A copy of this document is in docket number EPA–HQ–OAR–2010–0687.)

[3] These exemption or exception provisions are conceptually the same as the ICAO exemption provisions and provide the same regulatory flexibilities to all engine manufacturers.

[4] 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).

[5] This includes turbofan and turbojet engines less than 26.7 kN thrust and all turboprop engines that are subject to any emission standard, e.g., smoke.

[6] As discussed further in section III.D., the voluntary emission data report to ICAO does not include turbofans at or below 26.7 kN or turboprops subject to any emission standard.

[7] 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).

''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.'' [8] 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 191 participating member States of ICAO.[9] [10]

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.[11] 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.[12] 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.[13] However, if a nation sets tighter standards than ICAO, air carriers not based in that nation would only be required to comply with ICAO standards or more stringent standards imposed by their own nations, if applicable.

ICAO'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 committees whose contributing members include atmospheric, economic, aviation, environmental, and other professionals interested in aviation and environmental protection. At CAEP meetings, the United States is represented by the FAA, which plays an active role at these meetings.[14] 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).[15] [16]

### *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.[17] Since that time, we have occasionally revised those regulations. Two of these revisions are most pertinent to today's final rule. 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.[18] 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) [19] 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.[20] 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 (D.C. 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

[8] 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 *www.icao.int.*

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

[10] There are currently 191 Contracting States according to ICAO Web site located at *www.icao.int.*

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

[12] 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 *www.icao.int/icaonet/arch/doc/7300/7300_9ed.pdf.*

[13] 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 *www.icao.int/icaonet/arch/doc/7300/7300_9ed.pdf.*

[14] Pursuant to the President's memorandum of August 11, 1960 (and related Executive Order No. 10883 from 1960), the Interagency Group on International Aviation (IGIA) was established to facilitate coordinated recommendations to the Secretary of State on issues pertaining to international aviation. The DOT/FAA is the chair of IGIA, and as such, the FAA represents the U.S. on environmental matters at CAEP.

[15] 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.

[16] CAEP develops new emission standards based on an assessment of the technical feasibility, cost, and environmental benefit of potential requirements.

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

[18] 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 section IV.A.2. of today's notice, we are expanding the scope of that finding and of our standards pursuant to section 231(a)(2)(A) of the Clean Air Act to include such emissions from both commercial and non-commercial aircraft engines based on the physical and operational similarities between commercial and noncommercial civilian aircraft and to bring our standards into full alignment with ICAO's.

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

[20] 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.

adopted by ICAO in 1981.[21] 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.[22] 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 previously certified, newly-manufactured engines unlike the CAEP/2 standards). In 2004, CAEP/6 recommended a 12 percent $NO_X$ reduction, which ICAO approved in 2005.[23] [24] The CAEP/6 standards applied to new engine designs (newly-certified models) certified 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.[25] [26] The Committee also recommended that the CAEP/6 standards be applied to newly-manufactured engines. ICAO approved these recommendations in 2011.[27]

## III. 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 $NO_X$, a precursor to the formation of tropospheric ozone and secondary PM.[28] Most commercial airports are located in urbanized areas [29] and many urbanized 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 $PM_{2.5}$).[30] 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 and $PM_{2.5}$ 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, known as non-LTO emissions. Collectively, the emissions associated with all ground and flight operations are generally referred to as full flight emissions.

In this section, we will discuss $NO_X$ emission inventories for commercial turbine-engine aircraft, both nationally and for selected ozone and $PM_{2.5}$ 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).[31] 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 LTO operations contributed about 97 thousand tons to the national $NO_X$ inventory.[32] 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.[33] It is also worth noting that these LTO emissions are more localized in that they occur near airports, which are mostly within urban areas.

[21] ICAO, Foreword of ''Aircraft Engine Emissions,'' International Standards and Recommended Practices, Environmental Protection, Annex 16, Volume II, Third Edition, July 2008. Copies of this document can be obtained from the ICAO Web site at *www.icao.int.*

[22] 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.

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

[24] 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 *www.icao.int.*

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

[26] 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.

[27] ICAO, ''Aircraft Engine Emissions,'' Annex 16, Volume II, Third Edition, July 2008, Amendment 7 effective on July 18, 2011. Copies of this document can be obtained from the ICAO Web site at *www.icao.int.*

[28] 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.

[29] According to Airport Council International—North America and similar FAA databases, most commercial operations occur at airports that are in or near large cities or urbanized areas. There are about 130 commercial airports in 78 ozone and fine particulate nonattainment areas (based on the nonattainment areas status of 2008). There are about 325 commercial airports in the U.S.

[30] For a current list of nonattainment areas see: *http://www.epa.gov/oar/oaqps/greenbk/index.html.*

[31] ''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.

[32] The cumulative LTO $NO_X$ reduction associated with the new $NO_X$ standards is projected to be about 100,000 tons from 2014 to 2030 (2014 is the implementation date of the CAEP/8 $NO_X$ standards). See ''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.

[33] 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.

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 NAAs with airports which had high commercial traffic volumes were identified. Second, the 25 NAAs with the largest population were identified. These lists were combined. However, there was some overlap, and this led to a total of 40 NAAs being identified for the study.[34] These NAAs collectively include 200 airports, accounting for about 70 percent of commercial air traffic operations.

Of the 40 NAAs originally studied by ERG as previously described, we identified the 30 areas that were in nonattainment for ozone or $PM_{2.5}$ as of March 30, 2012.[35] Current (2008) and projected (2020) $NO_X$ emissions for these 30 ozone and $PM_{2.5}$ 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.[36] [37] [38] 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—$NO_X$ EMISSIONS IN SELECTED OZONE AND $PM_{2.5}$ NONATTAINMENT AREAS

| Nonattainment area | 2008 Total $NO_X$ (tons) | 2008 Aircraft percent of mobile source $NO_X$ | 2020 Aircraft percent of mobile source $NO_X$ |
| --- | --- | --- | --- |
| 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 |
| 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 |
| 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 |
| 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 |
| Milwaukee-Racine, WI | 557 | 0.9 | 3.2 |
| 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 |
| 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 |
| 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.

[34] 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.

[35] For a current list of nonattainment areas see: *http://www.epa.gov/oar/oaqps/greenbk/index.html.*

[36] 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.

[37] 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.

[38] U.S. EPA, ''Update 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, April 30, 2012.

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.*

*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 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 aligning will help reduce ambient ozone and secondary PM levels and thus will help areas with airports achieve or maintain attainment with the National Ambient Air Quality Standards (NAAQS).[39]

1. Background on Ozone, PM and $NO_X$

a. What is ozone?

Ground-level ozone pollution is typically formed through reactions involving 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.[40] 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 and its precursors can be transported hundreds of miles downwind from 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). The current PM NAAQS uses $PM_{2.5}$ as the indicator for fine particles (with $PM_{2.5}$ generally referring to particles with a nominal mean aerodynamic diameter less than or equal to 2.5 micrometers (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 $PM_{10\text{-}2.5}$). Ultrafine particles are a subset of fine particles, generally less than 100 nanometers (0.1 μm) in 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 components 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. $NO_2$ and its gas phase oxidation products can dissolve in water droplets and further oxidize to form nitric acid which reacts with ammonia to form nitrates, an important component of ambient PM. $NO_X$ and VOC 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 and 2007 Staff Paper.[41] [42] People who are more susceptible to effects associated with exposure to ozone can include children,

[39] The discussion of PM health and welfare effects throughout this notice relates exclusively to the effects of the $NO_X$ 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.

[40] 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.*

[41] 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.*

[42] 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.*

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 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.[43] Animal toxicological evidence indicates that with repeated exposure, ozone can 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).[44] The ISA summarizes health effects evidence associated with both short-term and long-term exposures to $PM_{2.5}$, $PM_{10-2.5}$, and ultrafine particles.

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 myocardial ischemia, 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 and respiratory infections.[45] The ISA notes that long-term exposure (months to years) to $PM_{2.5}$ is associated with the development/progression of cardiovascular disease, premature mortality, and respiratory effects, including reduced lung function growth in children, increased respiratory symptoms, and asthma development.[46] 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 premature 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 including respiratory-related infant mortality and cancer, mutagenicity, and genotoxicity and long-term exposure to $PM_{2.5}$.[47]

For $PM_{10-2.5}$, the ISA concludes that the current evidence is suggestive of a causal relationship between short-term exposures and premature mortality, cardiovascular effects, 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 particles, the ISA 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 ultrafine particles and respiratory effects. Data are inadequate to draw conclusions regarding the health effects associated with long-term exposure to ultrafine particles.

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.[48] 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. 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. Small but significant increases in non-specific airway hyperresponsiveness were reported following 1-hour exposures of asthmatics to 0.1 ppm $NO_2$. 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

[43] 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.

[44] 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.

[45] 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.

[46] 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.

[47] 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.

[48] 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.

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 United States. 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 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 damage to forest productivity and reductions in ecosystem services. Potential impacts also include adverse effects to human health through ingestion of contaminated vegetation or livestock (as in the case for dioxin deposition), reduction in crop yield, and limited use of land due to contamination.

Atmospheric deposition of pollutants 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.[49] Atmospheric deposition may 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 $PM_{2.5}$.[50] 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.[51]

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 promulgating would affect ambient concentrations of air pollutants. Nationally, levels of $PM_{2.5}$, ozone, and $NO_X$ are declining.[52] However as of March 30, 2012, over 15 million people live in areas designated nonattainment for one or more of the current NAAQS.[53] 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 ozone nonattainment areas are required to take action to bring

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[49] 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.*

[50] 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.*

[51] 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.

[52] 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/.*

[53] U.S. EPA, 2012. *http://www.epa.gov/oar/oaqps/greenbk/index.html*

those areas into attainment. The attainment date assigned to an ozone nonattainment area is based on the area's classification. Most ozone nonattainment areas are required to attain the 1997 8-hour ozone NAAQS in the 2007 to 2013 time frame and then to maintain it thereafter.[54] We anticipate designating areas for the 2008 ozone standards in late spring 2012; thus, the attainment dates for areas designated nonattainment for the 2008 8-hour ozone NAAQS would likely be in the 2015 to 2032 timeframe, depending on the severity of the problem in each area.[55]

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 compliance with them thereafter. The 2006 24-hour $PM_{2.5}$ 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.

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 10 counties with a population of over 30 million may not attain the 2008 ozone standard of 0.075 ppm (75 ppb) without additional controls.[56] In addition, our air quality modeling projects that in 2030 at least four counties with a population of nearly 7 million may not attain the 1997 annual $PM_{2.5}$ standard of 15 μg/m³ and 22 counties with a population of over 33 million may not attain the 2006 24-hour $PM_{2.5}$ standard of 35 μg/m³ without additional controls.[57] [58] 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.

In summary, the aircraft $NO_X$ reductions resulting from these new aircraft engine emission standards will be useful to states in attaining or maintaining the ozone, $PM_{2.5}$, and $NO_2$ NAAQS standards.

## IV. Details of the Final Rule

The following is a description of the regulations being adopted in this final rule, with any changes from the proposal also noted. The descriptions also include our response to the most significant comments received on the proposal. A full summary of the comments and our responses are contained in the response to comments document for the rule that is available in the public docket for this action.[59]

We are establishing 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).[60] Each of the tiers 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.[61]

We are also requiring newly-manufactured engines to comply with the first tier of the two tiers of standards. 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 must comply with the same $NO_X$ limits as newly-certified engines, but at a later date or cease production.[62] The end of this ''phase-in'' period for the newly-manufactured engine standards is sometimes referred to as a ''production cutoff.''. Again, we are adopting 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 established in this final rule. First, we are revising provisions for 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 new $NO_X$ standards because of specific technical or economic reasons.[63] Second, we are defining ''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 establishing 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. Promulgating these standards meets our treaty obligation under the Convention on International Civil Aviation as previously described

[54] The Los Angeles South Coast Air Basin 8-hour ozone nonattainment area and the San Joaquin Valley Air Basin 8-hour ozone nonattainment area are designated as extreme and will have to attain before June 15, 2024. The Sacramento, Coachella Valley and Houston 8-hour ozone nonattainment areas are designated as severe and will have to attain by June 15, 2019. In addition, the Western Mojave 8-hour ozone nonattainment area has requested to be reclassified as severe. This request has not yet been acted on.

[55] U.S. EPA, 2012. Proposed Rule—Implementation of the 2008 National Ambient Air Quality Standards for Ozone: Nonattainment Area Classifications Approach, Attainment Deadlines and Revocation of the 1997 Ozone Standards for Transportation Conformity Purposes. (77 FR 8107, February 14, 2012).

[56] U.S. EPA (2010). Regulatory Impact Analysis: Final Rulemaking To Establish Greenhouse Gas Emission Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles. Chapter 8: Health and Environmental Impacts. EPA 420–R–11–901.

[57] U.S. EPA (2010). Regulatory Impact Analysis: Final Rulemaking To Establish Greenhouse Gas Emission Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles. Chapter 8: Health and Environmental Impacts. EPA 420–R–11–901.

[58] These figures are based on the results of EPA computer modeling, which is not affected by the upcoming 2008 ozone NAAQS nonattainment designations.

[59] U.S. Environmental Protection Agency, ''Summary and Analysis of Comments: Control of Air Pollution From Aircraft and Aircraft Engines,'' Office of Transportation and Air Quality, EPA–420–R–12–011, May 2012. A copy of this document is in docket number EPA–HQ–OAR–2010–0687.

[60] The standards will 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.

[61] 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. Copies of this document can be obtained from the ICAO Web site at *www.icao.int.* The term ''first individual production model'' means the first engine ever produced of a unique model or type.

[62] 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 *www.icao.int.*

[63] These apply only to the first tier of $NO_X$ standards. We are not adopting a production cutoff for the second tier of standards.

in section I.C. Fourth, we are making several changes 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 amending the current regulatory provisions that address 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 amendments reflect those changes that were previously adopted by ICAO.

This final rule 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 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 final rule provides 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 new standards. Today's final rule is also consistent with U.S. treaty obligations under the Chicago Convention as described in section I.C., because the requirements are consistent with current ICAO standards.

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 revising exhaust emission standards for HC, CO, or smoke. All engines subject to the 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 including these existing HC, CO, and smoke standards in a new section 87.23, which would also contain the new Tier 6 and Tier 8 $NO_X$ standards, we are not actually adopting new standards for these three pollutants, 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.

As discussed above, we are adopting a new naming convention in this preamble and the regulatory text to more easily distinguish between the 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 $NO_X$ standards, which correspond to CAEP/6, are referred to as Tier 6 in the remainder of today's notice. The second tier of standards is referred to as Tier 8, which correspond to 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 when today's final rule becomes effective, 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 adopting 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.[64] (See section III.B for a discussion of how these standards 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 the numerical 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.[65] The new tiers are described separately below.

#### 1. Tier 6 $NO_X$ Standards for Newly-Certified Engines

This first tier of new standards is equivalent to the CAEP/6 $NO_X$ limits that were adopted by ICAO and became internationally applicable after December 31, 2007. Given that aircraft turbofan engines are international commodities, engine manufacturers 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, our evaluation of the necessary lead time, and the lack of any comments on this aspect of the proposal, this tier of standards takes effect immediately upon the effective date of this final rule.

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 new Tier 6 $NO_X$ standards for each of these power groupings are described separately below.

##### a. Numerical Emission Limits for Higher Thrust Engines

The Tier 6 $NO_X$ standards for newly-certified gas turbine engines with rated thrusts more than 89 kN 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:

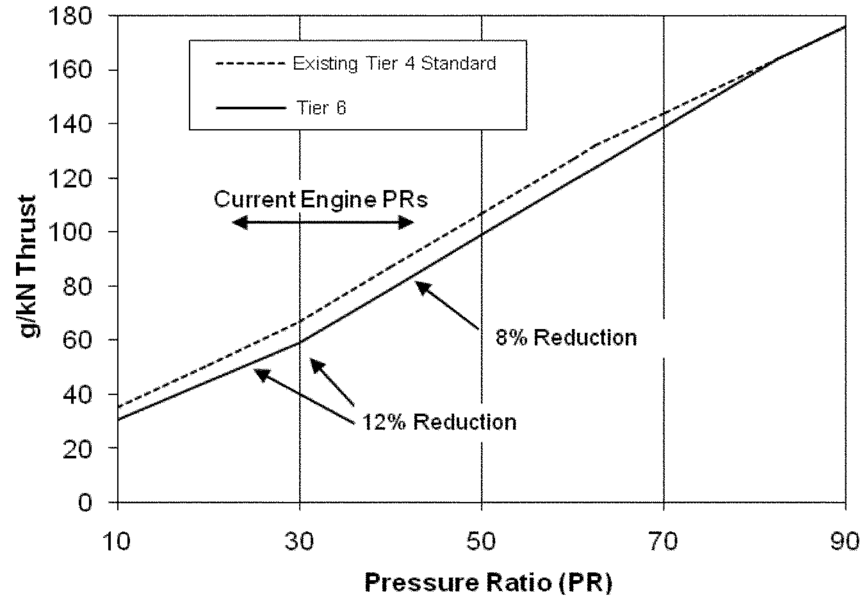
g/kN rated output = 32 + (1.6 * engine pressure ratio)

The new Tier 6 $NO_X$ standards for these higher thrust engines are presented in Figure 1 along with the previous EPA $NO_X$ standards, which were based on CAEP/4, for comparison.

[64] 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.

[65] 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.

Figure 1: 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 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 new Tier 6 $NO_X$ standards for newly-certified gas turbine engines with rated thrusts between 26.7 and equal to or 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 = 46.1600 + (1.4286 * engine pressure ratio) − (0.5303 * kN rated thrust) + (0.00642 * engine pressure ratio * kN rated thrust)

In developing the corresponding $NO_X$ standards for lower thrust engines, CAEP recognized the technical challenges that physically smaller-sized engines sometimes present relative to incorporating some of the lowest $NO_X$ technology approaches, which are otherwise available to their larger counterparts. These technical difficulties are well documented and increase progressively as size is reduced (from around 89 kN).[66] For example, the relatively small combustor 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.[67] 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, 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 new 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 Tier 6 $NO_X$ standards for lower thrust engines based on the engine size versus technological challenge described in the previous paragraph.

Comparing the new 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

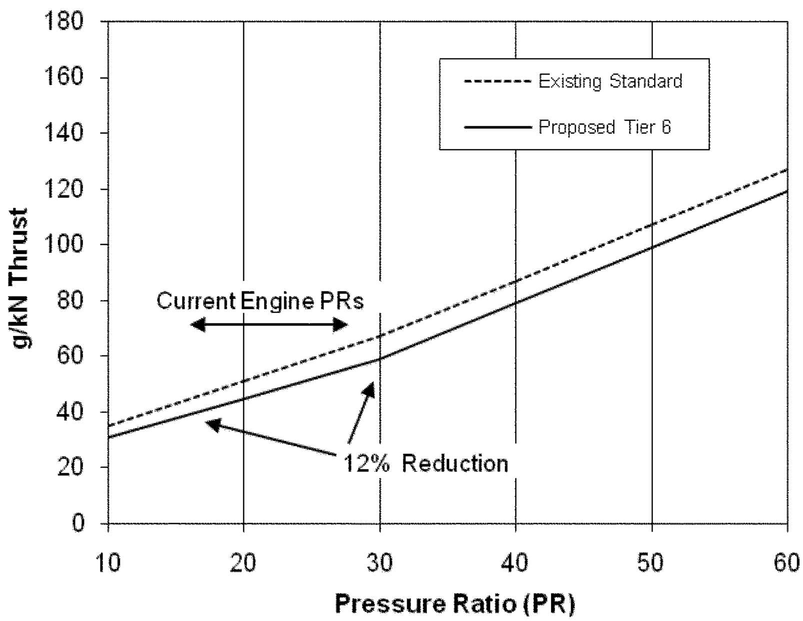
[66] ICAO/CAEP, ''Report of Third Meeting, Montreal, Quebec, December 5–15, 1995,'' Document 9675, CAEP/3. A copy of this paper can be found in Docket EPA–HQ–OAR–2010–0687.

[67] 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.

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.

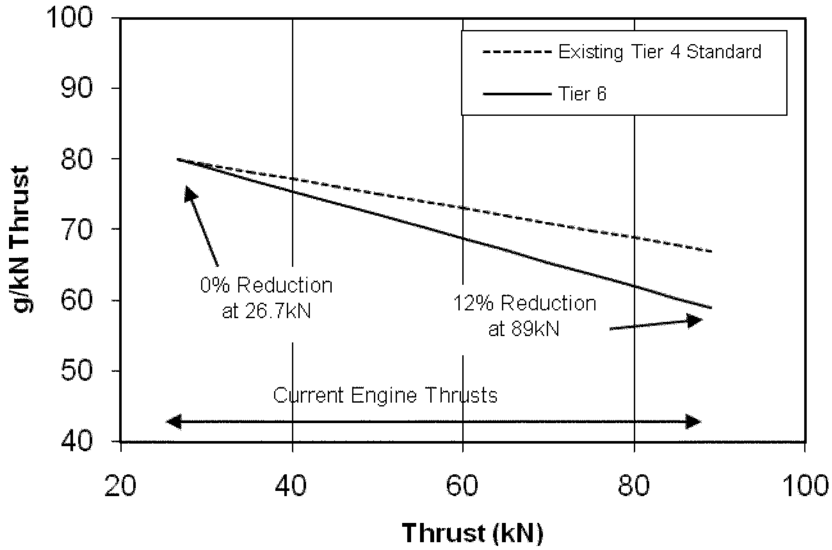
Again focusing only on 89 kN engines, the new Tier 6 standards represent a 12 percent reduction from the existing EPA Tier 4 (CAEP/4 based standards) for pressure ratios of 30 or less as shown below in Figure 2. This includes the region represented by almost all current engine designs. At higher pressure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

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




At other thrust ratings the percent reduction between the new 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: 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 new 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.[68] The CAEP/8 recommended standards have a recommended applicable 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.[69] Therefore, this tier of standards takes effect on January 1, 2014. As with the new Tier 6 $NO_X$ standards, the basic form of the new 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 new 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)

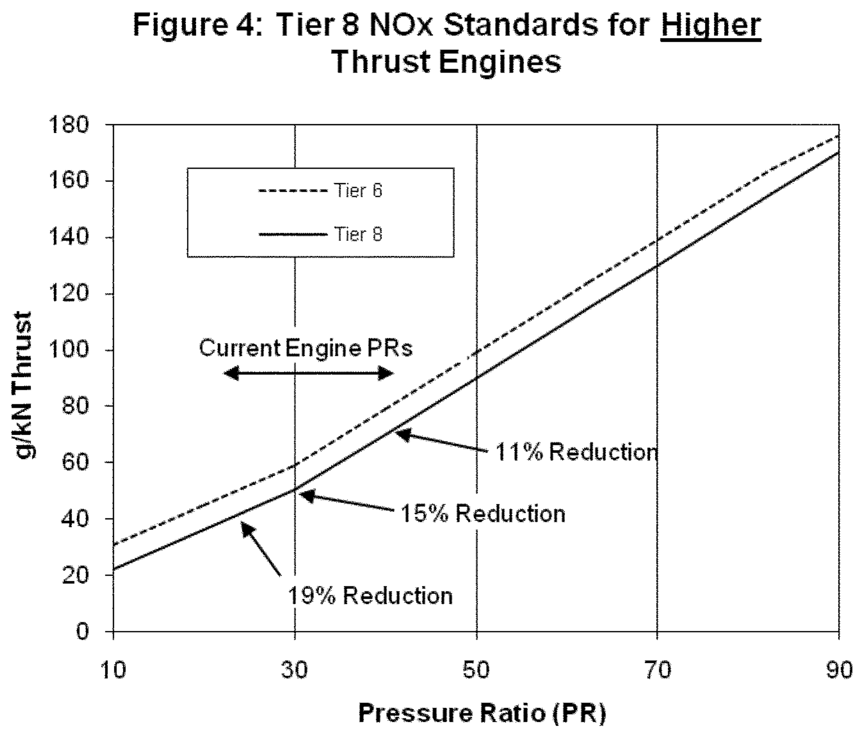
- For engines with a pressure ratio of 104.7 or more:

g/kN rated output = 32 + (1.6 * engine pressure ratio)

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

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

[69] Leadtime in this context refers to the time between CAEP adoption of a new emission standard and the effective date of the requirement. ICAO emission standards are global in nature and designed to provide engine manufacturers with adequate time to develop and deploy the requisite technology. Manufacturers produce engines that comply with new ICAO standards to ensure their products can be sold and used worldwide even in the absence of specific U.S. regulations. Based on this response to the ICAO standard, we find that there is also adequate leadtime between EPA's promulgation of the new requirement and the associated effective date. No public comments pertaining to leadtime were received.




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 new Tier 8 standards (CAEP/8) are referred to as being 15 percent more stringent than the new 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 engine designs range from about 11 to 19 percent.

b. Numerical Emission Limits for Lower Thrust Engines

The new Tier 8 $NO_X$ standards for newly-certified gas turbine engines with rated thrusts between 26.7 but less than or equal to 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)

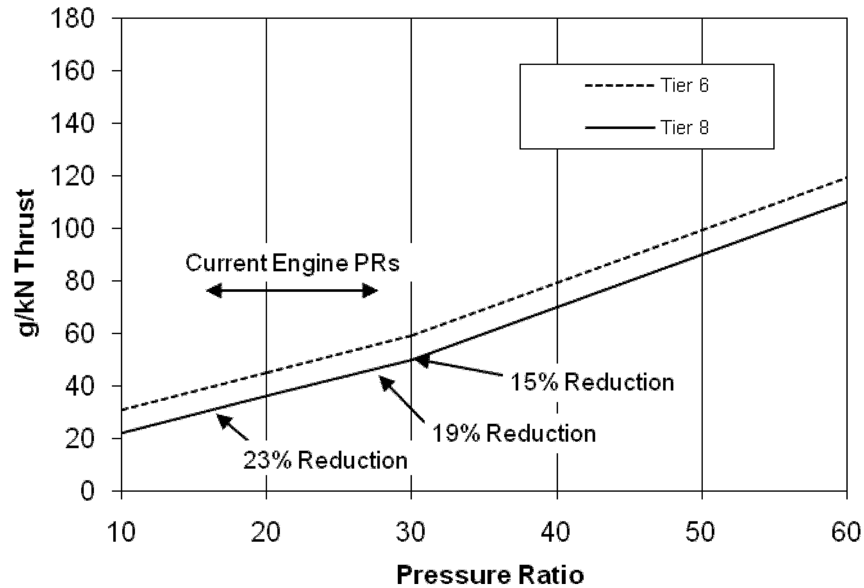
- For engines with a pressure ratio of more than 30 but less than 104.7:

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 Tier 6 low-thrust engine standards.

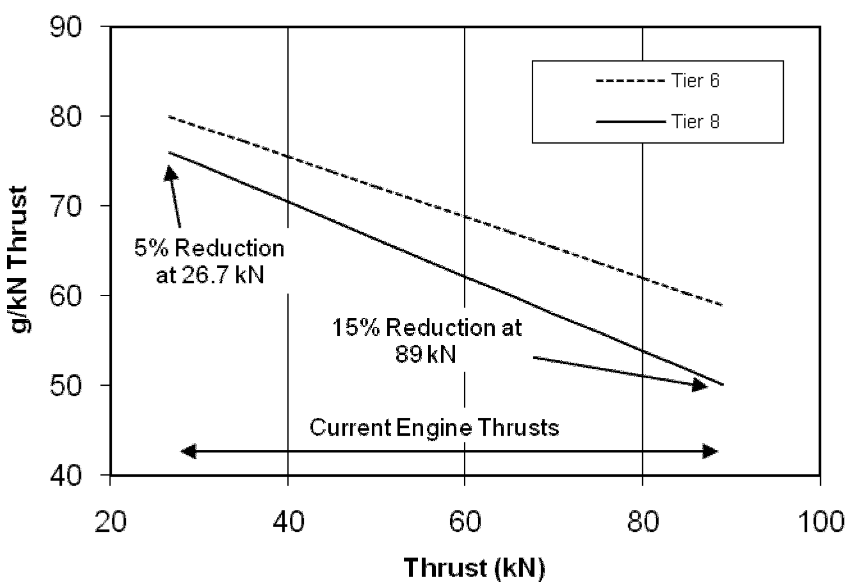
Also as previously described, no single line graph showing the standards for all engines within the thrust range is possible as it was for higher thrust engines, because the equations have two variables. However, some general observations are useful to characterize the new Tier 8 $NO_X$ standards for lower thrust engines based on the engine size versus technological challenge described in the previous paragraph. First, the new 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 Tier 6 standards. Second, as shown below in Figure 5 for 89 kN engines, at this thrust rating the new Tier 8 standards represents a 15 percent reduction from the 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: Tier 8 NOx Standards for Lower Thrust Engines Rated at 89.0 kN




Third, at other thrust ratings the percent reduction between the new 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: 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 the application of the new Tier 6 $NO_X$ standards to newly-manufactured engines, and our amended temporary flexibilities for newly-manufactured engines that show significant problems complying with these requirements. Also, consistent with CAEP/8, we are not applying the new 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 new Tier 6 $NO_X$ standards apply to all engine types or models that receive a *new* type certificate after the effective date of the final rule. We are also phasing 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.[70] As a result, manufacturers 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.[71] 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 necessary to ensure that the full benefits of newer, more stringent requirements will be achieved in a reasonable time.[72] We are, however, adopting certain limited flexibilities for engines that cannot be made compliant because of specific technical or economic reasons, as discussed later in this section.

As described in the proposal, the effective date of January 1, 2013 [73] 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 [74] [75] [76] 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 2012 time frame, and (3) any noncompliant models will be phased out of production because of low market demand.

We think that the five-year phase-in period from ICAO's effective date of the CAEP/6 standards (corresponding to our new Tier 6 $NO_X$ standards) for newly-manufactured engines is adequate for manufacturers and their customers to respond to the new requirements without disrupting their future planning and purchasing decisions.[77] [78] This phase-in period for applying the Tier 6 $NO_X$ standards to newly-manufactured engines is also identical to the date for this same requirement that was adopted by ICAO. No comments were received expressing concern with this phase-in period for newly-manufactured engines.

We did, however, receive two comments expressing the view that the time between the date of our final rule and the January 1, 2013 effective date of the production cutoff would be too short if it is less than one year. General Electric Aviation (GE) was the most detailed and began by noting that most of the engine models currently in production were certified to the Tier 4 standards and had demonstrated $NO_X$ emissions below the Tier 6 at that time. They continued that if the original certification reports are sufficient for the FAA to formally certify these engines to the Tier 6 standards, then none of these engines would be adversely affected by the production cutoff. However, GE expressed the concern that if additional interactions or formal action by the FAA were needed, or revisions to the FAA's FAR Part 34 were required, then having less than one year between EPA's final rule and the production cutoff could disrupt current engine production. As a result, GE asked that the date of the production cutoff be delayed to take effect 12 months after the final rule, i.e., 2013. The other joint comment from the Aerospace Industries Association (AIA) and the General Aviation Manufacturers Association (GAMA) was similar in nature, but without supporting details.

The commenters' concerns do not relate to the technical or economic feasibility of newly-manufactured engines achieving emission levels in compliance with the new Tier 6 standards by the date of the production cutoff as proposed. The concerns expressed do not argue that additional time is necessary ''to permit the development and application of the requisite technology'' to comply with the standards under CAA section 231(b). Therefore, the date of the Tier 6 production cutoff is appropriate and consistent with the Clean Air Act.

Section 232(b) of the Act directly addresses our obligation relative to the effective date of the regulation. Specifically, it says: ''Any regulation prescribed under this section (and any revision thereof) shall take effect after such period as the Administrator finds necessary (after consultation with the

[70] 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.

[71] 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.

[72] 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.

[73] The 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 standards for newly-manufactured engines is effectively January 1, 2013.

[74] 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.

[75] 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.

[76] 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.

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

[78] 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.

Secretary of Transportation) to permit the development and application of the requisite technology, giving appropriate consideration to the cost of compliance within such period.'' Based on the information provided above, the aircraft engine models described by GE are already capable of complying with the EPA Tier 6 $NO_X$ standards using already applied requisite technology, i.e., the cost of applying with has already been borne, as the effective date of the corresponding ICAO CAEP/6 $NO_X$ standard has already passed. We do not believe there are any technical feasibility or economic implications arising from the continued application of the requisite technology for those engines to meet the Tier 6 $NO_X$ standards. Also, consistent with our most recent previous amendment to the $NO_X$ standards, which similarly promulgated the standard at a level that was already being met by aircraft engine manufacturers who were already applying the requisite technology, the effective date does not need to include additional lead time for the development and application of additional technology that would be needed to comply with the standards. See, e.g., 70 FR 69604, 69674–76 (Nov. 17, 2005). As a result, the implementation dates provide more than adequate lead time under the statute. Therefore, because aircraft engine manufacturers are already able to comply with the Tier 6 $NO_X$ standard through the continued use of already applied requisite technology, and because the effective date of the corresponding ICAO CAEP/6 $NO_X$ standard has already passed (and also based on the assessment described in section V. Technical Feasibility, Cost, and Emission Benefits), we find that the dates provide more than adequate lead time under the statute for application of requisite technology.

We also want to stress that the production cutoff is actually an ICAO standard and we think it is important to stay aligned with the CAEP production cutoff date. We note that this is also being adopted by the European Aviation Safety Agency (EASA) and perhaps other aviation certification authorities. Our adoption of the proposed date insures international consistency regarding the production cutoff date and avoids contradicting our international bilateral agreements with other governments, e.g., the European Union.

Regarding the need for engine models to be formally recognized by the FAA as complying with the new Tier 6 standard, this is completely within the purview of the FAA. In our previous most recent amendment to the $NO_X$ standard, we provided just a one-month lead time period before the revised standard became effective, and FAA did not adopt corresponding implementing regulations until one year later, with no apparent disruption to the industry. (See 70 FR 69664, Nov. 17, 2005.) The new Tier 6 standards are the same as the CAEP/6 standards that were approved by ICAO in 2005 with an effective date of beginning after December 31, 2007. Therefore, just as for the 2005 revised $NO_X$ standard that we similarly promulgated significantly later than the effective date of the corresponding ICAO CAEP standard, we do not believe that it is necessary to delay the effective date based on a need for the FAA to revise its own implementation and enforcement regulations.

Finally, section 232(a) of the Act directs the FAA to ensure compliance with our standards. In this regard, the FAA has developed a streamlined process to recognize compliance with Tier 6 and or Tier 8 as appropriate for currently type certified engine models which meet the emission standards and they have assured the regulated industry that they will dedicate the necessary resources to formally recognize conformance with the standards before the production cutoff date.

For the reasons stated above, EPA is promulgating the Tier 6 production cutoff with the originally proposed effective date of January 1, 2013.

2. Carryover of Previously Generated Emission Test Data

Aircraft engine models normally receive type certificates, which include a determination that the model meets the emission standards in force at the time the type certificate is granted. EPA has not updated its aircraft emission standards or test procedure regulations since 2005. In this action we are adopting Tier 6 and Tier 8 $NO_X$ emission standards and are adopting either in 40 CFR part 87 directly or through incorporation by reference of Annex 16, Volume II a number of minor changes to test procedures and related requirements. These changes will become effective on the date when the rule becomes effective.

This leaves open a question regarding the future validity and acceptability for amended type certificates of emission tests and emission test data generated under previously specified test procedures and related requirements. For example, there may be an engine model tested in 2004 that demonstrated HC, CO, and $NO_X$ emission levels below the exhaust emission standards in effect at that time and also below the Tier 6 or perhaps even the Tier 8 standards that are being promulgated in this final rule. We want to be clear that we do not intend minor changes to test procedures or related provisions and requirements to trigger the need for additional testing. Thus, in cases where a manufacturer has a valid current type certificate based on emissions information generated under the test procedures in force at the time the type certificate was granted, we consider that data to be valid for any formal FAA recognition of compliance, e.g., an amended type certificate, with the Tier 6 or Tier 8 $NO_X$ emission requirements if the original test data demonstrate such compliance. The same is true for the HC and CO emission standards. This clarification should greatly facilitate compliance determinations by the FAA and eliminate any uncertainty regarding the potential for otherwise minor test procedure changes to trigger new emissions testing for previously certificated engines with emission levels below the new $NO_X$ standards.

3. Exemptions and Exceptions From the Tier 6 Production Cutoff

In conjunction with the implementation of the new Tier 6 $NO_X$ standards, we are establishing provisions which allow engine manufacturers to request an exemption or exception from meeting the Tier 6 $NO_X$ standards for newly-manufactured engines. These provisions replace existing provisions addressing exemptions that were promulgated in section 87.7 of our aircraft engine regulations. (Any exemptions previously issued under section 87.7 would not be affected by the revisions.) This section of the preamble describes these 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. It also includes a description of a short-term exception program (termed the low-volume, time-limited transitional exemption program). These provisions have largely been crafted to be consistent with exemption provisions in the ICAO Environmental Technical Manual (ETM).[79] [80] The provisions of

[79] 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.

[80] Note that EPA has submitted a paper to amend the exemption provisions included in this ETM to be consistent with this 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.

the ETM guidance were developed in the context of the CAEP/6 $NO_X$ production cutoff deliberations leading up to the CAEP/8 meeting in February 2010.

While we are revising 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.[81] 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.

We are deleting from our regulations the requirement in § 87.7(e) that the FAA publish a notice of the exemption in the **Federal Register**. The FAA has an established process in place for publishing requests for exemption that are filed in accordance with 14 CFR part 11. Under § 87.7(b) of the existing regulations, the FAA, with EPA concurrence, may also 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.[82] Therefore, we are deleting these provisions to avoid confusion.

We are also deleting the time-limited exemption provision for *in-use* engines that is contained in section 87.7(d) of the existing regulations. This provision applies to fuel venting and smoke emission standards, which were new when the exemption was adopted in 1973. The exemption allowance was limited to in-use engines that were unable to comply with the requirements when the regulation became effective in 1974. The in-use fleet of engines was fully retrofitted to comply with the standards later in the 1970s. Therefore, this provision is now obsolete and we are deleting it to avoid confusion. We proposed to delete the existing provisions for temporary exemptions based on flights for short durations and infrequent intervals. This proposal was based on the EPA's and FAA's belief that the provisions were unnecessary 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 appeared to have no utility.

We received two comments from the Aerospace Industries Association (AIA) and the General Aviation Manufacturers Association (GAMA) requesting that the provision be retained. First, they argued that as in the past, a new aircraft may be produced at a commercial facility that is destined for immediate conversion to a military only application at a separate facility. These aircraft may require a small number of airworthiness flight tests before being delivered to the conversion facility and conceivably would be subject to EPA standards during flight testing. While these aircraft would generally utilize compliant engines, it may be possible that non-compliant engines could be used (our standards do not apply to engines used on military aircraft as discussed later) and temporary exemptions would be necessary. Second, AIA and GAMA commented that it would be helpful if the provision also allowed for granting a discrete number of exemptions over a specified time period, rather than having to request the exemption prior to each flight as currently required.

In considering the commenters' suggestion to retain the exemption provision, we note that allowing such operations will not have any significant adverse affect on the environment because of the infrequent nature and short duration of such flights. Retaining the exemption is also consistent with exempting military aircraft from emission control requirements as discussed later. Therefore, we have retained the provision with one change, made in response to the comments, as described below.

The current provision calls for the Secretary of Transportation to consult with the EPA Administrator when considering any exemption request for infrequent interval and short duration flights not explicitly allowed by the regulations. Given the inconsequential nature of such flights on the environment, we believe that the Secretary should be able to consider and act on these petitions unilaterally to streamline the process. Therefore, we are deleting that portion of the previous exemption provision. Of course, we will consult with the Secretary if asked to do so. As for requesting a discrete number of temporary exemptions, we believe this is an issue that the Secretary of Transportation may address under its enforcement role as described in section 232 of the CAA.

The current regulations also provide for permanent exemptions for newly-manufactured engines based on consideration of the certain factors specified in section 87.7(c). We are replacing these provisions with new regulatory text generally consistent with the ETM that would provide for permanent exemptions or exceptions[83] for newly manufactured engines used on new aircraft and spare engines used for maintenance or replacement purposes. These are summarized below. (See § 87.50 of the regulations for additional details on these exemptions/exceptions.)

a. New Provisions for Spare Engines

We are revising the regulations to allow the sale of a newly-manufactured engine for installation on an in-service aircraft, i.e., a spare engine that does not conform to the applicable emissions standards at the time it was produced. It does *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.

As we explained in the proposal, explicitly allowing for the production of spare engines is 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, final regulations now apply a Tier 6 $NO_X$ production cutoff to all newly- manufactured engines. This means that if we did not also adopt a provision for the continued production of spare engines, manufacturers would be prohibited from producing Tier 4 engines under the existing type certificates for this purpose. We see no reason to change our policy of allowing manufacturers to

[81] 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.

[82] 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.

[83] As used in 40 CFR part 87, as a practical matter the meanings of ''exception'' and ''exemption'' are essentially equivalent. However, under FAA regulations, the meanings of these terms are distinct, especially with respect to the manner in which they are administered.

produce new engines for use as spares. Therefore, the final regulatory provisions allow this practice to continue.

To ensure there would be no adverse environmental effect from allowing the use of a spare engine as a direct replacement for an existing engine, we proposed that the spare could be used only when the emissions for all pollutants of that engine were equal to or lower than those of the engine it replaced. This proposed requirement was consistent with the ETM, which also contains this allowance. We received a joint comment from AIA and GAMA stating that this is impractical because, while unlikely, a spare engine might have a different emissions profile for some pollutants than the engine it would replace. As an example, they stated that the two engines could have somewhat different combustion systems that might make one engine lower in $NO_X$ but higher in CO. They also suggested that EPA should consider the totality of the emissions in the decision, or delete the requirement in the final rule.

These comments are surprising because this ETM provision, as well as the exception provisions, was subject to significant discussions within CAEP that included the engine manufacturers as well as a representative from AIA. Nonetheless, in this instance we believe the proposed provision should be modified to accommodate the potential for unusual circumstances as explained by the commenter.

As noted above, AIA and GAMA suggested that EPA consider of the totality of emissions relative to their environmental effects as the basis for evaluating spare engine exemptions. This would entail understanding and comparing the environmental consequences of the different pollutants. We find that could be very complicated because different pollutants have different health and welfare end points and consequences. For example, in the illustration offered by the commenters, the effects of LTO $NO_X$ and CO are largely unrelated to one another.

We think a preferred option to evaluating total environmental effects, or even dropping the provision entirely, is to incorporate an anti-backsliding requirement which ensures that at a minimum the excepted spare engine at least meets the same emission standards that are applicable to the engine it is replacing. For this reason, in response to the AIA and GAMA comment, we are modifying this provision in the final rule to allow an excepted spare engine to have different emission levels compared to the engine it replaces as long as it remains compliant with each of the applicable emission standards and any other requirements of its type certificate. Given the limited number of spare engines in the fleet, we expect allowing these engines to have somewhat different emissions profile from engines they are replacing will have no significant adverse environmental effect. This is especially true given that we expect the emissions of an excepted spare engine will be equal or better than the engine it is replacing in most cases in accordance with the basic tenant of the ETM.

We are not requiring engine manufacturers to obtain FAA or EPA approval before producing spare engines. However, they must submit information about the production of spare engines in an annual report to EPA (see section III. D for more on the annual report). We proposed that because manufacturers are not required to seek or obtain formal approval to produce spare engines, this allowance was referred to as an ''exception'' rather than an ''exemption''. This terminology would be consistent with current FAA regulations. Furthermore, we proposed that 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.

We received comments relating to allowing spare engines to be produced without requiring prior approval and the use of the terms ''exceptions'' or ''excepted.'' The Air Transport Association (ATA)[84] appreciated that there would be no case-by-case approval, noting that it simplifies administering the provision for FAA without compromising the structure of the exemptions program set forth in the ETM. Regarding the terminology, AIA and GAMA noted that the terminology was inconsistent with current engine name plate labeling practices. They stated that engines are currently either marked ''COMPLY'' or ''EXEMPT'' for emissions. Both organizations generally felt the change in terminology for spare engines might be concerning to the operators holding an engine with a plate reading ''EXCEPTED.'' They concluded that the name plate for spare engines should continue to use ''exempt.'' The ATA appeared to give at least tacit approval to the new terminology by acknowledging without objection that spare engines would be labeled accordingly.

First, we are puzzled that operators with a spare engine labeled as ''excepted spare'' rather than ''exempt'' may have a concern, because AIA and GAMA did not elaborate on just what the concern might be. Without at least an example, we are unable to discern the nature of the concern and respond directly to it. We also find it puzzling that the two organizations that represent aerospace manufacturers expressed a concern regarding operators of aircraft and aircraft engines when the actual organization representing those companies, ATA, did not express such a concern.

Second, regarding the terminology, the Tier 6 production cutoff does not apply to the continued production of engines that are designated spares. Spare engines are produced to replace a similar engine already in service that was removed from service for maintenance purposes. Accordingly, the production of a spare engine is not restricted by the production cutoff, and the regulation does not apply to these engines. The non-applicability of the cutoff eliminates the need to process an exemption for continued production of these engines beyond December 31, 2012.

Conversely, engines that are intended to be produced for new installations (i.e. not replacing an engine already in service) are subject to the production cutoff regulation and the continued production of such engines beyond the cutoff date would require a grant of exemption. Since the production of spare engines is not subject to the new cutoff regulations, the FAA proposed and the EPA accepted the idea that referring to these engines as exceptions to the regulation was more appropriate than requiring case-by-case consideration of exemptions when the regulation did not apply.

Moreover, the word ''exemption'' is a meaningful regulatory term. It is used by the FAA in 14 CFR Part 11 to mean that an applicant is subject to a particular regulation and is requesting time-limited relief under a specific set of criteria. It is a specialized form of rulemaking. When an entity or its product is specifically left out of a regulatory provision, it is considered ''excepted''. Any regulation adopted by the FAA would use these terms consistently.

As already mentioned, assuming incorporation of these provisions by the FAA, engines meeting the requirements for spare engines could be produced and entered into commerce without prior approval from EPA or FAA. It is

[84] The Air Transport Association has changed its name to Airlines for America (A4A).

important to note that while spare engines would be excepted from the Tier 6 $NO_X$ standards being promulgated today, they 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 also expect minimal additional burden for manufacturers, since we are not establishing new restrictions, monitoring, recordkeeping, or reporting requirements other than the end of year report.

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.'' We are replacing this provision with a new set of provisions addressing exemptions for new engines.

i. Time Frame and Scope

The final regulations allow engine manufacturers to request an exemption for newly-manufactured engines not meeting the Tier 6 $NO_X$ standards so they may be installed in new aircraft. If granted, manufacturers may produce a limited number of these newly-manufactured engines in a four year time period beginning after December 31, 2012 and going through December 31, 2016. This four-year time period is consistent with the ETM. The period for any given approved exemption could be shorter depending on the specifics of the application, but it could not be longer. This exemption limits $NO_X$ emissions from engines that are covered by a valid type certificate issued by FAA. The engines must meet all other applicable requirements. More specifically, an engine exempted from the Tier 6 $NO_X$ standards must be covered by a previously issued type certificate showing compliance with the Tier 4 $NO_X$ standards,[85] as well as the current HC, CO, fuel venting, and smoke standards.

As explained above, the scope of the exemption provisions are limited to newly-manufactured engines that do not comply with the Tier 6 $NO_X$ standards. No need has been identified to apply such exemption language to the other regulated exhaust pollutants, i.e., smoke, 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.[86] 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.

We received comments requesting that exemptions be available for newly-certified engines in addition to newly-manufactured engines. General Electric Aviation (GE) stated that unforeseen circumstances may arise during the lengthy aircraft engine development process that necessitates a change in design, and that may affect the ability of that engine model to meet the prevailing Tier emission standard at certification. For that reason, GE concluded that exemptions for newly-certified engine would be beneficial. The AIA and GAMA jointly stated that the existing 40 CFR 87.7(c) not only provides the flexibility to exempt newly-manufactured engines from a production cutoff, but also for newly-certificated engine models subject to any emission standards, e.g., the Tier 8 $NO_X$ standards. They requested that this flexibility should be retained.

Regarding the availability of exemptions for newly-certified engine models, the proposed regulatory text made clear that the exemption provisions would only apply to newly-manufactured engines. Specifically, the intent was to establish provisions for newly-manufactured engines to address the potential technology and economic adversities that may arise as part of adopting the Tier 6 production cutoff. The ICAO ETM provisions are clearly intended for that same purpose. Also, the original intent of EPA's current exemption provisions in § 87.7(c), which we are modifying in this rulemaking, is clear from the proposed rulemaking and final rulemaking that resulted in those provisions. The March 24, 1978 proposal described the concern as ''* * * engines which are nearly [at] the end of their production life would be terminated prematurely because there would be insufficient future sales to justify incorporating emission controls.'' (See 43 FR 12619, March 24, 1978.) The December 30, 1982 final rule referenced ''* * * the removal of an engine model from the market because of its failure to comply.'' (See 47 FR 58468, December 30, 1982.) Obviously, the intent of the existing exemption provision cited by AIA and GAMA was to make it apply only to newly-manufactured engines.

As a general matter, we believe an exemption from the Tier 6 standard, or any other standard, for newly-certified engine models is speculative at this time and would undermine the goal of regulatory compliance by new engine designs. In any event, neither the current ICAO Annex 16, Volume II provisions nor the ETM provide for newly-certified engine exemptions. We believe that such would be a fundamental shift from Annex 16 and the ETM should be explored within the framework of ICAO/CAEP. Furthermore, engine manufacturers already have

[85] Engines certified only for compliance with earlier Tier 2 $NO_X$ 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 regulations.

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

significant leadtime between the date CAEP adopts a new emission standard and the standard's effective date, e.g., usually 3–5 years. Finally, engine manufacturers historically design new engine models to comply with the most stringent future standard that also provides for a longer development time horizon. Therefore, we are promulgating the exemption provisions for newly-manufactured engines as proposed.

ii. Production Limit

As proposed, § 87.5 of the final regulations reflect the essence of the general exemption language for exhaust emission standards regarding how to determine the number of allowable exemptions that is embodied in existing § 87.7(c) of the regulations. That provision generally 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.

As a result, § 87.5 does not specify a nominal number of exemptions. Rather, 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 effect associated with the exemptions.

In the proposal, we acknowledged that our approach to determining limits on the number of exempt engines differs from the language contained in the current ICAO ETM guidance. The ETM states that ''[t]he number of engines exempted would normally not exceed 75 per engine type * * *.'' [87] We chose not to propose adopting this language on the nominal number of engines based on a single type certificate. Our reasons for this deviation were detailed in the. The interested reader is referred to the proposed rule for more detail. (See 76 *FR* 45012. July 27. 2011.) We also want to emphasize that the exemption provisions as proposed and promulgated in this notice are not necessarily limited to the Tier 6 $NO_X$ production cut-off, but could in fact be applied to future aircraft engine emission standards if a similar production cut-off was adopted. Therefore, we believe our approach is preferable because it more clearly leaves the number of exemptions that might be granted open, not limited to either more or less than 75 per engine type, and subject to the justification supplied by the engine manufacturer, both for the Tier 6 production cut-off and the future.

We received several comments focusing primarily on the number of exemptions and the underlying process that is embodied in the ETM and our proposal. General Electric Aviation (GE) maintained that harmonization with the international community is not only required by the Chicago Convention, but also provides streamlined processes and procedures within the regulated industry. They contended that any purported benefits to EPA's unique exemption scheme were outweighed by setting up a conflict with the remainder of the world. They also suggested that if EPA wants a different approach for evaluating exemptions, it would be more appropriate to work inside the ICAO/CAEP process toward that end.

The ATA commented that EPA's case-by-case approach to determining the number of engines is a rejection of the ICAO/ETM provisions that limit ''* * * the number of exemptions * * * to 75 engines per type certificate * * *.'' They argued that this would create a serious discontinuity between the U.S. and the rest of the world, undermining ICAO's objective of international uniformity. The ATA also argued that the ICAO exemption limits are intended to be coordinated among international aviation authorities, and that differing rules would make this impracticable. As evidence of this problem, ATA cited the European Aviation Safety Agency's (EASA) proposed rulemaking, which they noted was based on the assumption that the ICAO proposals will be adopted unaltered by other aviation authorities of the world. The ATA also stated that the ICAO ETM guidance document supplements the official standards of Annex 16, Vol. II and, therefore, the ETM provides technical elaboration on the implementation of Annex 16. From this ATA concluded that differing practices in this regard are counter to the Chicago Convention.

Regarding consistency with the Chicago Convention, our proposal thoroughly explained that the ETM is guidance material; not an ICAO standard or regulation of any type. While consistency is desirable, it is not compelled when a deviation is justified. Therefore, we disagree with the commenters on this point, and specifically with ATA's comment that the ICAO guidance is effectively the equivalent of an ICAO Annex 16 standard.

Turning to ATA's comment regarding the ETM cap of 75 engines per type certificate, we first want to point out that this is not a maximum limit on the number of potential exemptions per type certificate nor is it an implied entitlement. Rather the ETM provision is an expectation that ''[T]he number of engines exempted would normally not exceed 75 per engine type certificate * * *.'' as stated in the document. With this perspective both the ETM and our approach are similar in that the maximum number of exempted engines is based on a consideration of the petitioner's justification for such exemptions.

Finally, we disagree with the comment that the differences with the ETM make international coordination unworkable. In fact, one of the proposed justification elements, i.e., how many affected aircraft will be registered in the U.S. and other countries (estimate allowed), was described in the preamble for the proposal as being aimed at helping to facilitate consultation and coordination. Also, as noted above, the ETM's expectation and our approach are similar in that the maximum number of exempted engines under both approaches is based on a consideration of the petitioner's justification for such exemptions. We do not think coordination with foreign aviation authorities, with these few differences, should pose any problems. After considering the above comments on the number of exemptions and the underlying process embodied in the ETM and our approach, we are promulgating the provisions relating to the comments as originally proposed.

iii. Exemption Requests

We are establishing a process for requesting exemptions (for engines used on new aircraft) that would be more formal and structured than the current process. We are requiring manufacturers 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 need to include the following details to describe the specific engine model for which the manufacturer is requesting the

[87] 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''.

exemption. The final 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 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 a manufacturer's justification needs 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 needs 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 regulations apply only to $NO_X$ 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.

As we detailed in the proposal, some manufacturers have requested exemptions in the past based on the largest number of engines they hoped to continue manufacturing 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. While we expect a manufacturer to have this specific information when they submit a request, the final regulations allow us to process exemption requests with somewhat less specific information. However, we expect this to apply only for unusual circumstances. Manufacturers also are being 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.

The final regulations also allow manufacturers to revise their requests to justify covering additional engines at any time before approval. We would then review the revised request. Similarly, for exemptions that are already approved, manufacturers could request that additional engines be added after providing the justification for the increase.

We received comments on the level of detail required in a request for exemption and the time needed to add more engines to such a request or an already approved exemption. First, ATA was concerned that requesting an increased amount of engine exemptions can take a significant amount of time. They stated that there may be insufficient time for a manufacturer to receive approval for additional engine exemptions if necessary to meet previously unknown market demands.

In response, we find it unfortunate that the comment does not provide a specific example or other information that may illustrate this concern. As a general response, given the long leadtime between the initiation of discussions among aircraft purchasers and aircraft manufacturers, and actual orders and final deliveries, we expect that manufacturers will have enough time to request additional engine exemptions, and if appropriate, for the FAA and EPA to approve such a request. We expect that amending an already approved exemption would take less time to act upon than the original petition. Also, engine manufacturers may request an expedited review from the FAA, and by association the EPA, if circumstances warrant. Finally, to the extent that an engine manufacturer has specific concerns in this area, they could be ameliorated by improving the lines of communication with air frame manufacturers to increase the manufacturer's awareness of market interest in potential new orders. Accordingly, we are promulgating the exemption provision relating to this comment as proposed.

Second, ATA commented negatively that the exemption request for each individual engine be justified, ''* * * including the exact number, initial purchasers/users, countries of registry and plans for bringing the product into compliance.'' They claimed that this knowledge may not be known at the time of the exemption request because of market leadtime. As an example, ATA cited the 1998 Rolls Royce (RR) exemption request from the CAEP/2 cutoff for 150 engines that was not based on that type of certainty, but was a prospective exemption for two years as protection against the uncertainties of technical development. They stated that RR did not know when the development process would be completed, and hence did not know the exact number of non-compliant engines that airlines would purchase. The ATA also added that the three affected airlines worked with RR to provide documentation of the financial and operational hardship that they would suffer based on their aircraft delivery schedules.

In response to ATA's second comment, we simply want to note that the information we would normally expect to be contained in the exemption application is actually not much different than the justification envisioned by the ETM. That guidance document explains that the petitioner should, to the extent possible, provide quantitative support to justify the exemptions. Specifically, the ETM states that it ''* * * provides guidelines on the process and criteria for issuing exemptions * * *.'' These include some of the same elements as contained in our proposal and referenced above, i.e., the exact number of exemptions being requested, to whom the engines will be originally delivered, and plans for producing a compliant product. Therefore, the ETM envisions a consideration of specific information as part of the exemption request, in a similar fashion as EPA's approach, in order to decide on the exact number of exemptions to grant. We are simply being more explicit in some areas concerning the type of information that should be included in any exemption request. We also note ATA's comment that ''[T]he airlines worked with Rolls Royce to provide documentation of the financial and operational hardship that they would suffer if there were an interruption in the supply of ICAO-compliant engines during their aircraft delivery schedules.''

Given the long lead times generally associated with new aircraft orders and deliveries, we expect aircraft operators will work closely with aircraft manufacturers as their new aircraft needs are identified. Engine manufacturers should in turn work with aircraft manufacturers to stay aware of market interest in potential new orders. This appears to be reflected in the commenter's example regarding the cooperation between airlines and RR in fashioning the exemption justification. Also, as explained in the proposed regulatory text, the petitioner should include information on the ''expected'' first purchasers/users of the aircraft. It also asked for information on the number of aircraft that will be registered in the U.S. versus other countries and that this may be estimated, if not known. Therefore, precise knowledge is not needed for certain elements of the justification. The preamble to the proposed requirements also stated that the regulations would allow us to process exemption requests with somewhat less specific information, although we expected that to apply only for unusual circumstances. We have made this clearer in the final regulations.

In order to allow us to oversee these exempted engines, manufacturers are being required to also provide an annual report to EPA on exempt engines similar to the information about spare excepted engines. The permanent record for each engine exempted under this provision must indicate that the engine is an exempted engine and the engine itself must be labeled as ''EXEMPT NEW.''

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 that certificating authorities and member states should coordinate whenever any authority receives an exemption request.

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

To facilitate this coordination, we are asking 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 consultation and coordination called for in the ETM was 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.[88] Nevertheless, because our final 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 an FAA type certificate is sought under a reciprocity agreement for an engine which was previously certificated under an exemption by a foreign certificating authority, 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.

v. Low-Volume, Time-Limited Transitional Exemption Program

We received a comment from one manufacturer expressing concern that once the final rule becomes effective additional time may be required for EPA and FAA to establish and undertake procedures to review and act upon exemption requests. They stated that the time needed for this process could be very disruptive for engine manufacturers that have already contracted to delivery engines during the period which FAA/EPA would need to consider exemption requests. They also claimed it would be harmful to airplane manufacturers and airlines. To avoid such an undesirable outcome, the commenter suggested that EPA should grant a one-time, interim block of perhaps 20 exemptions.

Based on supplemental information we received from the commenter,[89] we find the concerns center on six engines for which they have contract commitments to build and deliver within several months of this final rule. These six engines belong to two engine models, with four engines in one model

[88] It is possible that applications for exemptions by foreign entities may be filed with their national certificating authorities for engines manufactured after December 31, 2012 and could be operated in the United States. The FAA has several international bilateral agreements in place that include provisions and obligations for technical assistance on environmental certification matters. The FAA plans to continue to coordinate with those foreign certificating authorities in their considering and granting petitions for exemptions and, likewise, those that are filed with the FAA and in consultation with EPA.

[89] Memoranda documenting this supplemental information are located in docket number EPA–HQ–OAR–2010–0687.

and two engines in the other. The first model consisting of four engines is scheduled to begin shipping in January 2013, shortly after the January 1, 2013 Tier 6 production cut off. These engines are currently certificated to the Tier 4 $NO_X$ standards. The commenter has stated, however, that the design of this engine model has been technically modified to achieve the Tier 6 standards. Unfortunately, compliance testing of this model to meet the Tier 6 standards cannot be performed until December of 2012 when the first production version is built. Assuming that this testing is successful, inadequate time remains for the FAA to formally recognize Tier 6 compliance based on those tests before the production cutoff becomes effective.[90] The two new aircraft using these engines are being built and will be delivered to a foreign airline.

The second model is comprised of two engines with a contracted delivery date in May 2013. They are also certificated to the Tier 4 $NO_X$ standards. These engines are at the end of their production life, i.e., no additional future deliveries for civilian uses are anticipated beyond these two contracted engines. For this reason, the commenter has stated that it is not economically feasible to redesign this model to conform with the Tier 6 $NO_X$ standards, even if it were technically feasible. The single new aircraft using these engines is also being built for delivery to a foreign airline.

After assessing this concern, we are including an exception provision in the regulations that permits any aircraft engine manufacturer to produce and enter into commerce up to six newly-manufactured engines with a date of manufacture, as defined in the regulations, prior to August 31, 2013 that are not certificated to meet Tier 6 emission requirements. We find that a considerable amount of time will indeed be required between the time this final rule becomes effective and completing any formal FAA action using the normal exemption process as previously described in this notice. Specifically, time is needed for: (1) The FAA to amend 14 CFR part 34 through rulemaking to incorporate the production cutoff and procedures for granting exemption from the new standards; (2) the manufacturer to develop the information needed to support a request; (3) submitting the request for review by FAA and EPA; (4) coordination with other certificating authorities; and (5) EPA and FAA review and final action on the request, i.e., approval or disapproval. Regarding this review and final action, we note that FAA staff involved in reviewing the manufacturers request may also be engaged in conducting the processes to adopt this rule in 14 CFR part 34 and to review emission information on current type certificates to confirm that they meet either Tier 6 or Tier 8 requirements, as previously described. Therefore, we conclude that inadequate time exists to act on an exemption request with certainty for these six engines before their contract deliver dates. Consequently, we conclude that a limited modification to the otherwise universal effective date of the final Tier 6 compliance deadline is appropriate to accommodate the commenter's situation and that for these six specific engines additional lead time is needed due to cost and technical feasibility factors.

We also believe that disrupting the scheduled delivery dates of these engines could risk subjecting the commenter to possible financial penalties for late delivery, with possible follow-on effects for the aircraft manufacturer and airlines. We also find that there is no significant adverse effect on the environment in allowing these six engines to be produced and sold as compliant with Tier 4 standards, especially if four of the engines ultimately comply with the Tier 6 standards.

For the above reasons, and in response to the comments and under our authority under sections 231(a)(3) and (b) to issue final regulations with such modifications to the proposal as the Administrator deems appropriate and to make revised standards effective after such period as the Administrator finds necessary to permit the development and application or requisite technology, giving appropriate consideration to the cost of compliance within such period, we are including an exception provision in the regulations that permits any aircraft engine manufacturer to produce and enter into commerce up to six newly manufactured engines with a date of manufacture, as defined in the regulations, prior to August 31, 2013 that are not certificated to meet Tier 6 emission requirements. These engines must have a type certificate which indicates that they meet the 40 CFR part 87 requirements last updated on October 30, 2009 (i.e., Tier 4). No formal exemption request or approval will be required for these six engines. These engines will be reported to EPA as part of the annual reporting requirement as described above for exempt engines.

We know of no other engine manufacturer that is in this situation today, (i.e., contracted deliveries of engines not meeting the production cut-off within several months of the production cut-off date). However, as a matter of equity and to address situations which we may not be informed of at this time, we are extending this transitional flexibility to all manufacturers.

c. Voluntary Emission Offsets

We requested 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 was summarized in a memorandum to the docket.[91] The types of programs we were considering would be developed, promulgated, and administered by EPA.

As described in the proposal and summarized here, we expected 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. 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. Third, provided a provision was 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.

Under the proposed approach, generation of offsets would be voluntary and would be open to all certifying engine manufacturers. One concept was 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). There was a separate question, however, regarding how to calculate the credit. If we adopted, for example, 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.

[90] The FAA has stated to EPA that inadequate time exists for the required formal compliance determination before the production cutoff takes effect.

[91] 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.

This would ensure a net improvement in emissions. Also, 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 emission benefits from one aircraft model truly offset the higher emissions from another model. Equivalency factors could be developed to account for differences in the number of LTOs per year and the lifetime of the aircraft.

We received a number of comments on the possibility of implementing a voluntary credit offset program. The ATA expressed significant doubt that EPA had the legal authority to adopt a voluntary emissions offset program. They argued that the standard setting authority under section 231 of the CAA does not appear to provide such authority. ATA further stated that where offsets or emissions trading schemes exist for other source categories, the authority is express. Examples cited were the CAA authority for the trading program under the acid rain program, and the Energy Independence and Security Act authorization for the offset program used under the Corporate Average Fuel Efficiency Standards. Pratt & Whitney provided comments very similar to ATA relative to the lack of EPA's legal authority to create such a program.

The ATA also commented that the voluntary offset program embodied in the proposal would be unworkable in the context of aviation. They noted that unlike cars or trucks, aircraft engine manufacturers have relatively low production volumes and few frequently updated models for generating credits. Also, some manufacturers have more models than others and this could possibly lead to competitive distortions in the market. The AIA and GAMA also raised concerns regarding potential market disruptions. Further, ATA argued that opportunities for generating offsets would be limited by the proposal's high thresholds for generating those credits. In the context of using emission credits for exemptions ATA added that each situation would be unique and it would not be possible to match exemptions to credits, or to assess the further complexities of the ''equivalency factors'' described in the proposal. Finally, they stated that an airline's delivery schedule would be held hostage to the manufacturer's ability to justify credits based on some other engine that the airline is not buying. For these reasons, ATA asked that no offset program be adopted.

Pratt & Whitney stated that the EPA proposal assumes that an offset program would create an incentive for manufacturers to build lower-emissions engines. On the contrary they argued, manufacturers already have that incentive because using the lowest-emitting technology that is available maximizes the life of the engine. Such a program would simply create a windfall to manufacturers whose product lines are already capable of generating credits. The AIA, GAMA, and GE jointly commented that the proposed emission offset program goes beyond the borders of CAEP, and any emissions offset program should be developed within ICAO. General Electric was interested in exploring a potential emission offset program, particularly if the program would be applicable to new engine designs and derivatives that are subject to the proposed Tier 8 standards, and if it created the incentive to adopt new technologies earlier than would otherwise be the case in the absence of such incentives.

We appreciate the concerns raised by the commenters regarding the proposed voluntary offset emission program. We are also encouraged by GE's interest in further discussions about how this program may be useful in the context of the Tier 8 standards and a possible future Tier 8 production cutoff. EPA agrees that the proposal needs to be further developed to address certain aspects of the offset program. We have determined that the time it would take to sufficiently develop the program is incompatible with the need to promptly promulgate the Tier 6 production cutoff standard with a near-term effective date of January 1, 2013. Therefore we are not including the voluntary emission offset program in the final rule at this time. Nonetheless, we continue to see value in such a program for the aviation industry and recommend continuing to consider such a regulatory flexibility in the future.

Although we are deferring action on the proposed voluntary emission offset program for the time being, we believe that such programs are envisioned within the ETM language related to exemptions. Furthermore, we do not agree with the commenters who questioned the EPA's legal authority for adopting a voluntary emissions offset program as part of the aircraft engine emission standards. We are somewhat surprised by the industry commenters who questioned the authority for averaging, banking, and trading (ABT) programs outside of the narrow examples cited in their comments, and we are not yet persuaded by their claims. Note that the U.S. Court of Appeals for the D.C. Circuit has clearly stated that EPA has substantial discretion under the CAA section 231 to adopt final aircraft emission standards as the agency deems appropriate (*National Ass'n of Clean Air Agencies* v. *EPA* 489 F.3d 1221 (D.C. Cir. 2007)). We also wonder to what extent their view represents the industry as a whole, including any aircraft engine manufacturers who also manufacture engines that are subject to other EPA regulations that provide for ABT without the ''express'' statutory authority the commenters claim is necessary. If in future actions we seek additional comments on the legality of ABT programs under our aircraft standards, we will be interested in receiving comments from other stakeholders in the mobile source arena who might have views regarding the arguments presented by the industry commenters above.

In the meantime, we note that several of our mobile source regulations, in addition to the rule cited by industry commenters, have long provided regulated industry with the flexibilities inherent in an ABT program, under the authority of, for example CAA section 213, and none of those subject industries have opposed the creation of such programs or questioned their legal basis. (See, e.g., 40 CFR part 89, subpart C (averaging, banking and trading provisions for nonroad compression-ignition engines); 40 CFR part 90, subpart C (certification averaging, banking and trading provisions for nonroad spark-ignition engines at or below 19 kilowatts); 40 CFR part 91, subpart C (averaging, banking and trading provisions for marine spark-ignition engines); 40 CFR part 92, subpart D (certification averaging, banking and trading provisions for locomotives and locomotive engines); 40 CFR part 94, subpart D (certification averaging, banking and trading provisions for marine compression-ignition engines).) EPA continues to believe that the legal basis of these ABT programs is sound.

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

We did not propose a production cutoff for the Tier 8 $NO_X$ standards for newly-manufactured engines. This means that engine manufacturers may continue to produce Tier 6 compliant engines of previously certified models after the 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 that further consideration could be given to a related newly-manufactured engine standard pending new information on technology and market responses, although no formal action was taken at the time to explicitly make this a future work item for CAEP.[92]

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 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 (in our case the FAA) 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 more recent 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 raises 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 reviewed 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 including the ETM requirements in our regulations to address the 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. To ensure that the numerical decision criteria can be administered to allow for the consideration of unusual circumstances or special information, we are also providing the FAA with 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 § 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 a modified engine model can be considered a ''derivative'' only 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 rule provided that the engine manufacturer could show emissions equivalency by demonstrating 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:

±3.0 g/kN for $NO_X$
±1.0 g/kN for HC
±5.0 g/kN for CO
±2.0 SN for smoke

The proposed rule also provided that 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.

We received three significant comments on the proposed derivative provisions. First, ATA, PW, and Dassault-Aviation (DA) pointed out that the proposed criteria contained a substantial deviation from the expressed intent of the proposal and the ETM guidance. Specifically, they noted that the ETM provides that ''If a modified engine remains on the existing type certificate, it may retain the existing certification basis of the parent engine if the modification(s) * * * results in a decrease of the absolute emissions levels. * * * '' They pointed out, however, that the proposed rule provided that the certificate holder must demonstrate '' * * * the proposed derivative engine model's emissions meet the applicable standards and differ from the original model's emission rates only within * * * '' specified ranges for each pollutant. For example, the specified range is + or − 3 g/kN for $NO_X$. The commenters stated that this is more stringent than the ETM, and could discourage cleaner engines that are not clean enough to meet the next tier of standards. They asked that the final rule be consistent with the ETM to prevent this untoward effect.

We agree that the regulations should allow for such engines to be considered derivatives, even if the difference was outside the ''no emission change'' range. This allowance is clearly consistent with the ETM and was inadvertently left out of our proposed language. Therefore, the final regulations contain this allowance.

Second, AIA and GAMA jointly commented that the term ''new model'' was inappropriate when used to determine which engine models could demonstrate equivalency by engineering analysis, and when the manufacturer would be required to test the new engine model to demonstrate compliance with the equivalency criteria. They argued that because this provision applies to changes made to an existing engine, it could cause an engine manufacturer to conduct an additional emissions test in cases where a very small change was made to the engine

[92] 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.

due to a performance or engine weight change. The commenters recommended that this be altered to allow a manufacturer to consider ''* * * such emissions changes by analysis prior to this point, and only if such analysis revealed a deterioration that pushed the engine very close to the emission limits that the manufacturer be requested to complete an engine emissions test.''

The AIA and GAMA also jointly commented on the proposed regulatory text that states if the characteristic level of the original certificated engine model before modification is at or above 95 percent of the applicable standard for any pollutant, you must measure the proposed derivative engine model's emissions for all pollutants to demonstrate the derivative engine's resulting characteristic levels will not exceed the applicable emission standards. They claimed that the use of the term ''you must measure'' also implies further engine testing when additional analysis may likely prove sufficient.

We agree that the term ''new model'' should be modified and have instead used the term ''new engine configuration'' in the final regulations. We want to clarify, however, that the regulations do explicitly require engine testing when an original engine's emissions are within 5 percent of any emission standard. This text does not allow engineering analysis in such cases. We continue to believe this to be the appropriate policy. Given the greater uncertainty of engineering analysis relative to actual testing, we cannot rely on it for engines very close to the standard. This provision is also consistent with the ETM. Therefore, we are promulgating this requirement as proposed.

Third, AIA, GAMA, and GE commented that as a general matter, EPA should not codify the ETM's derivative engine decision criteria because the ETM guidance will evolve over time and the Agency's rigid regulations will not, even allowing for the FAA flexibility to use good engineering judgment if necessary when deciding what is or is not a derivative engine. They concluded it was simply better to let the FAA rely on the ETM guidance in its decision making. As noted by the commenters, the ICAO ETM itself is a guidance document for use by aviation authorities. It does not represent a standard or any other enforceable regulatory requirement. In the particular case cited by the commenters, they appear to ask that FAA be given unlimited discretion to determine which engines are subject to each new tier of standards.

In response to the comment, we also note that the Clean Air Act directs EPA to establish air pollution emission standards for aircraft engines. (See 42 U.S.C. 7551(a)(2)(A).) Implementation of this statutory directive mandates that we specify enforceable air pollution emission standards and control requirements for aircraft engines in regulatory form. We believe that it is reasonable for us to also establish other associated requirements in regulatory form. Our final rule achieves an appropriate balance between providing FAA discretion to implement the standards, and the need to establish aircraft engine emission regulations that ensure consistency in application.

We also disagree with the suggestion that the ETM will evolve over time, but that our regulations will not. As a working member of ICAO's Committee on Aviation Environmental Protection, we will participate in developing any relevant revisions to the ETM and will make appropriate adjustments to our regulations as needed.

We continue to believe that the ETM specifications for ''no emissions change'' are appropriate objective criteria for derivative engines. Thus, because we are codifying regulatory provisions to objectively specify when engines are considered to be ''derivative engines'', we are promulgating regulatory provisions consistent with the ICAO ETM guidance.

*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.[93] 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)[94] 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.[95] 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 EDB 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. 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 discharge our functions under the Act. (See 42 U.S.C. 7414(a)(1).)

Therefore, we proposed to require that each aircraft engine manufacturer submit a production report directly to EPA[96] 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

[93] 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.

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

[95] Under today's regulations, a grouping of engines with an essentially identical emission-related design are defined to be an ''engine sub-model''. Engines with slightly different designs are defined to be an ''engine model''.

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

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 also proposed 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. All of the specific reporting items we proposed were 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. We anticipated that the new emissions database would be a significant improvement over the current EDB because the data reporting is mandatory, it will be comprehensive in that it covers all engine models, and it must be updated annually.

In addition to some minor comments which are addressed in the analysis of comments document, we received comments from engine manufacturers addressing two specific areas of the proposed production reporting provision. First, the Aerospace Industries Association (AIA), General Aviation Manufacturers Association (GAMA) and Pratt & Whitney (PW) commented that annual production volume data is considered confidential business information (CBI) and as such, it should be exempt from Freedom of Information Act (FOIA) requests or other methods of public disclosure. Second, AIA, GAMA, PW and Williams International pointed out that for those engines which are only subject to smoke standards (turbofans with maximum thrust ratings less than or equal to 26.7 kN, and turboprops), manufacturers are not required under current regulations to measure gaseous emissions (HC, CO, $NO_X$, $CO_2$). As such, data on these gaseous emissions, as well as information used to measure gaseous emissions (reference pressure ratio and fuel flow data) are not readily available for these engines. Further, smoke data by mode of the LTO cycle may not be available for these older engines. These manufacturers pointed out that new testing of such engines would be required to generate these data, and that appropriate test procedures for these engines do not currently exist.

We understand and respect the needs of manufacturers to maintain the confidentiality of their legitimately proprietary data. However, we do not include in our regulations an up-front blanket CBI determination for any of the other mobile source sectors, and do not believe it is necessary here. As such, in response to the comments, we are including regulatory language patterned after existing regulations for several other mobile source categories which sets forth how we would treat—on a case by case basis—submitted data which is covered by a CBI claim from the manufacturer as provided by 40 CFR part 2. The addition of this provision will ensure that no information that is legitimately protected CBI gets inadvertently released to the public.

We do not believe it is appropriate to require additional testing for turbofans with maximum thrust ratings less than or equal to 26.7 kN and turboprops specifically for production reporting purposes. Thus, for these engines, we will not be requiring the submission of HC, CO, $NO_X$, $CO_2$, reference pressure ratio or fuel rate data. Further, we will not require additional testing of older engines for which smoke data by specific LTO cycle segment is not currently available.

We also noted in the proposal that the reported information would be used in conjunction with the $NO_X$ and $CO_2$ emission data already required to be submitted to us under section 87.64 for purposes of greenhouse gas (GHG) reporting to establish. This would effectively provide us with a complete and comprehensive engine exhaust emissions database. We noted our expectation that most manufacturers would likely add the proposed information items to the annual GHG report. No comments were received on combining the two reports. After further deliberation, we have decided to require a single, integrated report in this final rule to eliminate any possible confusion regarding the two separate reports and make reporting more efficient.

The incremental reporting elements for each affected gas turbine engine sub-model are listed below. Although not proposed, we have added engine type to the list for completeness. The reporting elements of the existing GHG report are also identified for completeness.

- Company corporate name as listed on the engine type certificate (GHG);
- Engine Type (turbofan, mixed turbofan, or turboprop);
- 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 (even if zero). If an engine sub-model is no longer being produced, state that the engine sub-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 intended for use as certified (non-exempt) spare engines on in-use aircraft;
- Reference pressure ratio (GHG) (not applicable to turbofans with maximum thrust ratings less than or equal to 26.7 kN, and turboprops);
- 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 (not applicable to turbofans with maximum thrust ratings less than or equal to 26.7 kN, and turboprops);[97]
- Unburned hydrocarbon (HC) characteristic level (i.e. mass of hydrocarbons over LTO cycle/Rated Thrust (Dp/Foo)) (not applicable to turbofans with maximum thrust ratings less than or equal to 26.7 kN, and turboprops);[98]

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

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

• 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) (not applicable to turbofans with maximum thrust ratings less than or equal to 26.7 kN, and turboprops);

• Carbon monoxide (CO) characteristic level (i.e. mass of CO over LTO cycle/Rated Thrust (Dp/Foo)) (not applicable to turbofans with maximum thrust ratings less than or equal to 26.7 kN, and turboprops);

• 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) (not applicable to turbofans with maximum thrust ratings less than or equal to 26.7 kN, and turboprops);

• Nitrogen oxides ($NO_X$) characteristic level (i.e. mass of $NO_X$ over LTO cycle/Rated Thrust (Dp/Foo)) (GHG) (not applicable to turbofans with maximum thrust ratings less than or equal to 26.7 kN, and turboprops);

• 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), if available;

• 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)) (not applicable to turbofans with maximum thrust ratings less than or equal to 26.7 kN, and turboprops);

• 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) (not applicable to turbofans with maximum thrust ratings less than or equal to 26.7 kN, and turboprops); and

• Any additional remarks to the EPA.

The annual report is required to be submitted for each calendar year in which a manufacturer produces any engine subject to emission standards as previously described. These reports will be due by February 28 of each year, starting with the 2014 calendar year, and cover the previous calendar year. This report shall 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 reports to help inform any policy approaches regarding aircraft engine emissions that we consider, including possible future emissions standards. The information will also enhance the general public's understanding of the emission characteristics of aviation gas turbine engines and allow independent development of emission inventories and assessments of local environmental effects. 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 will be updated annually. We have assessed the potential reporting burden associated with this annual reporting requirement. That assessment is presented in sections V. and IX.B of this notice.

### *E. Standards for Supersonic Aircraft Turbine Engines*

We proposed 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 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.

The Aerospace Industries Association (AIA) and the General Aviation Manufacturers Association (GAMA) commented that within CAEP it was agreed that these standards are ''not appropriate for future products'' and should not be adopted by EPA.[99] 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 adopt these conforming standards. Therefore, we are promulgating the standards for supersonic aircraft as proposed. As previously noted, this action has no practical effect, and simply aligns EPA standards with the rest of the world. (See section III.G for a brief discussion of potential revised emission standards for future engine designs that may be used on supersonic aircraft.)

### *F. Amendments To Test and Measurement Procedures*

We are incorporating 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.[100] [101] [102] These amendments to Annex 16, Volume II are primarily intended to ensure that the provisions reflect current certification practices. The amendments make clarifications or add flexibilities for engine manufacturers. They are described below.

• Standardizing the terminology relating to engine thrust/power

• 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

• Clarifying the appropriate value of fuel flow to be used at each LTO test point

• Clarifying exhaust nozzle terminology for exhaust emissions sampling

• Allowing an equivalent procedure for gaseous emission and smoke

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[99] The CAEP position referred to by AIA and GAMA is based on the expectation that future designs for supersonic aircraft will be significantly different from past designs. The agreement was reached at CAEP/8 to evaluate emission standards for these engines as a future work item.

[100] 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.

[101] 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.

[102] ICAO, ''International Standards and Recommended Practices, Annex 16 to the Convention on International Civil Aviation, Environmental Protection, Volume II Aircraft Engine Emissions, Amendment 7, effective July 18, 2011'' Third. A copy of this document is in docket number EPA–HQ–OAR–2010–0687.

measurement if approved by the certificating authority

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 have already done to meet ICAO's adopted and recommended amendments.

Our incorporation by reference of the ICAO test procedure makes most of the existing subpart G and all of subpart H of part 87 obsolete. Therefore, we are removing these sections from the regulation, as proposed.

*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 kN, 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.[103] 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.

**V. Description of Other Revisions to the Regulatory Text**

In addition to the changes discussed above, we are including 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 this final rule relates to engines used in military and noncommercial civilian aircraft. We do not believe these changes will have practical significance for current engine models because the changes align with manufacturers' current practice in certifying their engines.

[103] 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.

1. Military Engines

We do not intend today's action to have any impact on engines installed on military aircraft, or new aircraft that are destined to be converted for military use. 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 new standards and requirements will continue to apply only to engines used in aircraft for which standard airworthiness certificates are required, and thus are not applicable to engines used in military aircraft. 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, in the NPRM we proposed to include a statement in the regulations to clarify that the proposed production cutoff would not apply for previously certificated engines that are installed and used in military aircraft. One manufacturer commented that the definition of ''military aircraft'' we proposed should extend to sales of military aircraft outside of the U.S. While we believe the regulations as written do not apply to foreign sales of military aircraft, we are nonetheless revising our proposed definition of ''military aircraft'' to clarify that foreign aircraft considered military under international laws and agreements are not covered by 40 CFR part 87.

2. Noncommercial Engines

Prior to this action, section 87.21(d) specified that gaseous emission standards applied 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 were not required to comply with our current HC, CO, and $NO_X$ exhaust emission standards in § 87.21(d). They were and are subject, however, to the current standards for smoke and fuel venting.

In today's action we are applying the 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 action. First, the ICAO Annex 16, Volume II standards and recommended practices apply equally to commercial and noncommercial engines, and our rules' previous failure to reflect this meant that our requirements did 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 provision simply incorporates the status quo.

In order to make EPA standards conform to ICAO's, we needed 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.) In conjunction with the NPRM for this final rule, we proposed 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. We received no comments on that proposed finding, and are therefore finalizing our emissions assessment supporting this finding, which is contained in the docket for this rulemaking.[104]

*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 revising 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 changes to part 87 are not intended to significantly change the certification and compliance program. We did not reopen for comment the substance of any part of the program that remains unchanged substantively.

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

ICAO Annex 16, Volume II 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, Volume II. 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:

- 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 regulations 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

[104] U.S. EPA, ''Final Finding for Commercial and Noncommercial Turbofan and Turbojet Aircraft Emissions,'' memorandum from John Mueller, Assessment and Standards Division, Office of Transportation and Air Quality, March 2012. A copy of this document is in docket EPA–HQ–OAR–2010–0687.

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. The primary exception to this is the specification that smoke numbers be expressed to one decimal place. 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 definitions are intended to reflect the plain meaning of these terms.

The 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. |
| 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 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. |

| Regulation cite | Description of amendment | Notes |
| --- | --- | --- |
| 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 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 definition needs to be considered along with the 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 primarily 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. In response to comments, we added a clarification that military aircraft also include "other aircraft considered to be military aircraft under international law and conventions." |
| 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. |
| 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). |

## VI. Technical Feasibility and Cost Impacts

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.[105] [106] 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

[105] 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.

[106] 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.

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 believe this clearly demonstrates the technical feasibility of those standards. Therefore, we will limit our discussion below to 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 that 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. Based on these analyses, CAEP concluded that the CAEP/8 $NO_X$ standards were technically feasible within the lead time and time frame identified in the action.

Regarding the costs of this final rule, 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 being promulgated in this final rule. Also, the 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 this final rule. Therefore, EPA believes that today's 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 annual reporting requirement for emission related information. (See section III.D for a description of the 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).[107] We expect the incremental reporting burden for these 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 requiring 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 about 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.

## VII. Consultation With FAA

The requirements contained in this action were developed in 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

[107] As discussed in section III.D, we are requiring a single report that integrates the new reporting requirement contained in this final rule with the existing mandatory greenhouse gas (GHG) reporting of $NO_X$ and $CO_2$ as already required under § 87.64. Combining the existing GHG report with the new reporting requirement will not increase an engine manufacturer's reporting burden. A single, integrated report may actually reduce a manufacturer's total reporting burden somewhat because of the efficiency inherent in reporting to EPA once instead of twice.

under section 231.[108] 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.[109] 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 have been adopted ICAO.

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.

## VIII. Public Participation

We proposed this regulation on July 27, 2011 (76 FR 45012). A public hearing was held on August 11, 2011 in Chicago, IL. The public was invited to submit written comments on the proposal during the formal comment period, which ended on September 26, 2011. We received eight public comments from aircraft and aircraft engine manufacturers, airline operators and an individual.

The vast majority of commenters supported the central tenets of the proposed regulations. That is, there was broad support for the adoption of these standards and the alignment of U.S. and international emissions regulations. We received specific comments on several aspects of the proposal.

Throughout this notice, we discussed the key issues arising from the public comment and our responses. In addition, we have addressed all of the public comments in the analysis of comments document associated with this final action and located in the docket (Docket ID EPA–HQ–OAR–2010–0687).

## IX. 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.

## X. Statutory and Executive Order Reviews

### *A. Executive Order 12866: Regulatory Planning and Review, and Executive Order 13563: Improving Regulation and Regulatory Review*

Under Executive Order (EO) 12866 (58 FR 51735, October 4, 1993), this action is a ''significant regulatory action.'' This action promulgates 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 13563 (76 FR 3821, January 21, 2011) 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 regulations that conform to 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 adopted here. Therefore, EPA believes that today's 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 reporting requirements, as discussed in section IX.B.

### *B. Paperwork Reduction Act*

The information collection requirements in this 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 requirements are not enforceable until OMB approves them.

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. However, these reports are voluntary and aperiodic. As part of this action, we are requiring that engine manufacturers send this information to EPA on an annual basis. We are also requiring manufacturers to send us their annual production volumes, which 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 will simply require manufacturers to add the required 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 annual reporting requirement.

We have estimated the total annual burden of the 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. When this ICR is approved by OMB, the Agency will publish a technical amendment to 40 CFR part 9 in the **Federal Register** to display the OMB control number for the approved

[108] 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).

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

information collection requirements contained in this final rule.

*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 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 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 affected by the regulations. An analysis of the impacts of the proposed rule on small businesses has been prepared and placed in the docket for this rulemaking.[110] Since this final rule is largely unchanged from the proposal, that analysis remains valid for the final rule.

*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 III, today's 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 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 rule 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 revises 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.

*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.

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

This rule is not subject to Executive Order 13045 (62 FR 19885, April 23, 1997) because it is not economically significant as defined in EO 12866 and 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.

*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 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

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

Congress, through OMB, explanations when the Agency decides not to use available and applicable voluntary consensus standards.

This rulemaking involves technical standards for testing emissions for aircraft gas turbine engines. EPA is using test procedures contained in ICAO's International Standards and Recommended Practices Environmental Protection, Annex 16, Volume II along with the modifications contained in this rulemaking.[111] 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.

*J. Executive Order 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 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.

*K. Congressional Review Act*

The Congressional Review Act, 5 U.S.C. 801 et seq., as added by the Small Business Regulatory Enforcement Fairness Act of 1996, generally provides that before a rule may take effect, the agency promulgating the rule must submit a rule report, which includes a copy of the rule, to each House of the Congress and to the Comptroller General of the United States. EPA will submit a report containing this rule and other required information to the U.S. Senate, the U.S. House of Representatives, and the Comptroller General of the United States prior to publication of the rule in the **Federal Register**. A major rule cannot take effect until 60 days after it is published in the Federal Register. This action is not a ''major rule'' as defined by 5 U.S.C. 804(2). This rule will be effective July 18, 2012.

*L. Executive Order 13609: Promoting International Regulatory Cooperation*

Executive Order (EO) 13609 (77 FR 26413, May 4, 2012) promotes international regulatory cooperation in order to identify approaches that are at least as protective as those that are or would be adopted in the absence of such cooperation in meeting shared challenges involving health, safety, labor, security, environmental, and other issues. International regulatory cooperation can also reduce, eliminate, or prevent unnecessary differences in regulatory requirements.

These final standards are identical to the international standards developed through EPA's active participation in the United Nation's International Civil Aviation Organization (ICAO) activities. EPA has historically been a principal participant in the development of U.S. policy in various ICAO working groups and other international venues, assisting and advising the Federal Aviation Administration on aviation emissions, technology, and policy matters. These provisions provide a means by which the United States can meet its obligations under the Chicago Convention and ensure that engine manufacturers maintain worldwide acceptability of their products.

**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, Motor vehicle pollution, Penalties, Reporting and recordkeeping requirements, Warranties.

Dated: June 1, 2012.

**Lisa P. Jackson,**

*Administrator.*

For the reasons described in the preamble, title 40, chapter I, of the Code of Federal Regulations is amended as set forth below.

## 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

[111] 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 (*www.icao.int*).

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 that 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) and other aircraft considered to be military aircraft under international law and conventions.

*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* has the meaning given in 40 CFR 1065.1001.

*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 = 0.00634 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)(3), ''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, *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 (ICAO Annex 16). IBR approved for §§ 87.1, 87.42(c), and 87.60(a) and (b).

(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 July 18, 2012 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 subpart C 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 July 18, 2012, 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 a gaseous emission standard is specified by a formula, calculate and round the standard to three significant figures or to the nearest 0.1 g/kN (for standards at or above 100 g/kN). Where a smoke standard is specified by a formula, calculate and round the standard to the nearest 0.1 SN. Engines comply with an applicable standard if the testing results show that the engine type certificate family's characteristic level does not exceed the numerical level of that standard, as described in § 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 1 TO § 87.23—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 | .............. | $140 \cdot 0.92^{rPR}$ | $36 + 2.42 \cdot rPR$ | $4550 \cdot rPR^{-1.03}$ |
| rO ≥ 26.7 kN | $83.6 \cdot rO^{-0.274}$ or 50.0, whichever is smaller | $140 \cdot 0.92^{rPR}$ | $36+2.42 \cdot rPR$ | $4550 \cdot rPR^{-1.03}$ |

(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 2 TO § 87.23—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 50.0, whichever is smaller | .............. | .............. |
| rO ≥ 26.7 kN | $83.6 \cdot rO^{-0.274}$ or 50.0, 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 3 TO § 87.23—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 | $38.5486 + 1.6823 \cdot PR - 0.2453 \cdot rO - 0.00308 \cdot rPR \cdot rO$ |
| | 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 4 TO § 87.23—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 (d) 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 July 18, 2012 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.

(3) An engine manufacturer may produce up to six newly manufactured Tier 4 engines on or after July 18, 2012, subject to the provisions of this paragraph (d)(3). Tier 4 engines meeting the criteria of this paragraph (d)(3) are excepted without request from the otherwise applicable Tier 6 $NO_X$ emission standard. To be eligible for this exception the engines must have a date of manufacture prior to August 31, 2013 and be fully compliant with all requirements applicable to Tier 4 engines. The manufacturer must include these engines in the report required by § 87.50. This exception is void for any manufacturer that produces more than six excepted engines under this paragraph.

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

**Subpart E—Certification Provisions**

Sec.


87.40 General certification requirement.
87.42 Production report to EPA.
87.46 Recordkeeping.
87.48 Derivative engines for emissions certification purposes.


## Subpart E—Certification Provisions

### § 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. Note that § 87.64 requires you to report $CO_2$ emission rates to EPA in addition to $NO_X$. Include these data in the report required by this section. If you produce exempted or excepted engines, you may submit a single report with information on exempted/excepted and normally certificated 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 type of engine (turbofan, turboprop, etc.) and 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) Identify the combustor of the sub-model, where more than one type of combustor is available.

(4) The calendar-year production volume of engines from the sub-model that are covered by an FAA type certificate. Record zero for sub-models with no engines produced during the calendar year, 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. For engines delivered without a final sub-model status and for which the manufacturer has not ascertained the engine's sub-model when installed before submitting its production report, the manufacturer may do any of the following in its initial report, and amend it later:

(i) List the sub-model that was shipped or the most probable sub-model.

(ii) List all potential sub-models.

(iii) State "Unknown Sub-Model."

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

(6) 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. For purposes of this paragraph (c)(6), applicable test data means data required to certify the engine sub-model, which would typically include $NO_X$, HC, CO and smoke number. However, applicable test data would not include $NO_X$, HC, or CO emissions for engines subject to only smoke standards. Note that § 87.64 also requires you to report $CO_2$ emissions. 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) Clearly show what information you consider confidential by marking, circling, bracketing, stamping, or some other method. We will store your confidential information as described in 40 CFR part 2. Also, we will disclose it only as specified in 40 CFR part 2. If you send us information without claiming it is confidential, we may make it available to the public without further notice to you, as described in 40 CFR 2.204.

(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 configuration is considered a derivative engine for emissions certification purposes. This would mean that the engine configuration 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 configuration 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.

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

(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 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 paragraph (a) of this section must be approved by the FAA, with the written concurrence of EPA, to be effective. Exemption requests under paragraph (b) of this section must be approved only by the FAA 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 to the FAA before producing the engines to be exempted, who will provide a copy to the Designated EPA Program Officer. Exemption by an authority outside the United States does not satisfy this requirement. Unless EPA and FAA allow otherwise, 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.

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

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

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

(3) Official visits by representatives of foreign governments.

(4) Other flights the Secretary determines to be for short durations at infrequent intervals. A request for such a determination shall be made before the flight takes place.

(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 certificated to equal to or lower emission standards than those of the engines they are replacing, for all regulated 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 1 TO § 87.60—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.

**§§ 87.61–87.63 [Removed]**

■ 15. Remove §§ 87.61–87.63.

**§ 87.64 [Amended]**

■ 16. In § 87.64, remove and reserve paragraph (a).

**§§ 87.65–87.71 [Removed]**

■ 17. Remove §§ 87.65–87.71.

## Subpart H—[Removed]

■ 18. Remove subpart H.

## PART 1068—GENERAL COMPLIANCE PROVISIONS FOR HIGHWAY, STATIONARY, AND NONROAD PROGRAMS

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

**Authority:** 42 U.S.C. 7401–7671q.

## Subpart A—[Amended]

■ 20. 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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