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

Summary and Analysis of Comments

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## Summary and Analysis of Comments

Assessment and Standards Division  
Office of Transportation and Air Quality  
U.S. Environmental Protection Agency

### NOTICE

*This technical report does not necessarily represent final EPA decisions or positions. It is intended to present technical analysis of issues using data that are currently available. The purpose in the release of such reports is to facilitate the exchange of technical information and to inform the public of technical developments.*

# **Control of Air Pollution from Aircraft and Aircraft Engines; Final Emission Standards and Test Procedures**

## **Summary and Analysis of Comments**

### **Introduction**

In July of 2011, we proposed several new NO<sub>x</sub> emission standards, compliance flexibilities, and other regulatory requirements for aircraft turbofan and turbojet engines with rated thrusts greater than 26.7 kilonewtons (kN), as well as certain other requirements for gas turbine engines that are subject to exhaust emission standards. The proposed rule was published 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. The following is a list of entities that provided relevant comments on the proposed rule:

Aerospace Industries Association and General Aviation Manufacturers Association (joint comment)

Air Transport Association

Dassault Aviation

General Electric Aviation

Pratt & Whitney

Rolls Royce<sup>1</sup>

Williams International

A transcript of the public hearing and all of the written comments are available in public docket EPA-HQ-OAR-2010-0687. This document contains summaries of the comments received and EPA responses to those comments.

### **Issue: Leadtime Associated with the Production Cutoff**

Organization: General Electric Aviation (GE)

Comment: The intent of the proposal was to provide one year between formal implementation of the Tier 6 standard (assuming a final rule by December 31, 2011) and the proposed January 1, 2013 effective date of the Tier 6 production cutoff. Most of the engine models currently in

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<sup>1</sup> Rolls Royce submitted comments under a claim of confidential business information (CBI). As such, they are not available for public viewing. However, Rolls Royce did not raise any issues or present any new information that was not addressed in other comments to which we are fully responding.

production that are certified to the Tier 4 standard have NO<sub>x</sub> emissions below the Tier 6 levels, as demonstrated in the original Tier 4 emissions certification reports that were submitted to FAA. In our estimate, the existing certification reports should be sufficient for FAA to formally certify these engines to the Tier 6 standard, thereby ensuring they will not be adversely affected by the Tier 6 production cutoff. However, if further interaction with the FAA is necessary, and other formal FAA action is required, we are concerned that production could be interrupted due to revisions of FAR Part 34 and review of existing certification reports. Therefore, rather than adopting January 1, 2013 as the effective date for the production cutoff, the final rule should specify that the requirement goes into effect 12 months after the final rule.

Organization: Aerospace Industries Association (AIA) and General Aviation Manufacturers Association (GAMA)

Comment: There could be less than one year lead time between implementation of Tier 6 and the Tier 6 production cut-off if EPA's final rule is not adopted before January 1, 2012. Such lead-time is not appropriate for manufacturers or regulators to make such changes. We suggest that if the final rule is delayed, the dates should then be adjusted to provide at least one year between formal implementation of the Tier 6 standard and the Tier 6 production cut-off.

Response: We believe that our proposed dates for the Tier 6 requirements are appropriate and consistent with the Clean Air Act. Section 232(b) of the Act directly addresses our obligation relative to the effective date of regulations. 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 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 by the commenter above, the aircraft engine models described by GE are already capable of complying with the EPA proposed Tier 6 NO<sub>x</sub> standards through the continued use of already developed and already applied requisite technology (the cost of applying with has already been borne), as the effective date of the corresponding ICAO CAEP/6 NO<sub>x</sub> 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 proposed Tier 6 NO<sub>x</sub> standards. Also, consistent with our most recent previous amendment to the NO<sub>x</sub> 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 proposed effective date does not need to build in 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 proposed dates provide more than adequate lead time under the statute. The AIA/GAMA comment does not present a specific example or information to illustrate the basis of the generalized assertion that one year of lead time is necessary for this standard. Therefore, because aircraft engine manufacturers are already able to comply with the proposed Tier 6 NO<sub>x</sub> standard through the continued use of already applied requisite technology,

and because the effective date of the corresponding ICAO CAEP/6 NOx standard has already passed, we do not believe that a basis has been established that a full year of lead time is needed between the Tier 6 NOx standard and the production cutoff.

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.

Regarding the need for engine models to be formally recognized by the FAA as complying with the proposed Tier 6 standard, this is completely within the purview of the FAA. In our previous most recent amendment to the NOx 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 significantly later, with no apparent disruption to the industry. See 70 FR 69664 (Nov. 17, 2005). The proposed 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 NOx 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. Based on the FAA's assurances and description of the streamlined process to formally recognize conformance with the new standards, engine manufacturers now support promulgating the production cutoff date as proposed.<sup>2</sup>

For the reasons stated above, EPA is promulgating the production cutoff date as originally proposed.

#### **Issue: Exemptions/Exceptions from the Tier 6 Production Cutoff**

Organization: Aerospace Industries Association (AIA) and General Aviation Manufacturers Association (GAMA)

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<sup>2</sup> Email and letter from Leslie Riegler, Aerospace Industries Association, to Lourdes Maurice, U.S. Federal Aviation Administration, February 23, 2012.

Comment: Requesting an increased amount of engine exemptions can take a significant amount of time. There may be insufficient time for a manufacturer to receive approval for additional engine exemptions if necessary to meet previously unknown market demands. It is important that when the NPRM refers to flexibility, it does not lose sight of the time required go through the exemption granting process. The FAA is the agency that holds jurisdiction in this process, and we ask that the EPA takes into account the existing role of the FAA in this process.

Response: The comment does not provide a specific example or other information that may illustrate this concern. As a general matter, given the long lead time 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 not revising our proposal based on this comment.

Organization: Aerospace Industries Association (AIA) and General Aviation Manufacturers Association (GAMA)

Comment: The term "excepted" for spare engines that do not comply with the Tier 6 NOx standards, but may continue to be sold after the Tier 6 production cut-off requirements takes effect, is inconsistent with current engine name plate labeling practice. Currently engines are either marked "COMPLY" or "EXEMPT" for emissions. It might be concerning to the operators holding an engine with a plate reading "EXCEPTED." Therefore, for the purpose of the name plate we believe "exempt" should be utilized instead of "excepted."

Organization: Air Transport Association (ATA)

Comment: The EPA proposes a different means – that spares be considered "exceptions" for which case-by-case approval is not required, subjecting them only to a labeling requirement. ATA supports this change of approach, which follows CAEP's judgment but provides separate treatment of spares in a slightly differing way and simplifies administration for FAA without compromising the structure of the exemptions program set forth in the ETM.

Response: 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’.

Organization: Pratt and Whitney (PW)

Comment: Once the final rule is enacted there might be a delay before EPA and FAA can establish and undertake procedures to review exemption requests. This could be very disruptive to engine manufacturers that have already contracted to deliver engines or parts of engines during that period, and also be harmful to airplane manufacturers and airlines. To avoid this type of economic disruption, the final rule “...should grant a one-time, interim block of, perhaps, twenty (20) exemptions to each engine manufacturer.” This is well within EPA’s standard-setting authority under section 231 of the Clean Air Act. Such an approach would both head off uncertainty for the aviation industry, as well as give the FAA and EPA the time to establish exemption request review procedures and lighten their administrative burden while doing so.

Response: Based on supplemental information we received from Pratt & Whitney,<sup>3</sup> we find their 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 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 cutoff. These engines are currently certificated to the Tier 4 NOx standards. Pratt & Whitney have 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.<sup>4</sup> 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 deliver date in May 2013. They are also certificated to the Tier 4 NOx 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, Pratt & Whitney has stated that it is not economically

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<sup>3</sup> Memoranda documenting this supplemental information are located in docket number EPA-HQ-OAR-2010-0687.

<sup>4</sup> The FAA has stated to EPA that inadequate time exists for the required formal compliance determination before the production cutoff takes effect.

feasible to redesign this model to conform with the Tier 6 standards, even if it were technically feasible. The single new aircraft using these engines is also being built for delivery to a foreign airline.

In assessing Pratt & Whitney's concern, 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 certifying 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 manufacturer's 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 Pratt & Whitney's unique 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 Pratt & Whitney 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 of requisite technology, giving appropriate consideration to the cost of compliance within such period, we are including an exception provision in the regulations that permits Pratt & Whitney 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 would be required to have a type certificate which indicates that they meet the 40 CFR 87 requirements last updated on October 30, 2009 (i.e., Tier 4). No formal exemption request or approval would be required for these six 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 the availability of this transitional flexibility to any manufacturers that may be in similar circumstances.

Organization: General Electric Aviation (GE)

Comment: The proposed EPA exemption deviates from the current ICAO ETM guidance. Maintaining harmonization with the international community is not only required by the Chicago Convention, but also provides streamlined processes and procedures within the regulated industry. Any purported benefits to EPA's proposed unique exemption scheme are outweighed by setting up a conflict with the remainder of the world. If EPA wants a different approach to evaluating exemptions, it would be more appropriate to work inside the ICAO/CAEP process toward that end.

Organization: Air Transport Association (ATA)

Comment: The EPA proposed case-by-case approach to determining the number of engines that may be exempt for installation on new aircraft is a rejection of the ICAO/ETM provisions that limit "...the number of exemptions ... to 75 engines per type certificate...". This would create a serious discontinuity between the U.S. and the rest of the world, undermining ICAO's objective of international uniformity. The ICAO exemption limits are intended to be applied globally through the coordinated efforts of international aviation authorities. Differing rules would make this impracticable. That this would make coordination unworkable is evidenced by EASA's assumption in its proposal that "the ICAO proposals will be adopted unaltered by other aviation authorities of the world." It is also "... immaterial that the variance is from the ETM, an ICAO guidance document supplementing the official standards of Annex 16, Vol. II, rather than the Annex itself. The ETM provides technical elaboration on the implementation of Annex 16, and differing practices have the same disruptive effect."

Rather than accepting the ETM cap of 75 engines per type certificate, EPA proposes to require 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." This knowledge may not be known at the time of the exemption request because of market lead times. For example, the 1998 RR exemption request from the CAEP2 cutoff for 150 engines was not based on this type of certainty, but was a prospective exemption for two years as protection against the uncertainties of technical development. 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 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.

Also, the uncertainties regarding total production make it impossible to make an accurate estimate of the total environmental impact under the exemption. The ICAO cap of 75 engines per type certificate allows ready calculation of the global impact that CAEP has determined to be environmentally acceptable.

Response: The commenters' concerns appear to be primarily focused on the number of exemptions and the underlying process that is embodied in the ETM and our proposal. We proposed to continue using the general exemption language for exhaust emission standards contained in part 87.7(c) of our current regulations. More specifically, we proposed to evaluate each request for exemption 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. An engine manufacturer could also request that an exemption be expanded to include additional engines after providing additional information to justify such an increase. The intent, of course, would be to exempt the minimum number of engines that can be justified, including a consideration of the public health and welfare effects associated with the exemptions. We acknowledged that our proposed language differed from the ETM allowance that "...would normally not exceed 75 per engine type certificate..." However, the outcome in terms of number could be similar, if justified.

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. Moreover, even if the ETM were a standard, consistency is not compelled when a deviation is justified, and we were comfortable with our proposed exemption provision for those reasons. We disagree with ATA's comment that the ICAO guidance is effectively the equivalent of an ICAO Annex 16 standard. It is interesting to note that elsewhere in their comments, ATA supported a deviation from the ETM language for labeling spare engines as "except" rather than "exempt." Finally, as noted in the proposal, we intend to work within CAEP to align the ETM with our approach.

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. Rather the ETM provision is an expectation that "[T]he number of engines exempted would normally not exceed 75 per engine type certificate ...." With this perspective both the ETM and our proposed approach are similar in that the maximum number of exempted engines is based on a consideration of the petitioner's justification for such exemptions.

The commenter is correct that our proposed approach "...requires an applicant to provide detailed justification for each individual engine, including exact number, initial purchasers/users, countries of registry, and plans for bringing the product into compliance." This 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 "...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.

The commenter appears to contradict its position that a significant amount of information may not be available regarding expected purchases at the time of the exemption request, while also stating 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, the proposed regulatory text notes that the petitioner should include information on “expected” first purchasers/users of the aircraft. It also asks for information on the number of aircraft that will be registered in the U.S. versus other countries that 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 states 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.

We disagree with the comment that the proposed 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 that exemptions would normally not exceed 75 per type certificate and our proposal 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. Finally, as described in the proposal, it now appears that only one or two engine models may be candidates for exemptions, and that the potential number of justifiable exemptions would be less than 75 in total. We do not think coordination with foreign aviation authorities, most likely EASA, with these few exemptions should pose any problems. Therefore, we find nothing in the justification elements that should impinge upon the ability to internationally collaborate and consult on exemptions.

Finally, regarding the estimate of total environmental impact, the engine manufacturer must base this estimate on the number of exemptions requested, and the differences in pollutant levels between the non-compliant engine and an alternative that would meet the applicable standards. As noted above, this estimate would simply be based on the manufacturer’s ability to determine this information as accurately as possible, just as for the ETM. We are also unaware of any explicit CAEP analysis that characterized the “environmental acceptability” of the suggested ETM limit of 75 engines per type certificate, as implied by the Air Transport Association.

### **Issue: Exemptions for Newly-certified Engine Models**

Organization: General Electric (GE)

Comment: The development timeline for a new aircraft engine can span 6 or more years from concept to certification. As a result, unforeseen circumstances may arise during aircraft engine

development that necessitates a change in design that may impact the ability of that engine to meet the prevailing Tier emission standard at certification. Therefore, exemptions should be available for newly-certified engines in addition to newly-manufactured engines.

Organization: Aerospace Industries Association (AIA) and General Aviation Manufacturers Association (GAMA)

Comment: The existing 40 CFR section 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 NOx standards. This flexibility should be retained.

Throughout the NPRM the Agency suggests it will pursue a production cut-off for the proposed Tier 8 NOx standards at a later date. CAEP indicated that such a cut-off would need to take into account future work and the manufacturers' response to the CAEP/8 regulations. Not adhering to the same principles is concerning.

Response: Regarding the availability of exemptions for newly-certified engine models, the proposed regulatory text makes 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 section 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.) Clearly, the intent of the existing exemption provision cited by AIA/GAMA was to make it apply 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 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 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.

We do not understand the AIA and GAMA concern with our stated goal of pursuing a potential phase-in of the proposed Tier 8 standard, i.e., a production cut-off. The preamble clearly

described our intent to work within the ICAO/CAEP framework to develop harmonized international standards for any such requirement. We also generally described that CAEP had decided to consider a Tier 8 production cut-off "...as a future work item, pending new information on technology and market responses." So we believe we are adhering to the same principles as CAEP.

### **Issue: Limits on Pollutants from Excepted Spare Engines**

Organization: Aerospace Industries Association (AIA) and General Aviation Manufacturers Association (GAMA)

Comment: The proposal would require that the emissions of an excepted spare engine be equal to or lower than the engine it is replacing. This is impractical because, while unlikely, a spare engine might have a different emissions profile for some pollutants than the engine it would replace. For example, the engines could have somewhat different combustion systems that might make one engine lower in NO<sub>x</sub> but higher in carbon monoxide (CO). The EPA needs to consider the totality of the emissions in decision, or delete this requirement in the final rule. (AIA)

Response: The proposed language to limit the emissions from an excepted spare engine is consistent with the ICAO/CAEP ETM. This provision, as well as the exemption provisions, was subject to significant discussions 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.

The AIA and GAMA suggest 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 commenter, the effects of LTO NO<sub>x</sub> 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 meets specific emission limits. For this reason, and in response to the AIA and GAMA comments, we have modified 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 the emission standards and other requirements of its type certificate. Given the limited number of spare engines in the fleet, we expect that allowing these engines to have somewhat different emission profiles from the engines they are replacing will have no significant adverse environmental effect. We do expect, however, that in most cases the emissions of an excepted spare engine will be equal or better than the engine it is replacing in accordance with the basic tenant of the ETM.

### **Issue: Exemptions for Short Duration Flights**

Organization: Aerospace Industries Association (AIA) and General Aviation Manufacturers Association (GAMA)

Comment: The existing provision that allows temporary exemptions for flights of short duration and infrequent intervals should be retained. 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 ferried to the conversion facility. While these military-only aircraft would generally utilize compliant engines, it may be possible that non-compliant engines could be used in 2017 and temporary exemptions would be necessary. Additionally, it would be helpful if the provision also allowed for the granting of a discrete number of exemptions over a specified time period, rather than having to request the exemption prior to each flight as currently required.

Response: The proposal to delete the exemption allowance for infrequent interval and short duration flights that is contained in section 87.7(a)(4) was developed in consultation with the FAA. Unfortunately, the need for temporary exemptions for the specific scenario described by the commenters was not identified. In considering the commenters' suggestion to retain the exemption, we note that allowing such operations will not have any significant adverse affect on the environment because of the infrequent and short duration of such flights. Retaining the exemption is also consistent with the intent of the separate proposal to exempt military aircraft from emission control requirements. Therefore, EPA is retaining the provision in the final rule 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. 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 have deleted that portion of the current exemption. Of course, we will consult with the Secretary if asked.

As for requesting a discrete number of temporary exemptions, we believe this is an issue that the Secretary of Transportation may determine under its enforcement role as described in section 232 of the CAA.

### **Issue: Military Exclusion**

Organization: Pratt & Whitney (PW)

Comment: We support the recognition that the proposed standards should not apply to aircraft produced for military use, noting that this is consistent with the ICAO Convention, which does not apply to state aircraft, including military aircraft. However, the proposed definition of "military aircraft" covers only aircraft "owned by, operated by, or produced for sale to the armed forces or other agency of the Federal government responsible for national security." The military exception should extend to sales outside of the U.S. for four reasons. First, "There is no basis to distinguish between military-use engines used by the United States and other nations, and it furthers the interest of harmonization to allow engines intended for both domestic and

foreign military use to utilize the same exception to EPA’s emissions standards.” Second, “extending the military exception to international sales does not implicate the United States’ national security, because the State Department oversees such sales.” Third, “engines sold for foreign military use will rarely, if ever, enter American airspace, and thus will not affect air quality in the United States.” Finally, “a global military-use exception is in keeping with the international parity implicit in the ICAO’s Chicago Convention. “

Response: We agree with the commenter that foreign military aircraft should not be subject to our emission standards. However, we disagree with the commenter that the proposed regulations would do so. Section 87.3 of the proposed regulations, which addresses the general applicability of the entire part 87, limits the applicability to only those aircraft subject to FAA regulation. Since FAA does not regulate foreign military aircraft, such aircraft are not subject to our emission standards. Nevertheless, to avoid any potential confusion we are including in the final rule a revised definition of “military aircraft” which clarifies that foreign aircraft considered military under international laws or agreements are not covered by 40 CFR part 87.

**Issue: Voluntary Emissions Offsets (Credits)**

Organization: Air Transport Association (ATA)

Comment: There are significant doubts that EPA has the legal authority to adopt a voluntary emissions offset program. The standard setting authority under section 231 of the CAA does not appear to provide such authority. Where offsets or emissions trading schemes exist for other source categories, the authority is express. Examples of this are 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. A voluntary offset program embodied in the proposal would be unworkable in the context of aviation. Unlike car 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. Further, opportunities for generating offsets would be limited by the proposal’s high thresholds for generating those credits. First, the thresholds would make incremental technology improvements ineligible for offsets even though they produce real environmental benefits. Second, limiting credits to the improvements that exceed the proposed margins would make it even more unlikely that any manufacturer could realistically generate offsets.

Airlines may be caught in the middle of the proposed program because exemption applications are already costly and time consuming. In the context of using emission credits for exemptions, 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, 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, no offset program should be considered.

Organization: Pratt and Whitney (PW)

Comment: The EPA lacks the legal authority to create such a program. Other emission offset programs are based on express grants of statutory authority. For example, credit programs are directly authorized by The Energy Independence and Security Act for use in the Corporate Average Fuel Economy (CAFÉ) program. Also, the "averaging, banking, trading" ("ABT") offsets program for heavy-duty vehicles, though purportedly stemming from the general grant of authority in Clean Air Act section 202, is based on that section's "integral relationship" with the non-conformance penalty ("NCP") provision in section 206(g) of the Clean Air Act. *Nat'l Petrochemical & Refiners Ass'n v. EPA*, 287 F.3d 1130, 1148 (D.C. Cir. 2002) (internal quotation marks omitted). Finally, no statutory authority exists in the CAA or any other statute for EPA to establish an offset program for aircraft emissions.

The EPA proposal assumes that an offset program would create an incentive for manufacturers to build lower-emissions engines. On the contrary, 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 proposed program is not feasible based on the timeline EPA has identified for generating and using credits. Under the proposal, credits could be used for exemptions. Credits could not be generated beginning January 1, 2012. At the same time, the proposed exemptions are only available through 2016. Most engines that will be delivered in those four years have already been ordered and the production process already started. There is little, if any, opportunity for manufacturers to sell credit-generating engines in this narrow time window.

Even if feasible, the proposed program would create an unlevel playing field for different manufacturers based on their product lines and business plans. Manufacturers that happen to have product lines capable of generating sufficient credits would instantly be at a regulatory and competitive advantage over manufacturers without this capability. The less fortunate manufacturers might be forced to pay a competitor for the right to build a competing product. Given that three manufacturers dominate the global market and are fiercely competitive, manufacturers are unlikely to help their competitors. Even if they did, it could raise antitrust concerns.

In the event that EPA moves forward with the proposed program, PW believes the method for calculating offset credits must include an equivalency factor that allows credits generated from smaller airplanes to be used to justify exemptions for larger aircraft and vice-versa. This is essential to mitigate the substantial anti-competitive effects among manufacturers as previously described. Ideally the equivalency factor would be based on the useful life of the engines involved. However, EPA lacks specific knowledge in this area, so equivalency determinations need to be made on a case-by-case basis based on a simple, standardized table in the beginning of any assessment and then modified with input by the engine manufacturer.

Organization: Aerospace Industries Association (AIA) and General Aviation Manufacturers Association (GAMA)



Comment: The proposed emission offset program goes beyond the borders of CAEP, which has not endorsed such a plan to date. The limited number of aircraft engine types and models makes the effects of this type of program more pronounced on the aviation industry than in the automotive industry. Some manufacturers make only one or a few gas turbine engines subject to NOx standards, making this program impractical. It is critical that such a proposed program remain neutral and not cause disruptions to the industry. If EPA moves forward with an emissions offset program, it should work with manufacturers to ensure manufacturer neutrality. Finally, EPA should develop any program within ICAO.

Organization: General Electric Aviation (GE)

Comment: Any emissions offset program should be approved and adopted by the international community through ICAO/CAEP. With that in mind, GE is interested in further discussions of the voluntary option. This is particularly true if the program would be applicable to new engine designs and derivatives that are subject to the proposed Tier 8 standards, but are temporarily unable to meet those requirements. It would also be true if it created the incentive to adopt new technologies earlier than would otherwise be the case in the absence of such incentives.

Response: 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 staff 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 EPA is 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 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 C.F.R. part 89, subpart C (averaging, banking and trading provisions for nonroad compression-ignition engines); 40 C.F.R. part 90, subpart C (certification averaging, banking and trading provisions for nonroad spark-ignition engines at or below 19 kilowatts); 40 C.F.R. part 91, subpart C (averaging, banking and trading provisions for marine spark-ignition engines); 40 C.F.R. part 92, subpart D (certification averaging, banking and trading provisions for locomotives and locomotive engines); 40 C.F.R. 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.

### **Issue: Non-LTO Emissions**

**Organization:** Aerospace Industries Association (AIA), General Aviation Manufacturers Association (GAMA) and Pratt & Whitney (PW)

**Comment:** EPA should clarify in the final rule that it is not regulating cruise (non-LTO) NO<sub>x</sub> emissions. EPA should not regulate cruise NO<sub>x</sub> for several reasons. First, according to the commenters, the Agency lacks legal authority as it has not made a finding that such specific emissions endanger public health or welfare, as required under section 231(a)(2)A of the Clean Air Act. Additionally, there is insufficient evidence to support such a specific finding, noting that EPA cited only a single study on cruise NO<sub>x</sub> emissions in the NPRM. Further, many cruise NO<sub>x</sub> emissions from flights departing from and landing at U.S. airports do not occur in domestic airspace. Finally, there is no generally-accepted technique for measuring cruise NO<sub>x</sub> emissions.

**Organization:** Air Transport Association (ATA)

**Comment:** It would be premature to rely on a single study for a wholly new and potentially significant finding. The study EPA references acknowledges significant limitations, and some ground-level pollutants are actually the product of precursor emissions from aircraft at altitude which may or may not be combined with local emissions from other sources. EPA should continue to look at peer-reviewed work in this area before adopting a finding on non-LTO NO<sub>x</sub> emissions.

**Response:** As stated in the preamble to the proposed rule, our purpose in discussing non-LTO emissions was to present the limited analysis done to date that we are aware of and request comment on it, as well as the existence of other relevant research. Clearly, non-LTO emissions are part of the overall inventory. Also, we believe that the research conducted to date in this area suggests that continued examination of LTO and non-LTO emissions as they relate to ground-level health and welfare effects is warranted, regardless of the scope of any prior endangerment finding regarding NO<sub>x</sub> emissions generally. We also note that our pre-existing aircraft emissions standards, and our standards as revised,

do not expressly contain any limitation on operational applicability, although our test procedures are focused on measuring concentrations and determining mass emissions through calculations during simulated aircraft landing-takeoff cycles (LTOs), consisting of at least the following four modes of engine operation: taxi/idle, takeoff, climbout, and approach.

### **Issue: Inventory Projections**

Organization: Aerospace Industries Association (AIA) and General Aviation Manufacturers Association (GAMA)

Comment: EPA should not rely on the emissions estimates presented in Tables 2 and 3 of the NPRM when issuing the final rule. The data in Tables 2 and 3, when compared side-by-side, cannot be reconciled according to the commenters. The roughly three-fold increase in the relative contribution of aircraft NO<sub>x</sub> to total mobile source NO<sub>x</sub> shown in Table 2, in conjunction with the estimated nine percent increase in commercial air traffic shown in Table 3 suggests that NO<sub>x</sub> emissions from other mobile sources must decrease by a factor of approximately three by 2020. EPA has not adequately justified how it generated the 2020 estimates in Table 2.

Organization: Air Transport Association (ATA) Comment: "...concur with the analysis presented in the Preamble to the Proposed Rule on the contribution of NO<sub>x</sub> emissions from aircraft in the landing and takeoff (LTO) cycle – defined to be emissions released at or below 3000 feet – to emissions inventories and local air quality effects. Both EPA and ICAO/CAEP have a well-documented understanding of these emissions and their relationship to local air quality."

Response: Our purpose in including the emissions inventories in the NPRM was twofold. First, we wanted to identify the size of the aircraft inventory. Second, we wanted to show how that inventory compared to the emissions from other source categories. With this information the reader would have a better understanding of how aircraft cause and contribute to air pollution.

Our justification for this final rule is twofold. First, section 231(a)(2)(A) of the CAA authorizes the EPA Administrator to "from time to time, issue proposed emission standards applicable to emissions of any air pollution from any class or classes of aircraft engines which in his judgment causes, or contributes to air pollution which may reasonably be anticipated to endanger public health or welfare." In a 1997 action, we found "(1) that the public health and welfare is endangered in several air quality regions by violation of the National Ambient Air Quality Standards (NAAQS) for NO<sub>x</sub> (which contributes to ozone) and CO; and (2) that airports and aircraft are now or are projected to be, significant sources of emissions of NO<sub>x</sub> and CO in some of the air quality control regions in which the NAAQS are being violated."<sup>5</sup> Under the authority of the Act and our subsequent finding, we are thus updating our aircraft NO<sub>x</sub> regulations. Second, this final rule moves to make U.S. emissions

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<sup>5</sup> See 62 FR 25355, 25358 (May 8, 1997)

regulations consistent with those adopted by ICAO/CAEP. As an ICAO member, it is incumbent upon us to do so as a party to the Chicago convention.

Regarding the extreme reductions in non-aircraft mobile source NO<sub>x</sub> emissions in the future, these reductions are the result of aggressive federal emission regulations adopted by EPA at various times and are not easily summarized in a single document. The specific sources of the emissions inventories for the various mobile source categories can be found in the air quality modeling technical support document (TSD) developed in support of the proposed Federal Transport Rule Phase 1.<sup>6</sup>

**Issue: Annual Production Report to EPA**

Organization: Aerospace Industries Association (AIA) and General Aviation Manufacturers Association (GAMA), and Pratt & Whitney (PW)

Comment: “The EPA must recognize that production data is proprietary confidential business information (“CBI”) and must be protected as such. In 40 C.F.R. § 2.208, the EPA lists five factors for identifying CBI, all of which are applicable in this case. Production data (a) has not expired as confidential, (b) is protected by engine manufacturers, (c) is not reasonably obtainable without the manufacturer’s consent, (d) is not specifically required to be disclosed by statute, and (e) if disclosed would cause substantial harm to the manufacturer’s competitive position through data mining. The Final Rule, therefore, should exempt, at the outset, all production data received through annual reporting requirements, from Freedom of Information Act (“FOIA”) requests or other methods of public disclosure. Cf. Confidentiality Determinations for Data Required Under the Mandatory Greenhouse Gas Reporting Rule, 76 Fed. Reg. 30782 (May 26, 2011) (shielding categories of CBI obtained through the Mandatory Greenhouse Gas Reporting Rule from public disclosure, after assessing the information under 40 C.F.R. § 2.208).”

Response: We appreciate the concern that the manufacturers and their associations have on this topic. However, we do not believe that it is appropriate in this final rule to adopt a blanket categorical CBI determination for engine production volumes. In other EPA regulations for mobile sources, there is a long history of required annual reporting of production and sales data without a broad categorical determination of this data considered as CBI.

In response to the comments, however, EPA is adding a provision to the final rule that is consistent with how EPA has addressed CBI claims for submitted information under other mobile source rules. More specifically, this provision is patterned after our existing regulations for nonroad compression-ignition engines, small nonroad spark-ignition engines, marine spark-ignition engines, locomotives and marine compression ignition engines (as contained in 40 CFR parts 89.7, 90.4, 91.7 92.4 and 94.4, respectively). It sets forth how EPA would treat – on a case by case basis – submitted data which would, and

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<sup>6</sup> “Federal Transport Rule Phase 1 (TR1) Emission Inventory for Air Quality Modeling Technical Support Document, June 30, 2010, available in public docket EPA-HQ-OAR-2010-0687.

would not, be 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. EPA believes this fully addresses the commenters' concerns expressed above, and is a logical outgrowth of our proposed rule.

Organization: Aerospace Industries Association (AIA) and General Aviation Manufacturers Association (GAMA)

Comment: "Within the NPRM, the EPA requests reporting from all gas turbine and turboprop engine manufacturers. Small engines less than 6Klbf and turboprops are required only to meet the smoke standards, so it would be appropriate for manufacturers of these engines to supply only this information.

More specifically, 76 Fed. Reg. 45035-45036, wherein the expectations for the reporting requirements are outlined, small engines and turboprops will not be able to provide NO<sub>x</sub>, UHC or CO emissions (since these were not required or acquired in support of FAR Part 34 certification) nor will the fuel flow or pressure ratio be supplied (since these values based upon a reference standard engine was not required or acquired in support of FAR Part 34) at any mode of operation. In many older engine cases, the smoke number (by mode) may not be available and thus only the characteristic peak smoke value will be reported."

Organization: Pratt & Whitney (PW)

Comment: "...emissions reporting for a particular engine model should only be required to the extent that engine model is subject to EPA regulations. In its Notice, EPA proposes to require manufacturers to report HC, CO, NO<sub>x</sub>, smoke, and CO<sub>2</sub> emissions data for all models, including smaller turbofan engines, which EPA acknowledges are only subject to smoke standards. 76 Fed. Reg. at 45,035-36. Those reporting requirements are not feasible for small turbofan engines because there are no standardized procedures for measuring emissions other than smoke. Without consistent measurement procedures applied within and across manufacturers, EPA will not be able to gather valid data. Moreover, even if there were standardized procedures, imposing additional reporting requirements for unregulated emissions on smaller engines would create an unreasonable burden on manufacturers of those engines. Some of those engines may be in very limited production, meaning test engines may not be available, and any previously-existing data may have been gathered years before using non-standard testing methods. Forcing manufacturers to undertake expensive new testing now for emissions EPA does not even regulate is an unreasonable demand."

Organization: Williams International

Comment: "...It is recognized that the referenced NPRM is generally applicable to engines with rated thrust greater than 26.7 kN. However, Section III, subpart D, "Annual Reporting Requirement" states that the annual reporting requirement, in particular, will also "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.*" Smoke number total, smoke number

over each segment of the entire LTO cycle and smoke number characteristic level can be provided.

Also included in this section of the NPRM are the proposed elements that are to be provided in the annual report. The requirement to report the following elements is of concern to Williams International:

- Reference pressure ratio
- Mass total and over each segment of the landing-takeoff (LTO) cycle for UHC, CO, NO<sub>x</sub>, and CO<sub>2</sub>
- Fuel flow total and over each segment of the LTO cycle

U.S. manufactured gas turbine engines that are installed in U.S. manufactured Part 23 and Part 25 aircraft must show compliance to the 14 CFR Part 34 fuel venting and exhaust emissions requirements. FAA issues regulations under 14 CFR Part 34 to ensure compliance with EPA regulations under 40 CFR Part 87 and to reflect the requirements of ICAO Annex 16, Volume II. The only requirement in 14 CFR Part 34 relevant to turbofan engines with rated thrust less than 26.7 kN is the control of smoke emissions, measured by smoke number (reference section 34.21(e)(1) of 14 CFR Part 34). The maximum smoke number regulation limit is a function of rated thrust only and therefore reference pressure ratio determination is not required. In addition, smoke number measurement procedures do not require the measurement and correction of fuel flow at any of the LTO mode settings.”

For turbofan engines with rated thrust less than 26.7 kN, manufacturers will be unable to provide HC, CO, NO<sub>x</sub> or CO<sub>2</sub> emissions, as well as fuel flow and reference pressure ratio. They would like to understand how having only smoke number emission information from small engine manufacturers aligns with the objectives of the NPRM.

Response: Our intent was to require this more specific data set that related only to currently regulated emissions. We did not intend for manufacturers to have to conduct additional testing to obtain new data for this reporting. Therefore, we are requesting that all manufacturers of turbine engines report specific information regarding their engine fleet in order to verify that we have accurate emission records. Currently, as turbofan engines under 26.7kN thrust and turboprop engines are only regulated with respect to their smoke number, for these engines we will only be requesting data addressing engine ID, production volume and values related to smoke number. More specifically, we will be requesting the following information for these engines:

- Company corporate name as listed on the engine type certificate
- Engine type (turbofan, mixed turbofan, or turboprop)
- Calendar year for which reporting

- 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)
- The type certificate number, as issued by the FAA (Specify if the sub-model also has a type certificate issued by a certifying authority other than the FAA)
- Date of issue of type certificate and/or exemption, i.e. month and year
- Emission standards to which the engine is certified, i.e., the specific Annex 16, Volume II, edition number and publication date in which the numerical standards first appeared
- If this is a derivative engine for emissions certification purposes, identify the original certificated engine model.
- Engine sub-model that received the original type certificate for the engine type certificate family
- Production volume of the sub-model for the previous calendar year, or if engine is no longer produced, state that the engine model is not in production and list the date of manufacture (month and year) of the last engine produced
- Regarding the above production volume report, specify (if known) the number of engines that are intended for use on new aircraft and the number intended for use as certified (nonexempt) spare engines on in-use aircraft
- 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)
- Smoke number total and over each segment of the entire Landing and Takeoff Cycle (LTO) (i.e. Take-off, Climbout, Approach, Taxi/Ground Idle)
- Smoke number characteristic level
- Number of tests run per sub-model
- Number of engines tested per sub-model

Regarding how the reporting of smoke information aligns with the objectives of the NPRM, we note that the only currently accepted method for estimating aircraft PM emissions is EPA/FAA's First Order Approximation version 3a (FOA3a) methodology, which is incorporated into FAA's Emissions and Dispersion Modeling System (EDMS). EDMS is the official aviation environmental compliance tool in the U.S., and EPA works closely with FAA as an active member of FAA's EDMS design review group to maintain model robustness. In the absence of actual PM data from aircraft engines, the FOA3a methodology relies upon

smoke number information in order to estimate non-volatile PM emissions. Without reliable smoke number data, then the FOA3a methodology is rendered useless and would adversely affect EPA's ability to calculate emission inventories that underpin policies and guidance. Thus, we believe that the reasons stated in the NPRM in support of the reporting requirement in general apply equally and specifically to the reporting of smoke information.

In cases of older engines where smoke number by mode is not known, we do not believe it is appropriate to require additional engine testing to provide smoke number by mode. Thus, EPA is amending the regulatory text to allow for the reporting of only the total smoke number in cases where smoke data by mode does not exist for current production engines.

Organization: Aerospace Industries Association (AIA) and General Aviation Manufacturers Association (GAMA)

Comment: "An additional technical correction, in 76 Fed. Reg. 45035, we point out that even if an engine has no production during a 12 month period it would not necessarily be categorized as "out of production" as suggested. Different terminology should be used."

Organization: General Electric (GE)

Comment: "With respect to production status (in- or out of production), in the case of a specific engine sub-model that has not been manufactured in the previous year, should that sub-model be reported as out of production if it still is offered for sale, but there are no current firm orders for future deliveries?"

Response: If no engines of a specific model were produced in the previous 12 months and the engine model is not "out of production", the manufacturer should list "zero" (0) as number of engines produced for year in question.

Organization: Aerospace Industries Association (AIA) and General Aviation Manufacturers Association (GAMA)

Comment: "...NOx is not currently a regulated greenhouse gas in the U.S., and we are uncertain why reporting of this information would be of assistance to the EPA. Further, we do not believe this information would be beneficial or accurate information for the general public as it is based only on an airport landing and takeoff (LTO) cycle. Similarly, small engine reporting of smoke also would not be logical to factor into GHG reporting."

Response: It appears that the commenter has confused this proposed rule to update our aircraft emission standards with a separate rulemaking on Greenhouse Gas (GHG) emission reporting. Our proposed reporting requirements are completely separate from EPA's "Mandatory Reporting of Greenhouse Gases" that was finalized in October.

The data that is being requested in our proposal is directly related to conducting accurate emission inventories from aircraft turbine engines. These data will also aid us with



developing appropriate public policies regarding aircraft exhaust emissions through our standard setting role under the Clean Air Act (CAA) for engine standards.

In order to ease the burden to the manufacturers, EPA is requiring turbine engine manufacturers to report data from both rules to us in one report. This all encompassing report will reduce duplicate reporting of items such as engine ID and manufacturer, while allowing EPA access to pertinent emission data. In the proposal, we had identified the items that would reduce reporting burden by placing a (GHG) image next to the reporting data request, and maybe this is the source of the commenter's confusion.

As a point of clarification, the commenter is not entirely correct in stating that NO<sub>x</sub> is not currently regulated as a greenhouse gas in the U.S. We have, in fact, identified NO<sub>x</sub> from aircraft as a greenhouse gas and LTO NO<sub>x</sub> is already required to be reported to EPA as described above. However, as aircraft NO<sub>x</sub> emissions are currently regulated, we have not promulgated aircraft NO<sub>x</sub> standards aimed specifically at controlling greenhouse gases.

Organization: Aerospace Industries Association (AIA) and General Aviation Manufacturers Association (GAMA)

Comment: "The NPRM proposes some changes in reporting requirements from that of the ICAO emissions databank. We thank the EPA for understanding the difficulties of reporting, and agree that the entries in the databank should be at least 2 dp, the smoke and HC values reported to 1 dp, and all other values such as OPR and thrust should be reported to at least 3 significant figures. Manufacturers have taken the initiative within ICAO to improve the emissions databank to reflect this viewpoint."

Response: We note this comment is somewhat confusing as it seems to generally express support for our proposed emissions certification regulations while primarily addressing an issue outside of the scope of this rulemaking, namely that of reporting data to ICAO's emissions databank. We do note a difference in the suggested reporting standard for smoke number (one decimal place) compared to what we proposed for emissions certification (three significant figures). We also note that our provisions for significant figure reporting were proposed in the context of emissions certification rather than annual production reporting. However, as this comment seems to address the annual reporting provision, and our provisions for significant figure reporting in the emissions certification process would carry over to the annual production reports, we are addressing this comment here in the context of the production reporting requirement.

We recognize the value to industry of having consistent reporting requirements across organizations and platforms where possible. Further, we recognize our role in achieving such consistent reporting requirements, both through working with relevant industries and organizations to develop appropriate requirements, and in implementing these requirements in our own regulations. Thus, we took part in discussions among ICAO's Certification Task Group (CTG) to work toward streamlining emissions data reporting among EASA, ICAO, and EPA. At these discussions, it was agreed to by subject matter

experts from industry, EASA, EPA, and FAA that at least three significant figures are appropriate for all of the different data types which will be required under our reporting program, as we proposed, with the exception of Smoke Number (SN). Since a smoke number measurement typically is only accurate within +/- 2 or 3 SN; the CTG advised that reporting SN to more than a single decimal point would imply a level of accuracy that is not statistically supported for the measurement. We agree with the CTG and are making the appropriate revisions in the final regulatory text to require smoke numbers be reported to one decimal place.

Organization: Aerospace Industries Association (AIA) and General Aviation Manufacturers Association (GAMA)

Comment: “Within the Proposed Rule, the EPA requests that manufacturers provide to them a production report. This request extends beyond manufacturers located in the United States, which can prove difficult. It also may be difficult to separate spare and new engines with certain sales; to do so correctly would require additional monitoring.”

Response: It is not clear what the actual concern regarding production reporting is, as the comment did not provide any examples or specifics as to the nature of the issue. We note, however, that AIA represents both domestic and foreign aircraft engine manufacturers, which makes it even more difficult to understand why the reporting would be an issue only for manufacturers with production facilities outside of the U.S. We further note that no such concerns regarding the difficulty of reporting for domestic manufacturers were expressed, either by AIA/GAMA or any individual manufacturers directly. It would seem a simple thing for manufacturers to track any production of engines covered by our standards, regardless of where they are produced. Further, engine manufacturers tend to have an extremely limited number of manufacturing facilities for their engine production, and barring specific examples of the potential difficulties, we do not see how a company that manufactures such a limited quantity of such a specialized and expensive product might have difficulty monitoring its production quantities throughout its company. We note that foreign manufacturers of a wide variety of other nonroad engines and equipment routinely track and provide production data to us as part of their participation in our emissions standards’ averaging, banking and trading programs. Thus, we do not believe that engines being manufactured in a foreign country and that are subject to our standards provide any unique circumstances that would make it more difficult to track their production. Similarly, it is hard to imagine what the difficulty would be regarding separating spare engines from new for purposes of reporting given that the two types of engines will be easily differentiated by the labels they will be required to carry. Further, the permanent record for each excepted spare engine must indicate that it was produced as an excepted spare, much like current FAA regulations require that the permanent record of an exempted engine must indicate that status.<sup>7</sup> Therefore, EPA is promulgating the production report without change.

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<sup>7</sup> 14 CFR 45.13(a)(7)(ii)

Organization: Pratt and Whitney (PW)

Comment: The final rule should expressly state that engines that are both manufactured and sold outside of the United States are not subject to production data reporting requirements. Under the extraterritoriality principle, the commenter argued, EPA lacks the legal authority to subject foreign-made and foreign sold engines to reporting requirements. Two U.S. Supreme Court rulings support the general proposition that unless a contrary intent appears, United States law is meant to apply only within the territorial jurisdiction of the United States, *Equal Employment Opportunity Comm'n v. Arabian American Oil Co.*, 499 U.S. 244, 248 (1991) and *Morrison v. Nat'l Austl. Bank Ltd.*, 130 S. Ct. 2869, 2878 (2010). Also two lower court rulings holding that CERCLA and RCRA do not have extra-territorial application, *Arc Ecology v. United States Dep't of the Air Force*, 294 F. Supp. 2d 1152 (N.D. Cal. 2003) and *Amlon Metals, Inc. v. FMC Corp.*, 775 F. Supp. 668 (S.D.N.Y. 1991). Finally, expressly excluding foreign-made and foreign-sold engines is consistent with EPA's stated goal in requiring production data: to acquire accurate inventories of the domestic aircraft fleet. 76 Fed. Reg. at 45,035 (EPA needs to "understand how current gaseous emissions standards are affecting the current fleet").

Response: We do not believe it is necessary to promulgate the regulatory language the commenter requests. Both our proposed regulatory text at section 87.42, and our preamble discussion of the proposed reporting requirements (76 FR at 45035-36) explained that the proposed reporting requirements would apply to each individual engine sub-model that (1) is designed to propel subsonic aircraft, (2) is subject to our exhaust emission standards, and (3) has received a U.S. type certificate. Thus, the scope of the proposed reporting requirement extends just as far as the scope of EPA emission standards, which extend just as far as the United States' certificating authority. Unless an engine which is both manufactured and sold outside of the United States is intended to operate in U.S. airspace, it is not subject to our emissions standards. The relevant regulatory text for this is §87.3 of the proposed regulations, which addresses the general applicability of the entire part 87. It specifically limits the applicability to only those aircraft *required* by FAA to meet our standards. Since FAA does not *require* aircraft that will never operate in the United States to meet our standards, such aircraft are not subject to our reporting requirements.

Consequently, EPA does not agree that the cases cited by the commenter have any relevance to the scope of our proposed reporting requirement -- we are not attempting to apply the requirement in an extra-territorial manner beyond the reach of the standards and U.S.-issued type certificates that reflect the standards. This could indeed include engines that are "foreign-made" and "foreign-sold" that may be used in a manner that makes them subject to our standards and necessitate U.S. certification. It is reasonable and appropriate for us to require reporting of such information under section 114 of the Clean Air Act, as it will help us to understand how gaseous emission standards are affecting the current aircraft fleet, to conduct accurate emissions inventories, and to develop sound public policy approaches and possible future emission standards.

Organization: General Electric Aviation (GE)

Comment: We request that EPA clarify the following aspects of the proposed reporting provisions:

- “87.42(c)(2)(v) requires identifying if an engine sub-model is a derivative engine for certification purposes. We are unsure whether this information already appears on the Type Certificate Data Sheet, and if not, how we can document the engine’s status.
- 87.42(c)(2)(vi) requires reporting of the engine sub-model that received the original type certificate. Typically, several sub-models appear on a new type certificate. Should all of these original sub-models be listed in such a case?
- 87.42(c)(3) requires reporting of calendar year production of each sub-model. We interpret this to mean, and seek your confirmation, that “production” in this case is the actual number of engine assemblies delivered to customers in a given calendar year...
- 87.42(c)(3) requires reporting of the engine sub-model for each engine produced. In some cases, engines are delivered to the airframe manufacturer without sub-model specific control software. What should be reported?”

Response: With respect to §87.42(c)(2)(v), engines certified as derivative engines, must be approved as derivatives by FAA. We expect the manufacturer to keep track of this status for reporting. With respect to §87.42(c)(2)(vi), where an original type certificate covers multiple sub-models, the manufacturer should treat the sub-model that was tested as the original sub-model.

With respect to §87.42(c)(3), the manufacturer should base its reports on the date of delivery to the airframe manufacturer. For engines delivered without a final sub-model status, it is important to note that the production report for a given production year does not need to be reported until two months after that production year ends. So in most cases, the manufacturer will have time to ascertain the engine’s sub-model when installed before submitting its production report. Nevertheless, we recognize that sometimes a manufacturer will not know the engine’s ultimate sub-model until after it submits its report. In such cases the manufacturer may do any of the following:

- 1) List the sub-model that was shipped or the most probable sub-model.
- 2) List all potential sub-models.
- 3) State “Unknown Sub-Model”.

Once the manufacturer had complete information, it would then amend its report.

### **Issue: Supersonic Aircraft Engines**

Organization: Aerospace Industries Association (AIA) and General Aviation Manufacturers Association (GAMA)

Comment: “We do not believe section E. Proposed Standards for Supersonic Aircraft Turbine Engines should be included in this NPRM. Within CAEP it was agreed that standards are “not appropriate for future products” and therefore should not be done so independently by the U.S. EPA.”

Response: Our objective is to adopt standards that are equivalent to ICAO/CAEP standards to meet U.S. treaty obligations under the Convention on International Civil Aviation. The proposal to adopt the NO<sub>x</sub> and CO emission standards for turbine engines that are used to propel aircraft at sustained supersonic speeds-- to complement our existing HC standard for these engines – would meet this objective. It is irrelevant if CAEP has declared or stated that standards are not appropriate for future engines of supersonic aircraft because NO<sub>x</sub> and CO standards for this category of engines remain in ICAO’s Annex 16, Volume IV, International Standards and Recommended Practices. As stated above, we intend to have our aircraft engine emission standards remain equivalent to ICAO/CAEP standards to meet our treaty obligations. As part of EPA’s continued participation in CAEP proceedings, we will keep abreast of any ICAO/CAEP action regarding emission standards for future engines of supersonic aircraft. Therefore, EPA is promulgating the standards applicable to engines used on supersonic aircraft as proposed.

#### **Issue: Annual Reporting Burden and Cost**

Organization: Aerospace Industries Association (AIA) and General Aviation Manufacturers Association (GAMA)

Comment: The cost estimate for reporting burden is underestimated, especially for the first report. There is no guidance yet on what should be contained in the reports.

Response: The information collection request (ICR) we submitted to the Office of Management and Budget estimated the annual burden and cost per respondent (i.e., basically each engine manufacturer) to be 6 hours and \$365. We believe AIA/GAMA understood our cost estimate to be for the whole effort to compile the specified information. However, our cost estimate relates only to the incremental burden of sending EPA the information that has already been prepared for submission to ICAO and/or FAA. We believe our estimate accurately reflects the additional burden associated with the requirement to send EPA the specified information. We also note that the annual estimate is based on the fact that information which is initially reported, but remains unchanged, does not need to be reported again in subsequent years. This could mean that subsequent annual reports for an engine sub-model may only contain the annual production volume for that sub-model. Further, as noted in the previous discussion of reporting requirements, we are streamlining these reporting requirements by combining them with the greenhouse gas reporting requirements, allowing manufacturers to comply with both requirements with a single data submission. Therefore, we are making no changes to the burden estimates in the ICR.

Regarding the second point made by the commenter, once the requirement is in place, we will consider publishing a guidance regarding any further clarification that is needed. We expect to provide an electronic reporting format that will include information regarding data fields, formatting the information, and submitting the files to EPA.

**Issue: Humidity Correction Factor**

Organization: Aerospace Industries Association (AIA) and General Aviation Manufacturers Association (GAMA)

Comment: The value for humidity when speaking of *Standard day conditions* (76 FR 45046) differs from Annex 16; EPA specifies “0.00” while CAEP specifies 0.00634. EPA should follow the same figure as used by CAEP.

Response: The standard humidity value of 0.00 percent applies under our existing regulations and we did not propose to revise it. This value is slightly lower than the value of 0.00634 included in Annex 16. Although this difference has little practical impact, in response to the comment, EPA is changing our regulations to be consistent with the Annex.

**Issue: Regulatory Text Terminology**

Organization: Air Transport Association (ATA)

Comment: Regulatory definitions of “tiers” should reference their source CAEP standards for the sake of transparency

Response: We are not including regulatory cross-references between tiers of EPA standards and levels of CAEP standards. We do consider the CAEP standards in setting our standards, and generally attempt to ensure that manufacturers can produce a single product that complies with both EPA and CAEP standards as adopted by foreign authorities. However, in the context of implementing U.S. regulations, the CAEP standards are not directly applicable or enforceable. We believe the naming convention using tiers appropriately emphasizes that it is the EPA emission standards that apply.

**Issue: Derivative Engines**

Organization: Aerospace Industries Association (AIA), General Aviation Manufacturers Association (GAMA), and General Electric Aviation (GE)

Comment: The EPA proposed to adopt the ETM provisions that would be used to evaluate if the emission characteristics of a modified engine design were significant enough from the parent engine’s emission certification basis so that a demonstration of compliance with newer emission standards is necessary, or if it is a “derivative” version of the original model with no emissions changes. As a general matter, the EPA should not codify the ETM language. The ETM will evolve over time and rigid EPA regulations will not, even allowing for FAA flexibility to use good engineering judgment if necessary when deciding what is

and is not a derivative. It is better to just let FAA rely on the ETM guidance in its decision making.

Response: Regarding the adoption of ETM language into EPA regulations, 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 fully enforceable air pollution control requirements for aircraft engines. This in turn requires that we establish such standards and any other associated requirements in regulatory form. 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. Such unlimited discretion is inconsistent with our responsibilities under the Clean Air Act.

We also disagree with the comment suggesting that the ETM will evolve over time, but the EPA 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 may 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 must codify regulatory provisions to objectively specify when engines are considered to be "derivative engines", EPA is finalizing regulatory provisions consistent with the ICAO ETM guidance.

Organization: Air Transport Association (ATA), Dassault-Aviation (DA), and Pratt and Whitney (PW)

Comment: The proposed regulatory text for determining if a new engine design is a derivative of an existing engine model contains a substantial deviation from the expressed intent of the rule as described in EPA's preamble and the ETM guidance. Specifically 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...." The proposed part 87.7 provides that the 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..." specified ranges for each pollutant. For example, the specified range is + or - 3 g/kN for NOx. This is more stringent than the ETM, and could discourage cleaner engines that are not clean enough to meet next tier of standards. The final rule should be consistent with the ETM to prevent this untoward effect.

Response: 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 consistent with the ETM and was inadvertently left out of our proposed language. EPA is adding this allowance to the final regulations.

Organization: Aerospace Industries Association (AIA) and General Aviation Manufacturers Association (GAMA)

Comment: The preamble to the proposed rule states that “...engine models represented by characteristic levels at least 5 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.”

In the above quoted text, the term “new model’ is used. This is the wrong term because it would be referring to changes made to an existing engine. This could cause an engine manufacturer to conduct an additional emissions test in cases where a very small change was made to the engine due to a performance or engine weight change. We recommend 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 proposed regulatory text states that 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. The use of the terms “you must measure” also implies further engine testing when additional analysis may likely prove sufficient.

Response: We want to clarify that this text explicitly requires engine testing when an original engine’s emission are within 5% 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, EPA is promulgating the language as proposed.

In response to the comment on the term “new model” we are revising the regulations to say “new engine configuration”.