Tiltrotors

**SUPPLEMENTARY INFORMATION:**

**Authority for This Rulemaking**

The FAA’s authority to issue rules on aviation safety is found in Title 49 of the United States Code. Subtitle I, Section 106 describes the authority of the FAA Administrator. Subtitle VII, Aviation Programs, describes in more detail the scope of the agency’s authority.

This rulemaking is promulgated under the authority described in Subtitle VII, Part A, Subpart III, Section 44715, Controlling aircraft noise and sonic boom. Under that section, the FAA is charged with prescribing regulations to measure and abate aircraft noise. This regulation is within the scope of that authority since it would establish new noise certification test procedures and noise limits for a new class of aircraft. Applicants for type certificates, changes in type design, and airworthiness certificates for tiltrotors are required to comply with these new regulations.

**Overview of Final Rule**

The standards in this final rule apply to the issuance of an original type certificate, changes to a type certificate, and the issuance of a standard airworthiness certificate for tiltrotors. This final rule creates noise certification standards that are applicable to all tiltrotors, such as the AgustaWestland Model AW609 currently under development. These regulations incorporate the same standards as ICAO Annex 16, Volume 1, Chapter 13, Attachment F (Amendment 7) for tiltrotors, consistent with the FAA goal of harmonizing U.S. regulations with international standards.

**Background**

A new aircraft type known as a tiltrotor is currently in production after more than six decades of research and development. The aircraft uses rotating nacelles, a hybrid of propellers and helicopter rotors, to provide both lift and propulsive force. The tiltrotor is designed to function as a helicopter for takeoff and landing and as an airplane during the en-route portion of flight operations.

The most recognizable tiltrotor operating today is the V–22 Osprey used by the U.S. Marines and the U.S. Air Force. The V–22 Osprey was designed by the U.S. Marine and the U.S. Air Force. The Bell XV–3 completed a successful full conversion from vertical flight to forward cruise and demonstrated the feasibility of tiltrotor technology. Following the successful full conversion of the Bell XV–3, the U.S. Army and National Aeronautics and Space Administration awarded Bell a prototype development contract in the mid 1970s to build two Bell XV–15 tiltrotor demonstrator aircraft. These tiltrotor aircraft served as predecessors to the V–22 Osprey to demonstrate mature tiltrotor technology and flight capabilities.

**ICAO Noise Certification Standards**

ICAO is the international body with responsibility for the development of International Standards and Recommended Practices pursuant to the Convention on International Civil Aviation (the Chicago Convention). Consistent with their obligations under the Chicago Convention, Contracting States agree to implement ICAO standards in their national regulations to the extent practicable. The standards for aircraft noise are contained in Annex 16, Environmental Protection, Volume 1, Aircraft Noise.

In anticipation of civil tiltrotor production, ICAO’s Committee on Aviation Environmental Protection (CAEP) chartered the Tiltrotor Task Group (TRTG) in 1997 to develop noise certification guidelines for tiltrotors. The FAA participated in the TRTG and its development of the tiltrotor noise guidelines from 1997 to 2000. The ICAO tiltrotor guidelines used the same noise limits that the United States had incorporated into part 36, Appendix H for helicopter noise certification. The ICAO has included additional requirements that are unique to the design of tiltrotors.

On June 29, 2001, the TRTG’s guidelines were adopted by the ICAO Council for incorporation into Annex 16, Volume 1, Chapter 13, Attachment F (Amendment 7). The ICAO guidelines became effective on October 29, 2001, with an applicability date of March 21, 2002.

**Statement of the Problem**

Current regulations in part 36 do not contain noise certification requirements specific to the tiltrotor and its unique...
flight capabilities. Since no standards for the tiltrotor currently exist, the FAA is adding new standards to part 23, and amending part 21, § 21.93 (Classification of Changes in Type Design) to accommodate certification of the tiltrotor. In order to harmonize the U.S. regulations with the international standards, this rulemaking adopts the same noise certification standards as used in ICAO Annex 16, Volume 1, Chapter 13, Attachment F (Amendment 7) for tiltrotors.

Type Certification Activity in the United States
As the tiltrotor concept and technology proved promising with the production of the V-22 Osprey, Bell and Agusta (now AgustaWestland) established a joint business venture in September 1998 to co-develop the Bell/Agusta model BA609 civil tiltrotor.

In August 1996, Bell, the original and lead developer of the tiltrotor, applied for a type certificate for the model BA609 tiltrotor, prior to the establishment of the joint venture. The BA609 would be type certified as a “special class” of aircraft under §§ 21.17 and 21.21, using the applicable airworthiness provisions of part 25 (Airworthiness Standards: Transport Category Airplanes) and part 29 (Airworthiness Standards: Transport Category Rotorcraft).

In June 2011, the contract for the joint tiltrotor program between Bell and AgustaWestland was renegotiated, with AgustaWestland assuming full ownership. The change in ownership resulted in the BA609 designation being renamed to the AW609, and on February 15, 2012, AgustaWestland applied for a type certificate from the FAA. AgustaWestland is targeting existing helicopter operators as the primary civil market for the AW609, and has stated that the AW609 could operate from existing heliports without the need for new infrastructure to accommodate the aircraft.

Summary of the NPRM
The FAA published a notice of proposed rulemaking (NPRM) on June 21, 2011 (76 FR 36001) that proposed the changes to parts 21 and 36 discussed above that would establish noise certification standards for issuing type and airworthiness certificates for the tiltrotor.

Discussion of Public Comments
The comment period for the NPRM closed on October 19, 2011. The FAA received one comment, from AgustaWestland. AgustaWestland stated that the proposed rule did not specify the entity that would determine the flyover configuration in Appendix K to Part 36. AgustaWestland recommended that the regulation specify that the applicant be the entity that prescribes the constant flyover aircraft configuration.

The FAA agrees the regulation needs to specify what entity prescribes the constant flyover configuration. The FAA agrees the applicant is the proper entity, and has modified the final rule to incorporate this change.

Differences Between the NPRM and the Final Rule
We are adopting this final rule for the reasons stated in the NPRM, with the following changes. First, the NPRM incorrectly included V_{MCP} and V_{SO} as requirements for tiltrotors. Both V_{MCP} and V_{SO} are voluntary reporting parameters for airspeeds at maximum continuous power and maximum operating limit for airplane mode as noted in the ICAO standards. The FAA is not requiring them in Part 36.

However, the voluntary reporting of V_{MCP} and V_{SO} will be recommended in an accompanying Advisory Circular as supplemental information. The FAA is removing V_{MCP} and V_{SO} representing airplane mode from § 36.1 and Appendix K in the final rule since airplane mode is only a voluntary and supplemental condition for noise. The harshest (maximum) noise levels are identified in helicopter mode.

Second, the labels used in the proposed Figure K.2 of Appendix K to part 36 incorrectly describe the two sideline noise measurement points as S_{(board)} and S_{(poro)} instead of S_{(sideline)} for both. Since the flyover condition has a symmetrical test set-up, the generic label assignment, S_{(sideline)}, is used to indicate that flight from either direction is allowable without a reference to right or left. The figure is adopted in this final rule with the corrected labels.

Third, the NPRM included the term “power-on” in section K.6.1(f) of Appendix K to part 36. That terminology is outdated and is replaced in this final rule by the term “reference”.

Fourth, the final rule adds the phrase “throughout the 10 dB-down time interval.” in sections K.7.5, K.7.9 and K.10 of Appendix K of part 36 to be consistent throughout the appendix.

Fifth, based on AgustaWestland’s comment discussed previously, section K.6.3(b) of Appendix K to part 36 specifies that the flyover configuration is to be selected by the applicant.
governments, or on the private sector by exceeding the monetary threshold identified.

These analyses are summarized below.

No comments were received on the regulatory evaluation of the proposed rule. However, after the NPRM was published on June 21, 2011, there was a change in the ownership of the known civil tiltrotor program.

When the NPRM was published, the one known civil tiltrotor development program was jointly owned by the Bell and AgustaWestland helicopter companies; the project was designated the BA609. In November, 2011 AgustaWestland purchased Bell’s share of the civil tiltrotor program and changed the designation of the aircraft in development to AW609. The former Bell Agusta Aerospace Company (BAAC) was renamed the AgustaWestland Tilt-Rotor Company, LLC and merged with Agusta US Incorporated to become AgustaWestland Tilt-Rotor Company Incorporated, an American company that is the applicant for a type certificate for the AW609. The new company is incorporated in Delaware and is a wholly owned subsidiary of AgustaWestland that is owned by Finmeccanica, an Italian firm.

The AgustaWestland Tilt-Rotor Company, Inc. has rented a facility at the Arlington, Texas Municipal Airport. The facility consists of approximately 99,000 square feet including a hangar/office building. The company plans to construct an adjacent office building. The facilities may be used for aircraft sales, engineering and design, flight testing, and aircraft maintenance, and other activities when approved by the airport.

Because of the change in ownership of the civil tiltrotor program that occurred after the publication of the NPRM, this regulatory evaluation has been revised to incorporate the changed circumstances.

There are currently no part 36 noise certification standards for tiltrotors in U.S. regulations. This final rule provides part 36 noise certification requirements for tiltrotors by adopting existing ICAO standards. The initial regulatory evaluation estimated that these noise requirements would be minimal cost. We asked for comments and received none. Accordingly, we affirm our determination that these requirements will be minimal cost.

Providing U.S. tiltrotor noise certification standards will facilitate the startup and development of a new commercial class of aircraft, the tiltrotor, and allow for certification in the United States as exists for other aircraft designs. The tiltrotor aircraft type can then be marketed domestically and internationally. The FAA believes that this could result in substantial benefits.

The FAA used the same price/cost estimates for the NPRM and received no comments. The FAA maintained in the NPRM that this rule was minimal cost and we received no comments on that determination.

The total value of the estimated market equals the aircraft purchase price multiplied by the estimated units sold. The potential size of the tiltrotor market has been estimated using the sales projections of the previous developer, Bell/Agusta. In the next 10 years, one model of a civil tiltrotor is expected to be available, the AW609 (previously the BA609). This aircraft is currently in development.

The price of a BA609 (now the AW609) was estimated to be $10 to $14 million (aircraftcompare.com, “Bell Agusta BA609”, http://www.aircraftcompare.com/helicopter-airplane/Bell%20Agusta%20BA609%20/279). This is an increase from the original estimate of $7 million in 2000. The price of $14 million for a BA609 was used to estimate the potential market size for tiltrotor aircraft because AgustaWestland has not announced a purchase price for the AW609.

Bell estimated that the market would result in sales of approximately 100 BA609s over 10 years, making the potential near-term tiltrotor market worth a nominal $1 billion to $1.4 billion. Table 1 shows the nominal and present value estimates of the tiltrotor market. The present value is based on a 7 percent discount rate, and a ten year production period with 10 tiltrotors being delivered each year. The present value of the tiltrotor market is estimated to be between $702,000,000 and $983,000,000.

<table>
<thead>
<tr>
<th>Year</th>
<th>Units Produced</th>
<th>Unit Price</th>
<th>Total Market Value Nominal</th>
<th>Total Market Value Present Value @ 7%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10</td>
<td>$14,000,000</td>
<td>$140,000,000</td>
<td>$130,844,000</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>$14,000,000</td>
<td>$140,000,000</td>
<td>$122,276,000</td>
</tr>
<tr>
<td>3</td>
<td>10</td>
<td>$14,000,000</td>
<td>$140,000,000</td>
<td>$114,282,000</td>
</tr>
<tr>
<td>4</td>
<td>10</td>
<td>$14,000,000</td>
<td>$140,000,000</td>
<td>$106,806,000</td>
</tr>
<tr>
<td>5</td>
<td>10</td>
<td>$14,000,000</td>
<td>$140,000,000</td>
<td>$99,282,000</td>
</tr>
<tr>
<td>6</td>
<td>10</td>
<td>$14,000,000</td>
<td>$140,000,000</td>
<td>$93,282,000</td>
</tr>
<tr>
<td>7</td>
<td>10</td>
<td>$14,000,000</td>
<td>$140,000,000</td>
<td>$87,178,000</td>
</tr>
<tr>
<td>8</td>
<td>10</td>
<td>$14,000,000</td>
<td>$140,000,000</td>
<td>$81,480,000</td>
</tr>
<tr>
<td>9</td>
<td>10</td>
<td>$14,000,000</td>
<td>$140,000,000</td>
<td>$76,146,000</td>
</tr>
<tr>
<td>10</td>
<td>10</td>
<td>$14,000,000</td>
<td>$140,000,000</td>
<td>$71,162,000</td>
</tr>
<tr>
<td>Totals</td>
<td>100</td>
<td>N.A.</td>
<td>$1,400,000,000</td>
<td>$983,276,000</td>
</tr>
</tbody>
</table>

3/29/2011
Table 2 summarizes the incremental manufacturer costs for the noise certification of a civil tiltrotor as discussed in the initial regulatory evaluation. At that time we determined that these costs were minimal. We received no comments on that determination and it is not changed in the final rule.

<table>
<thead>
<tr>
<th>Item</th>
<th>Hours</th>
<th>Cost Per Hour</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acoustics Group</td>
<td>2,000</td>
<td>$125</td>
<td>$250,000</td>
</tr>
<tr>
<td>Flight Test Groups</td>
<td>2,000</td>
<td>$110</td>
<td>$220,000</td>
</tr>
<tr>
<td>Aircraft</td>
<td>10</td>
<td>$5,000</td>
<td>$50,000</td>
</tr>
<tr>
<td>Miscellaneous Expenses</td>
<td></td>
<td></td>
<td>$68,000</td>
</tr>
<tr>
<td><strong>Total Hours &amp; Costs</strong></td>
<td>4,010</td>
<td>N.A.</td>
<td><strong>$588,000</strong></td>
</tr>
</tbody>
</table>

Issuance of a type certificate requires compliance with the applicable noise certification requirements of part 36. Full noise certification testing is generally required for each new aircraft type and for certain voluntary changes to type design that are classified as acoustical change under §21.93(b). The incremental costs recur only when a new type certificate is issued, or when a change to a type design results after an acoustical change is made.

Noise certification costs consist of four major items: Acoustics; Flight Test; Aircraft; and Miscellaneous. For tiltrotors noise certification, as for any aircraft certification, the noise demonstration flight testing and reporting is the largest incremental cost of the noise certification.

To meet the regulatory requirements for noise control, acoustical measurements are used to quantify the characteristic noise levels of the aircraft. Almost half the noise certification expense ($250,000) is invested in the acoustics group equipment and analysis. This cost includes overall noise test planning and coordination, noise test site preparation and measurement set-up.

The second highest noise certification expense involves the flight test support. The last two noise certification expense groups are aircraft and miscellaneous expenses. The aircraft expense ($50,000) involves costs associated with aircraft flight time, fuel, and flight crew support. Most other general expenses of test support are miscellaneous costs ($68,000).

The cost estimates for noise certification were provided by Bell Helicopter Textron, the original developer of the civil tiltrotor. The cost of noise certification for the tiltrotor is comparable to that for a large helicopter (over 7,000 pounds). As shown in Table 2, the estimated total incremental cost of a single noise certification is $588,000. As the $588,000 would be incurred in the first year, the nominal value equals the present value.

The FAA may incur costs in this certification process. However, these costs are not expected to vary significantly from the agency’s current costs to noise certificate any other new aircraft type.

The FAA may incur costs in this certification process. However, these costs are not expected to vary significantly from the agency’s current costs to noise certificate any other new aircraft type.

The FAA believes that this final rule will be cost beneficial because it is minimal cost, and because it facilitates the development of tiltrotor aircraft and the commercial market for them.

Regulatory Flexibility Determination

The Regulatory Flexibility Act of 1980 (RFA) establishes “as a principle of regulatory issuance that agencies shall endeavor, consistent with the objective of the rule and of applicable statutes, to fit regulatory and informational requirements to the scale of the businesses, organizations, and governmental jurisdictions subject to regulation.” To achieve that principle, the RFA requires agencies to solicit and consider flexible regulatory proposals and to explain the rationale for their actions. The RFA covers a wide-range of small entities, including small businesses, not-for-profit organizations and small governmental jurisdictions.
Agencies must perform a review to
determine whether a proposed or final
rule will have a significant economic
impact on a substantial number of small
entities. If the agency determines that it
will, the agency must prepare a
regulatory flexibility analysis as
described in the Act.

However, if an agency determines that a
proposed or final rule is not expected
to have a significant economic impact
on a substantial number of small
entities, section 605(b) of the 1980 RFA
provides that the head of the agency
may so certify and a regulatory
flexibility analysis is not required. The
certification must include a statement
providing the factual basis for this
determination, and the reasoning should
be clear.

When the NPRM was published, the
tiltrotor was being developed by a joint
venture of Bell Helicopter, an American
company and AgustaWestland, an
Italian firm. Because an American firm
was potentially affected by the proposed
rule, Flexibility Analysis was prepared. No comments were
received on the Regulatory Flexibility
Analysis which concluded there was no
significant economic impact on a
substantial number of small entities.

After the NPRM was published,
AgustaWestland, an Italian company,
bought the ownership interests of Bell
Helicopter. As such, the original BAAC
was renamed and merged to become
AgustaWestland Tilt-Rotor Company
Incorporated, a wholly owned
subsidiary of AgustaWestland, an Italian
company. AgustaWestland is owned by
Finnmeccanica, also an Italian company.

Section 601 of the RFA defines the
term “small business” as follows: “The
term ‘small business’ has the same
meaning as the term ‘small business
concern’ under section 3 of the Small
Business Act.”

Section 3(a)(1) of the Small Business
Act defines a small business concern as
follows: “For the purposes of this Act,
a small business concern, including, but
not limited to enterprises that are
engaged in the business of the
production of food and fiber, ranching
and raising of livestock, aquaculture,
and all other farming and agricultural
related industries, shall be deemed to be
one which is independently owned and
operated and which is not dominant in
its field of operation.”

Section 3(a)(2) of the Small Business
Act discusses the establishment of size
standards. The Small Business
Administration (SBA) size standard for
a small entity in aircraft manufacturing
is 1,500 employees.

The AgustaWestland Tilt-Rotor
Company Incorporated currently
employs 12 people. While the number
of employees of the AgustaWestland Tilt
Rotor Company meets the SBA
employment size standard for a small
entity, the company is not a small entity
as defined by the SBA because it is not
independently owned and operated.

The owner of the AgustaWestland Tilt
Rotor Company, Inc. is Finnmeccanica,
which has 75,733 employees, far
exceeding the aircraft manufacturing
size standard of 1,500 employees.

There are no other companies which
are known to be developing or
manufacturing a civil tiltrotor. Therefore,
Finnmeccanica (including its
subsidiaries) is the dominant company
involved in the development of a
civilian tiltrotor. This final rule is
expected to be minimal cost and there
are no small entities affected. Therefore,
as the acting FAA Administrator, I
certify that this final rule will not have a
significant economic impact on a
substantial number of small tiltrotor
manufacturers.

International Trade Impact Assessment

The Trade Agreements Act of 1979
(Pub. L. 96–39), as amended by the
Uruguay Round Agreements Act (Pub.
L. 103–465), prohibits Federal agencies
from establishing standards or engaging
in related activities that create
unnecessary obstacles to the foreign
commerce of the United States.

Pursuant to these Acts, the
establishment of standards is not
considered an unnecessary obstacle to
the foreign commerce of the United
States, so long as the standard has a
legitimate domestic objective, such as
the protection of safety, and does not
operate in a manner that excludes
imports that meet this objective. The
statute also requires consideration of
international standards and, where
appropriate, that they be the basis for
U.S. standards.

The FAA has assessed the potential
effect of this final rule and determined
that it will encourage international trade
by adopting the international standards of
ICAO as the basis for a rule for the
noise certification of tiltrotors.

Unfunded Mandates Assessment

Title II of the Unfunded Mandates
Reform Act of 1995 (Pub. L. 104–4)
requires each Federal agency to prepare
a written statement assessing the effects
of any Federal mandate in a proposed or
final agency rule that may result in an
expenditure of $100 million or more
(adjusted annually for inflation) in any
one year by State, local, and tribal
governments, in the aggregate, or by the
private sector; such a mandate is
deemed to be a “significant regulatory
action.” The FAA currently uses an
inflation-adjusted value of $143.1
million in lieu of $100 million. This
final rule does not contain such a
mandate; therefore, the requirements of
Title II do not apply.

Paperwork Reduction Act

The Paperwork Reduction Act of 1995
(Pub. L. 104–18) requires that the
FAA consider the impact of paperwork
and other information collection
burdens imposed on the public. The
FAA has determined that there is no
new requirement for information
collection associated with this final
rule.

International Compatibility

In keeping with U.S. obligations
under the Convention on International
Civil Aviation, it is FAA policy to
conform to International Civil Aviation
Organization (ICAO) Standards and
Recommended Practices to the
maximum extent practicable. In 2001,
ICAO adopted tiltrotor noise guidelines.
This regulation harmonizes U.S. noise
standards with the international
standards by adopting the same
requirements, adapted for the U.S.
regulatory format.

Environmental Analysis

FAA Order 1050.1E identifies FAA
actions that are categorically excluded
from preparation of an environmental
assessment or environmental impact
statement under the National
Environmental Policy Act in the
absence of extraordinary circumstances.
This rule adopts internationally
established noise standards for a new
civil, hybrid airplane-rotorcraft known
as the tiltrotor. Based on the presence of
both helicopter and propeller airplane
characteristics inherit in the tiltrotor,
the noise standards use preexisting
helicopter noise certification limits and
procedures. This final rule adopts these
noise limits to control the harshest
(maximum) noise levels when the
tiltrotor operates in its noisiest
configuration—helicopter mode. In
airplane mode, the tiltrotor is
significantly quieter because of its low
RPM design in cruise mode. The FAA
finds the applicability of the noise
limits adopted here as technologically
and environmentally consistent for this
new class of aircraft.

The FAA has determined this
rulemaking action qualifies for the
categorical exclusion identified in
paragraph 312f of the Order and
involves no extraordinary
circumstances.
Executive Order Determinations

Executive Order 13132, Federalism

The FAA has analyzed this final rule under the principles and criteria of Executive Order 13132, Federalism. The agency determined that this action will not have a substantial direct effect on the States, or the relationship between the Federal Government and the States, or on the distribution of power and responsibilities among the various levels of government, and, therefore, does not have Federalism implications.

Executive Order 13211, Regulations That Significantly Affect Energy Supply, Distribution, or Use

The FAA analyzed this final rule under Executive Order 13211, Actions Concerning Regulations that Significantly Affect Energy Supply, Distribution, or Use (May 18, 2001). The agency has determined that it is not a “significant energy action” under Executive Order 12866 and DOT’s Regulatory Policies and Procedures, and it is not likely to have a significant adverse effect on the supply, distribution, or use of energy.

How To Obtain Additional Information

Rulemaking Documents

An electronic copy of a rulemaking document may be obtained by using the Internet—

1. Search the Federal eRulemaking Portal (http://www.regulations.gov);

Copies may also be obtained by sending a request (identified by notice, amendment, or docket number of this rulemaking) to the Federal Aviation Administration, Office of Rulemaking, ARM–1, 800 Independence Avenue SW., Washington, DC 20591, or by calling (202) 267–9680.

Comments Submitted to the Docket

Comments received may be viewed by going to http://www.regulations.gov and following the online instructions to search the docket number for this action. Anyone is able to search the electronic form of all comments received into any of the FAA’s dockets by the name of the individual submitting the comment (or signing the comment, if submitted on behalf of an association, business, labor union, etc.).

Small Business Regulatory Enforcement Fairness Act

The Small Business Regulatory Enforcement Fairness Act (SBREFA) of 1996 requires FAA to comply with small entity requests for information or advice about compliance with statutes and regulations within its jurisdiction. A small entity with questions regarding this document, may contact its local FAA official, or the person listed under the FOR FURTHER INFORMATION CONTACT heading at the beginning of the preamble. To find out more about SBREFA on the Internet, visit http://www.faa.gov/regulations_policies/rulemaking/sbre_act/.

List of Subjects

14 CFR Part 21

Aircraft, Aviation safety, Reporting and recordkeeping requirements.

14 CFR Part 36

Aircraft, Noise control.

The Amendment

In consideration of the foregoing, the Federal Aviation Administration amends chapter I of title 14, Code of Federal Regulations, as follows:

PART 21—CERTIFICATION PROCEDURES FOR PRODUCTS AND PARTS

§ 21.93 Classification of changes in type design.

(i) For the purpose of showing compliance with this part for tiltrotors, the following terms have the specified meanings:

Airplane mode means a configuration with nacelles on the down stops (axis aligned horizontally) and rotor speed set to cruise revolutions per minute (RPM).

Airplane mode RPM means the lower range of rotor rotational speed in RPM defined for the airplane mode cruise flight condition.

Fixed operation points mean designated nacelle angle positions selected for airworthiness reference. These are default positions used to refer to normal nacelle positioning operation of the aircraft. The nacelle angle is controlled by a self-centering switch. When the nacelle angle is 0 degrees (airplane mode) and the pilot moves the nacelle switch upwards, the nacelles are programmed to automatically turn to the first default position (for example, 60 degrees) where they will stop. A second upward move of the switch will tilt the nacelle to the second default position (for example, 75 degrees). Above the last default position, the nacelle angle can be set to any angle up to approximately 95 degrees by moving the switch in the up or down direction. The number and position of the fixed operation points may vary on different tiltrotor configurations.

Nacelle angle is defined as the angle between the rotor shaft centerline and the longitudinal axis of the aircraft fuselage.

Tiltrotor means a class of aircraft capable of vertical take-off and landing, with the powered-lift category, with rotors mounted at or near the wing tips that vary in pitch from near vertical to near horizontal configuration relative to the wing and fuselage.

Vertical take-off and landing (VTOL) mode means the aircraft state or configuration having the rotors orientated with the axis of rotation in a vertical manner (i.e., nacelle angle of approximately 90 degrees) for vertical takeoff and landing operations.

VCON is defined as the maximum authorized speed for any nacelle angle in VTOL/Conversion mode.

VTOL/Conversion mode is all approved nacelle positions where the
design operating rotor speed is used for hover operations.

VTOL mode RPM means highest range of RPM that occur for takeoff, approach, hover, and conversion conditions.

5. Add § 36.13 to subpart A to read as follows:

§ 36.13 Acoustical change: Tiltrotor aircraft.

The following requirements apply to tiltrotors in any category for which an acoustical change approval is applied for under § 21.93(b) of this chapter on or after March 11, 2013:

(a) In showing compliance with Appendix K of this part, noise levels must be measured, evaluated, and calculated in accordance with the applicable procedures and conditions prescribed in Appendix K of this part.

(b) Compliance with the noise limits prescribed in section K4 (Noise Limits) of Appendix K of this part must be shown for a tiltrotor for which the application for the issuance of a type certificate is made on or after March 11, 2013.

(c) After a change in type design, tiltrotor noise levels may not exceed the limits specified in § 36.1103.

6. Add Subpart K to part 36 to read as follows:

Subpart K—Tiltrotors

Sec.

36.1101 Noise measurement and evaluation.

36.1103 Noise limits.

§ 36.1101 Noise measurement and evaluation.

For tiltrotors, the noise generated must be measured and evaluated under Appendix K of this part, or under an approved equivalent procedure.

§ 36.1103 Noise limits.

(a) Compliance with the maximum noise levels prescribed in Appendix K of this part must be shown for a tiltrotor for which the application for the issuance of a type certificate is made on or after March 11, 2013.

(b) To demonstrate compliance with this part, noise levels may not exceed the noise limits listed in Appendix K, Section K4, Noise Limits of this part. Appendix K of this part (or an approved equivalent procedure) must also be used to evaluate and demonstrate compliance with the approved test procedures, and at the applicable noise measurement points.

7. Add Appendix K to part 36 to read as follows:

Appendix K to Part 36—Noise Requirements for Tiltrotors Under Subpart K

Sec.

K1 General

K2 Noise Evaluation Measure

K3 Noise Measurement Reference Points

K4 Noise Limits

K5 Trade-offs

K6 Noise Certification Reference Procedures

K7 Test Procedures

Section K1 General

This appendix prescribes noise limits and procedures for measuring noise and adjusting the data to standard conditions for tiltrotors as specified in § 36.1 of this part.

Section K2 Noise Evaluation Measure

The noise evaluation measure is the effective perceived noise level in EPNdB, to be calculated in accordance with section A36.4 of Appendix A to this part, except corrections for spectral irregularities must be determined using the 50 Hz sound pressure level found in section H36.201 of Appendix H to this part.

Section K3 Noise Measurement Reference Points

The following noise reference points must be used when demonstrating tiltrotor compliance with section K6 (Noise Certification Reference Procedures) and section K7 (Test Procedures) of this appendix:

(a) Takeoff reference noise measurement points—

As shown in Figure K1 below:

(1) The centerline noise measurement flight path reference point, designated A, is located on the ground vertically below the reference takeoff flight path. The measurement point is located 1,640 feet (500 m) in the horizontal direction of flight from the point Cr where transition to climbing flight is initiated, as described in section K6.2 of this appendix;

(2) Two sideline noise measurement points, designated as S(starboard) and S(port), are located on the ground perpendicular to and symmetrically stationed at 492 feet (150 m) on each side of the takeoff reference flight path. The measurement points bisect the centerline flight path reference point A.

BILLING CODE 4910–13–P
(b) Flyover reference noise measurement points—
As shown in Figure K2 below:

(1) The centerline noise measurement flight path reference point, designated A, is located on the ground 492 feet (150 m) vertically below the reference flyover flight path. The measurement point is defined by the flyover reference procedure in section K6.3 of this appendix;
(2) Two sideline noise measurement points, designated as S_{sideline}, are located on the ground perpendicular to and symmetrically stationed at 492 feet (150 m) on each side of the flyover reference flight path. The measurement points bisect the centerline flight path reference point A.

(c) Approach reference noise measurement points—
As shown in Figure K3 below:

![Figure K3. Comparison of Measured and Reference Approach Profiles](image-url)

**Section K4 Noise Limits**

For a tiltrotor, the maximum noise levels, as determined in accordance with the noise evaluation in EPNdB and calculation method described in section H36.201 of Appendix H of this part, must not exceed the noise levels as follows:

(a) At the takeoff flight path reference point: For a tiltrotor having a maximum certificated takeoff weight (mass) of 176,370 pounds (80,000 kg) or more, in VTOL/Conversion mode, 109 EPNdB, decreasing linearly with the logarithm of the tiltrotor weight (mass) at a rate of 3.0 EPNdB per halving of weight (mass) down to 89 EPNdB, after which the limit is constant. Figure K4 illustrates the takeoff noise limit as a solid line.

(b) At the flyover path reference point: For a tiltrotor having a maximum certificated takeoff weight (mass) of 176,370 pounds (80,000 kg) or more, in VTOL/Conversion mode, 108 EPNdB, decreasing linearly with the logarithm of the tiltrotors weight (mass) at a rate of 3.0 EPNdB per halving of weight (mass) down to 88 EPNdB, after which the limit is constant. Figure K4 illustrates the flyover noise limit as a dashed line.

(c) At the approach flight path reference point: For a tiltrotor having a maximum certificated takeoff weight (mass) of 176,370 pounds (80,000 kg) or more, in VTOL/Conversion mode, 110 EPNdB, decreasing linearly with the logarithm of the tiltrotor weight (mass) at a rate of 3.0 EPNdB per halving of weight (mass) down to 90 EPNdB, after which the limit is constant. Figure K4 illustrates the approach noise limit as a dash-dot line.
Section K5  Trade-Offs

If the noise evaluation measurement exceeds the noise limits described in K4 of this appendix at one or two measurement points:
(a) The sum of excesses must not be greater than 4 EPNdB;
(b) The excess at any single point must not be greater than 3 EPNdB; and
(c) Any excess must be offset by the remaining noise margin at the other point or points.

Section K6  Noise Certification Reference Procedures

K6.1  General Conditions
(a) [Reserved]
(b) [Reserved]
(c) The takeoff, flyover and approach reference procedures must be established in accordance with sections K6.2, K6.3 and K6.4 of this appendix, except as specified in section K6.1(d) of this appendix.
(d) If the design characteristics of the tiltrotor prevent test flights from being conducted in accordance with section K6.2, K6.3 or K6.4 of this appendix, the applicant must revise the test procedures and resubmit the procedures for approval.
(e) The following reference atmospheric conditions must be used to establish the reference procedures:
(1) Sea level atmospheric pressure of 2,116 pounds per square foot (1,013.25 hPa);
(2) Ambient air temperature of 77 °Fahrenheit (25 °Celsius, i.e. ISA + 10 °C);
(3) Relative humidity of 70 percent; and
(4) Zero wind.
(f) For tests conducted in accordance with sections K6.2, K6.3, and K6.4 of this appendix, use the maximum normal operating RPM corresponding to the airworthiness limit imposed by the manufacturer. For configurations for which the rotor speed automatically links with the flight condition, use the maximum normal operating rotor speed corresponding with the reference flight condition. For configurations for which the rotor speed can change by pilot action, use the highest normal rotor speed specified in the flight manual limitation section for the reference conditions.

K6.2  Takeoff Reference Procedure.
The takeoff reference flight procedure is as follows:
(a) A constant takeoff configuration must be maintained, including the nacelle angle selected by the applicant;
(b) The tiltrotor power must be stabilized at the maximum takeoff power corresponding to the minimum
K7.6 The rotor speed must be stabilized at the maximum normal operating RPM certified for level flight.

K7.7 The average rotor RPM must not vary from the normal maximum operating RPM by more than ±1.0 percent throughout the 10 dB-down time interval.

K7.8 The tiltrotor must operate between ±10 degrees from the vertical or between ±65 feet (±20 m) lateral deviation tolerance, whichever is greater, above the reference track and throughout the 10 dB-down time interval.

K7.9 The tiltrotor altitude must not vary during each flyover by more than ±9 km/h (±5 kts). The average altitude must not in total exceed 2.0 EPNdB.

K7.10 During the approach procedure, the tiltrotor must establish a stabilized constant speed approach and fly between approach angles of 5.5 degrees and 6.5 degrees throughout the 10 dB-down time interval.

K7.11 During all test procedures, the tiltrotor weight (mass) must not be less than 90 percent and not more than 105 percent of the maximum certificated weight (mass). For each of the test procedures, complete at least one test at or above this maximum certificated weight (mass).

K7.12 A tiltrotor capable of carrying external loads or external equipment must be noise certificated without such loads or equipment fitted.

Section K7 Test Procedures

K7.1 [Reserved]

K7.2 The test procedures and noise measurements must be conducted and processed to yield the noise evaluation measure designated in section K2 of this appendix. For either the test conditions or test procedures do not comply to the applicable noise certification reference conditions or procedures prescribed by this part, the applicant must apply the correction methods described in section H36.205 of Appendix H of this part to the acoustic test data measured.

K7.3 Adjustments for differences between test and reference flight conditions or procedures must not exceed:

(a) For takeoff: 4.0 EPNdB, of which the arithmetic sum of delta 1 and the term –7.5 log (QK/QRkr) from delta 2 must not in total exceed 2.0 EPNdB;

(b) For flyover or approach: 2.0 EPNdB.

K7.5 The average rotor RPM must not vary from the normal maximum operating RPM by more than ±1.0 percent throughout the 10 dB-down time interval.

K7.7 The number of level flyovers made with a head wind component must be equal to the number of level flyovers made with a tail wind component.

K7.8 The tiltrotor must operate between ±10 degrees from the vertical or between ±65 feet (±20 m) lateral deviation tolerance, whichever is greater, above the reference track and throughout the 10 dB-down time interval.

K7.9 The tiltrotor altitude must not vary during each flyover by more than ±30 ft (±9 m) from the reference altitude throughout the 10 dB-down time interval.

K7.10 During the approach procedure, the tiltrotor must establish a stabilized constant speed approach and fly between approach angles of 5.5 degrees and 6.5 degrees throughout the 10 dB-down time interval.

K7.11 During all test procedures, the tiltrotor weight (mass) must not be less than 90 percent and not more than 105 percent of the maximum certificated weight (mass). For each of the test procedures, complete at least one test at or above this maximum certificated weight (mass).

K7.12 A tiltrotor capable of carrying external loads or external equipment must be noise certificated without such loads or equipment fitted.

The value of $V_{CON}$ used for noise certification must be included in the approved Flight Manual.