UNITED STATES

ENVIRONMENTAL PROTECTION AGENCY

RECOMMENDED

NOTICE OF PROPOSED RULEMAKING

ON

NOISE STANDARDS

FOR

PROPELLER DRIVEN SMALL AIRPLANES

25 NOVEMBER 1974

IV-96-01
II-A-257

Department of Transportation

Federal Aviation Administration

[14 CFR Part 91]

[Docket No. ; Notice No. 74-]

Aircraft Noise Certification Standards:

Propeller Driven Small Airplanes

Notice of Proposed Rulemaking

In accordance with a recommendation made by the Administrator of the Environmental Protection Agency, the Federal Aviation Administration is considering an amendment to Part 36 of the Federal Aviation Regulations which would further protect the public health and welfare by prescribing noise standards for propeller driven small airplanes.

Interested persons are invited to participate in the subject rule making process by submitting such written data, views, or arguments as they may desire. Communications should identify the regulatory docket or notice number and be submitted in duplicate to: Federal Aviation Administration, Office of the Chief Counsel, Attention: Rules Docket, GC-24, 800 Independence Avenue, S.W., Washington, D.C. 20590, and Environmental Protection Agency, Office of Noise Control Programs, AW-571, Attention: Aviation Rules Docket, 401 M Street, S.W., Washington, D.C. 20460. All communications received on or before will be considered by the Administrators before taking action on the proposed rule. The concepts contained in this notice may be changed in the light of comments received. All

comments submitted will be available, both before and after the closing date for comments, in the Rules Dockets for examination by interested persons.

Under the requirements of Section 7(a) of the Noise Control Act of 1972 (Pub. L. 92-574, 86 Stat. 1234) the Administrator of the Environmental Protection Agency conducted a study of aircraft and airport noise and submitted a report thereon to the Congress. (Report on Aircraft/Airport Noise, Senate Committee on Public Works, Serial No. 93-8, Aug. 1973). Under Section 611 of the Federal Aviation Act, as amended by the Noise Control Act of 1972, the Administrator of the EPA is also required, not earlier than the date of submission of his report to the Congress, to submit to the Federal Aviation Administration proposed regulations to provide such control and abatement of aircraft noise and sonic boom (including control and abatement of aircraft noise through the exercise of any of the FAA's regulatory authority over air commerce or transportation or over aircraft or airport operations) as the Administrator of the EPA determines is necessary to protect the public health and welfare. In accordance with the foregoing requirement, the EPA published in the Federal Register on February 19, 1974, (39 F.R. 6112) a "Notice of Public Comment Period" containing a synopsis of the proposed rules it is considering to achieve a satisfactory level of aircraft noise control and abatement for the protection of the public health and welfare.

The proposed rules and the type of control which each rule would implement are as follows:

Flight procedures noise control.

(1) Takeoff procedures.

(2) Approach procedures.

(3) Minimum altitudes.

Source noise control.

(4) Retrofit/ fleet noise level.

(5) Supersonic civil aircraft noise.

(6) Modifications to Part 36 of the Federal Aviation Regulations.

(7) Propeller driven small airplanes.

(8) Short haul aircraft.

Airport operations noise control.

(9) Airport goals, mechanisms and processes by which noise exposure of communities around airports can be limited to levels consistent with public health and welfare requirements.

This proposed rule, identified as Item (7), is one of the five whose purpose is to implement engineering noise control at the source. As proposed herein the EPA believes that the rule, if adopted, would control the noise of propeller driven small airplanes to levels as low as is consistent with safe technological capability, without (1) imposing unreasonable economic burdens on the users of those airplanes, (2) degrading the environment in any manner, and (3) any significant increase in fuel consumption. In substance, the proposed rule would provide for the following changes in the aircraft noise standards of Part 36 of the Federal Aviation Regulations.

(1) Noise standards for propeller driven small airplanes in the

normal, utility, acrobatic, transport and restricted categories would be added to that Part. Agricultural and firefighting airplanes, however, would be excluded from the standards when operated in compliance with a current noise abatement flight plan.

(2) The noise evaluation requirement for the standards would be Effective Perceived Noise Level (EPNL) in units of EPNdB, as now required under Part 36 for transport category airplanes and turbojet powered airplanes.

(3) Compliance with the noise limits prescribed in this proposed rule would be achieved in the following stages based upon implementation of the current, available, and future noise control technology:

(a) Current technology. An application for a type certificate on or after the date of publication of NPRM 73-26 on October 10, 1973, would be subject to the current technology noise standards.

(b) Available technology. An application for a type certificate on or after January 1, 1975, would be subject to the available technology noise standards. These standards would also apply to an airplane of an older type design manufactured on or after January 1, 1977.

(c) Future technology. An application for a type certificate on or after January 1, 1980, would be subject to the future technology standards.

A. Regulatory Background.

Part 36, "Noise Standards: Aircraft Type Certification", was effective on Dec. 1, 1969, (34 F.R. 18355), prescribing noise measurement, noise evaluation, and noise levels for the type certification, and changes to those certificates, for subsonic transport category airplanes, and for subsonic turbojet powered airplanes regardless of category. Although propeller driven small airplanes (as defined in Part 1 a small aircraft means an aircraft of 12,500 pounds or less, maximum certificated takeoff weight) have not created noise problems as severe as that of the turbojet or large transport category airplanes, it was deemed appropriate to take regulatory action to place limits on future noise impact from this segment of aviation. Accordingly, on October 9, 1973, the FAA issued NPRM 73-26 (38 F.R. 28016) proposing standards and simplified procedures for measuring the noise levels for propeller driven small airplanes in the normal, utility, acrobatic, transport, and restricted categories. However, in response to the invitation for comments to the NPRM, the EPA advised the FAA that it did not concur with some of the provisions of that proposal and recommended specific changes. The recommended modifications affect four elements of the proposed rule. They are, in general; (1) the noise evaluation measure, (2) the noise compliance levels, (3) the performance correction factor, and (4) the noise data sample size. The substance of these key issues may be summarized as follows:

(1) Flight procedures. A minimum of only four horizontal flights with maximum continous power, at a height of 1000 feet over a single noise measurement station would be required under NPRM 73-26 to demonstrate compliance with the proposed noise level requirements. The EPA has no objection to this simplified procedure for small airplanes, but believes that a minimum of six flights (as required in Part 36) is necessary to properly evaluate the noise output of an airplane regardless of the airplane size. A minimum of six noise data samples will yield more reliable averages and this change is incorporated herein.

(2) Performance correction. The EPA believes that the climb-out performance correction concept as proposed in NPRM 73-26 is reasonable, but needs minor corrections and an additional factor to account for difference between the aircraft test speed and the aircraft take-off speed. A performance correction concept incorporating minor changes to the original concept plus a speed correction factor is recommended herein.

(3) Noise evaluation measure. NPRM 73-26 proposed that maximum A-weighted noise level (AL) in units of AdB should be used as the measure for type certification of aircraft noise. The EPA recommends that the use of Effective Perceived Noise Level (EPNL) in units of EPNdB be used, as is required for turbojet powered airplanes and transport category airplanes

Regulations and Annex 16 of ICAO. The use of EPNL as the noise evaluation measure is incorporated in this proposed rule.

(4) Noise compliance levels. The EPA believes that the noise level requirements to be achieved under NPRM 73-26 are not sufficiently representative of the safe and economical noise control that can be implemented by applications of current and available technology. Furthermore, modifications are necessary to properly reflect the achievements that can be accomplished by applications of future technology.

As used here, current technology includes "shelf item" hardware and commonly known techniques and procedures that have been used effectively by some manufacturers. Available technology represents the results of research and development that have not been put into common practice but are available for implementation. Some performance testing may still be necessary, but reliability and effectiveness has been demonstrated in the laboratory and on model and full scale tests. Future technology represents the results of research now in progress that have not been fully tested but the results to date indicate high potential to a reasonable degree of confidence.

B. References.

In the development of this proposed rule the EPA conducted its own studies and evaluated several pertinent studies made by other Federal agencies and private contractors. Those studies are listed herein for the information of all interested persons and are available for

examination at the FAA Rules Docket Office, GC-24, 800 Independence Avenue, S. W., Washington, D. C. 20590, or the Environmental Protection Agency, Office of Noise Control Programs, Crystal Mall 2, 1921 Jefferson Davis Highway, Arlington, VA, 20460. Copies of these studies prepared by Government Agencies are also for sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

(1) "Aircraft Noise", Annex 16 to the Convention on International Civil Aviation, International Standards and Recommended Practices, International Civil Aviation Organization (ICAO), Amendment Number 2, April 1974.

(2) "Subjective Evaluation of General Aviation Aircraft Noise", FAA Report FAA-NO-68-35, April 1968.

(3) "Comparisons Between Subjective Ratings of Aircraft Noise", FAA Report FAA-NO-68-33, April 1968.

(4) "Aircraft Noise Evaluation", FAA Technical Report, FAA-NO-68-34, September 1968.

(5) "The Effects of Temporal and Spectral Combinations on the Judged Noisiness of Aircraft Sounds", FAA Report FAA-NO-69-3, June 1969.

(6) "Conference on STOL Transport Aircraft Noise Certification", FAA Report FAA-NO-69-1, 30 January 1969.

(7) "Effective Perceived Noise Level Evaluated For STOL and Other Aircraft Sounds", FAA Report FAA-NO-70-5, May 1970.

(8) "Report on Aircraft/ Airport Noise", Report of the Administrator of the Environmental Protection Agency in Compliance with Public Law 92-574, Senate Committee on Public Works, Serial No. 93-8, August 1973.

(9) "Impact Characterization of Noise Including Implications of Identifying and Achieving Levels of Cumulative Noise Exposure", Report of Task Group 3, EPA NTID 73.4, 27 July 1973.

(10) "Information on Levels of Environmental Noise Requisite to Protect Public Health and Weflare with an Adequate Margin of Safety", EPA Technical Document No. 550/9-74-004, March 1974.

(11) "Noise Source Abatement Technology and Cost Analysis Including Retrofitting", Report of Task Group 4, EPA NTID 75.5, 27 July 1973.

(12) "Noise Levels of Propeller Driven Light Aircraft", Table 2, Working Paper No. 11, Second Meeting of the Committee on Aircraft Noise (CAN), International Civil Aviation Organization (ICAO), Federal Republic of Germany, January 1971.

(13) "Results of Noise Surveys of Seventeen General Aviation Type Aircraft", FAA Report FAA-EQ-73-1, December 1972.

(14) "Measurement and Analysis of Noise From Seventeen Aircraft in Level Flight (Military, Business Jet, and General Aviation)", FAA-RD-71-98, November 1971.

(15) "Progress Report on Quiet Propulsion", M.I.T. Summer Workshop on Low/Medium Density Air Transportation, 9 August 1973.

(16) "New Low Pressure Ratio Fans for Quiet Business Aircraft Propulsion", S.A.E. Business Aircraft Meeting, Wichita, Kansas, 3-6 April 1973.

(17) "Advanced V/STOL Propeller Technology; Far-Field Noise Investigation", Air Force Flight Dynamics Laboratory, Technical Report AFFDL-TR-88, Vol. XIII, December 1971.

C. Introduction.

As previously stated, the rules proposed herein are based primarily upon recommendations submitted by the EPA pursuant to the mandates of Section 611 of the Federal Aviation Act. It is to be noted that these rules parallel, in many respects, the provisions contained in the FAA NPRM 73-26. However, since they contain differences from that NPRM in regard to the key elements of noise evaluation measures, noise compliance levels, performance correction, and flight procedures, each of these elements is discussed herein under a separate heading.

Initially, it is to be noted that those rules do not apply to rotorcraft, balloons, dirigibles, or gliders since those aircraft are not classified as airplanes. Agricultural and firefighting airplanes would also be excepted under certain conditions from the proposed noise limit levels. The retrofit of existing airplanes would not be required.

Only those airplanes manufactured in the future would be required to be noise controlled under the rule as proposed.

The EPA believes that the noise standards proposed herein will prevent an escalation of noise from propeller driven small airplanes, substantially reduce the noise for continued production of many existing models, and set standards for original type certification of future airplanes; all of which will assist in the protection of the public health and welfare from aircraft generated noise.

D. Flight procedures.

Under NPRM 73-26, the three point (sideline, takeoff and approach) noise certification procedure prescribed in Appendix C of Part 36 would be replaced with a single point, level flight procedure at maximum continuous power. This simplified flight procedure would require a minimum of only four level flights over the measuring station at a height of 1000 feet $\pm$ 30 feet and $\pm$ 10 degrees from the zenith when passing overhead.

The EPA believes that an aircraft certification concept should have two principal objectives. First, it should require that the latest state of the art of technologically practicable and economically reasonable noise control is utilized. Second, it should provide baseline noise levels suitable for use by airport and community planners and architects in planning airports, determining noise compatible land usage, and designing noise insulated structures. The ideal way of achieving those objectives would be to conduct sufficient noise measurements to be able to construct equal noise level contours for all of

the potential operating modes of the aircraft. In lieu of the ideal, three strategically located noise certification measuring points are necessary and sufficient to define a rectangular boundary or box which would contain an equal noise level contour. Ordinarily a noise certification procedure that has less than three points will not provide adequate information to make a judgment as to whether the airframe and power plant combination is optimally matched for minimum noise exposure. However, if the the particular aircraft has operational or noise characteristics wherein either one operational mode provides the major source of noise and the others are relatively minor, or the noise control devices or procedures effective for the major operational noise mode are equally effective for all the modes; then simpler test procedures may be adequate. The EPA believes that the propeller driven small airplane has such characteristics, and for those reasons (not those stated in NPRM 73-26) the simpler flight procedures would be acceptable.

Another important operational procedure to be considered is the choice of maximum continuous power instead of takeoff power. Takeoff power is very close to maximum continuous power in terms of noise generation, and for many of the small airplanes it is the same. Furthermore, takeoff power is used, when available, for a relatively short portion of the climb path. After clean up (landing gear and flaps) the airplane is operated at maximum continuous power. Consequently, the use of maximum continuous power in a horizontal flight procedure would also be acceptable, especially since takeoff power,

when available, is extremely functional (getting the airplane off the ground) and is used for relatively short periods of time.

Notwithstanding its acceptance of the foregoing flight procedures, the EPA points out that a level flight procedure is deficient since it does not indicate (as a three-point procedure would) whether the airframe and power plant combination is optimally matched for minimum noise exposure on the ground at climbout. To correct this deficiency the EPA recommends that performance correction factors including one such as proposed in NPRM 73-26 (with certain minor changes) and another to account for differences in test and takeoff speeds be used to correct the measured data. These factors are more fully discussed in paragraph E, below.

Although it is difficult to precisely predict the exact number of test flights needed over a measuring station to make a proper evaluation of a particular type of airplane, the EPA believes that there is no evidence to indicate that the minimum of six flights now required under Part 36 should be reduced because a simplified flight procedure is used. Accordingly, the procedures proposed herein would require a minimum of six flights over the noise measuring station.

E. Performance Correction.

A measure of the capability of an airplane to expose communities beyond the end of the takeoff runway to noise in excess of a specified level, is the land area contained within the boundary of the noise contour. (An equal noise contour is the locus of points on the ground which are exposed to a particular level of noise.) The size of the

contour area is dependent upon both the noise energy and the climb performance of the aircraft. The noise energy generated will be constant for a given engine power setting (such as takeoff or maximum continuous) but the noise radiated to the ground will also be dependent upon the climb path. At a given point on the extended centerline of the runway, the steeper the climb, the higher the airplane, and the lower the noise level.

The simplified horizontal flight noise certification procedure of the type proposed in NPRM 73-26, by itself, will not provide sufficient information to make a judgment on the relationship between airplane climbout performance and noise exposure on the ground. For example, two airplanes with the same power plant would be expected to produce about the same noise level over the measuring station at a height of 1000 feet, even though the total weight of one may be substantially greater than the other. However, the higher performance airplane (greater horsepower/weight ratio) would be expected to have the capability to produce smaller contour areas and, hence, less community noise degradation.

To compensate for this deficiency in the simple flyover certification procedure, as compared with the three point procedure contained in Appendix C of Part 36, NPRM 73-26 provides a "performance correction methodology" intended to penalize airplanes with poor climb performance. As stated in the preamble to that notice, the proposed correction "reflects the importance of good climb performance in removing the airplane as a noise source from the airport environs

as rapidly as possible". As proposed in that notice the climb-out performance correction factor would be computed by using the following formula:

$$C = 60\text{-}20 \log [(1430\text{-}D50)(R/C)/VY + 50] \quad (1)$$

Where: C is the correction that must be added algebraically to the measured values but limited to $\pm$ 5 dB; D50 is the takeoff distance in feet to a point at which the airplane is at a height of 50 feet at maximum certificated takeoff weight; R/C is the certificated best rate of climb in feet per minute; and VY is the airplane speed in feet per minute corresponding to the best rate of climb. When D50 is not listed as approved performance information, it must be taken as 1375 and 1600 feet for single engine and multi-engine airplanes, respectively.

The EPA believes that a climb performance correction factor proposed in NPRM 73-26, is a sound concept and with the minor changes proposed herein could be converted into a regulatory requirement which will insure that all future types of propeller driven small airplanes have climb capability and therefore community noise reduction capability at least as good as the best of the exisiting types.

The climb-out performance correction factor, however, can be made more meaningful with only a very slight change. It can be made to yield a noise incremental value which, when added algebraically to the measured noise level at 1000 feet, approximates the noise level at a specified reference distance from brake release, assuming a normal climbout.

The reference distance assumed in Equation (1) is 11,430 ft. which has no apparent significance, except possibly a poor approximation to the reference distance of 3,500 meters proposed by the International Civil Aviation Organization (ICAO) in Annex 16 (Reference 1). The concept of a reference distance is a good one because it can provide useful information for planning purposes. The particular distance, however, is not too important. Therefore, the EPA recommends that the reference distance be rounded off to 11,500 feet, which is a closer approximation of the 3,500 meters used by ICAO. This is a very slight modification that would change the correction values only a small fraction of a decibel from those computed by means of Equation (1). The revised formula is given in the following Equation (2) and plotted in attached Figure 1.

$$C = 60 - 20 \log [(11500 - D50) \sin \alpha + 50] \quad (2)$$

Where: $\alpha = \arcsin [(R/C)/VY]$

All airplane manufacturers should be encouraged to list the takeoff distance at maximum certificated weight from brake release to a point on the ground at which the airplane will clear an obstacle of 50 ft. in height (D50). Those manufacturers that do not choose to list this distance would be required by NPRM 73-26 to use 1,375 ft. for single engine airplanes and 1,600 ft. for multi-engine airplanes. The EPA believes that those distances are too liberal and may encourage manufacturers of low performance airplanes to choose not to list the D50 distances. Therefore, in order to encourage the manufacturers to determine climb-out performance correction factors based upon actual

performance characteristics, the distances should be increased to 2000 feet for single engine airplanes and 3000 feet for multi-engine airplanes as plotted in Figure 1.

Also it is noted that the aircraft under test conditions (horizontal flight, maximum continuous power at 1000 feet height above the test site) can be expected to fly-over the test site at a speed greater than the takeoff, climb-out speed. Therefore, the duration of the sound, a factor to be considered in human subjective reaction to noise, would be less under test conditions than the duration of the sound experienced under or alongside the climb path. In order to make a proper assessment of the noise measured under the simplified test conditions, the noise level corrected for climb performance must be further corrected to account for the change in speed which results in a change in noise duration. The speed correction factor appropriate for this purpose is:

$S = 10 \log VH/VY$, where;

VH = maximum speed in horizontal flight with maximum continuous power or maximum test speed in horizontal flight over the noise measuring point averaged for all test flights, whichever is greater, fpm,

VY = best rate of climb speed at maximum take-off weight, fpm, and

S = a correction factor to be added algebraically to the measured noise level, decibels.

Thus the total correction formula, including the climb performance factor and the test speed correction factor is proposed to be:

$P = C + S$, or

$$P = 60 - 20 \log [(11,500 - D50) \sin \alpha + 50] + 10 \log(VH/VY). \quad (3)$$

F. Noise Evaluation Measure.

The primary element in any procedure for certificating noise sources is the evaluation measure upon which the criteria is based. Aircraft noise signatures, which are the most intricate of the common noise sources, involve such complex interrelated spectral, temporal, and spatial functions of sound pressure that the search for a single number noise evaluator has been long and difficult. The end result to date, considered the best state of the art by the scientific community is Effective Perceived Noise Level (EPNL) (References (2) through (7), above). Simply stated, EPNL consists of instantaneous Perceived Noise Level (PNL) corrected for the presence of the maximum tone and the flyover duration. Both PNL and the A-weighted Level (AL) are methods for weighting the noise spectrum by deemphasizing the low and emphasizing the high frequency contributions. However, AL provides more suppression for the low and less amplification for the high frequencies than does PNL. Consequently, AL is less stringent in rating noise than is PNL, and therefore less effective in controlling noise, even before tone and duration corrections are added to PNL to form EPNL.

Most propeller driven small airplanes operating today have minimal high frequency noise content, contain only low frequency tones that would require about the same tone correction (one or two decibels at most), and have about the same noise duration time. On the surface, it appears as though it is not very important whether EPNL or AL is used for evaluating these current aircraft types be-

cause the compliance levels, in terms of either measure, could be adjusted to adequately control the noise. However, an analysis of the effects of various noise weighting factors on the noise signatures of this type of aircraft indicates that the use of the A-weighted measure, because of the massive de-emphasis of the low frequency components of the noise, may actually discourage noise reduction of propeller and engine noises. In addition, it is important that the noise evaluator chosen for a certification be versatile in the sense that it not only recognizes the annoyance effects (or any other health and welfare effects) for current aircraft, but is available (and capable of modification or refinement) for potentially obnoxious noise of future aircraft. EPNL is such a unit; not complete and not exact, but the best available at the present time. Furthermore, it is not too complex for use with modern electronic computational equipment and will be allowed, when desired and requested, by member states in international agreements (Reference 1, above).

The concept or rationale for maintaining two different aircraft noise measures (one for certification and one for community exposure or monitoring) was considered in depth by the EPA (References 8, 9 and 10, above). In the report to Congress (Reference 8), the EPA recommended a cumulative noise exposure measure which is based upon AL with the following caveat:

> "The use of an A-weighted sound level precludes the assessment of penalties for the existence of tones in the noise in the interest of simplifying the measure procedure. When appropriate, penalties for tones and other subjective attributes should be made in source regulations such as FAR 36".

In reference to the problem of choosing an appropriate noise measure that would evaluate the subjective effects of tone and other signature components, the report of EPA Task Group 3 in Reference (10), above, made the following pertinent conclusion:

> "After consideration of this problem, the Task Group concluded that the presence of a tone penalty in certification procedures effectively encourages a manufacturer to minimize tones in the sound of aircraft. Thus, certification requirements will minimize the need to consider tones in an environmental noise measure, so long as tonal effects are properly considered under source certification".
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> "Neglecting these characteristics in the proposed measure makes their control by other means necessary (emission/certification standards)".
>
> "The absence of a pure tone penalty in the basic measure for average sound level...is based on the assumption that pure tone components are primarily to be controlled by noise emission control standards. As long as such standards are not effective or in cases where, for technical or other reasons, significant pure tones remain, it is advisable to consider them in the detailed prediction/land use planning procedure...".

If tones or other aircraft noise signature anomalies are not evaluated and controlled by noise certification standards, then simplified measures using the A-weighted noise level will not be effective for use in environmental cumulative noise exposure methodologies and monitoring procedures. In that event, the EPA believes that other, more complex, methodologies such as noise exposure forecast (NEF) will be necessary to insure maximum protection to the public health and welfare.

The EPA has devoted considerable effort in a thorough study and analysis of the various noise evaluation measures. As a result of these

studies, the noise evaluation measure proposed herein is Effective Perceived Noise Level (EPNL). This measure, now required in Part 36 for transport category (including large propeller driven airplanes) and turbojet powered airplanes, would also apply to propeller driven small airplanes. The procedure in Appendix B of Part 36 would remain as the standard for converting the measured noise into EPNdB.

G. Noise Compliance Limits.

Under NPRM 73-26, Appendix F of Part 36 would be amended to require measured noise levels corrected for climb performance of propeller driven small airplanes to comply with the following noise limits and related effective dates:

1. Type certificate application on or after 10 October 1973.
   (a) 68 AdB up to airplane weights of 1,300 lbs.
   (b) 1 dB/165 lbs. up to 82 AdB at 3,630 lbs.
   (c) 82 AdB up to and including 12,500 lbs.
2. Type certificate application on or after 1 January 1975.
   (a) 68 AdB up to airplane weights of 1,320 lbs.
   (b) 1 dB/165 lbs. up to 80 AdB at 3,300 lbs.
   (c) 80 AdB up to and including 12,500 lbs.
3. New airplanes on or after 1 January 1980.
   Airplanes with no flight time, regardless of date of application of type certificate, would comply with the noise limits specified in paragraph 2, above.

The attached Figure 2, which compares the compliance noise levels proposed in NPRM 73-26 with a wide variety of existing propeller

airplanes, clearly indicates that the compliance levels do not represent the quieter airplanes. As a matter of fact, a large number of the existing propeller driven small airplanes are capable of producing significantly lower noise levels than those proposed for future types in NPRM 73-26. This, in spite of the fact that the Noise Control Act of 1972 requires aircraft noise regulations to protect the public health and welfare by decreasing or controlling the noise emissions to the highest degree possible within the regulatory constraints of safety, economics, and technology.

The attached Figure 3 shows the compliance levels of this proposal compared with those of NPRM 73-26; there is an 11-dB numerical difference between the two. The upper compliance level shown in Figure 3 is 93 EPNdB which is the Part 36 requirement for all turbojet and large propeller airplanes up to 75,000 pounds maximum weight. There is no reason why propeller driven small airplanes of 12,500 pounds or less, maximum certificated takeoff weight, should be permitted to exceed that level. It must be clearly understood that the compliance levels for the propeller driven small airplanes refer to a 1,000 ft. horizontal flyover, while the Part 36 levels refer to a measuring point 3.5 nautical miles from brake release. However, for many large turbojets and propeller driven large airplanes, the height above the measuring point will be between 700 and 1,500 feet, or close enough to 1,000 ft. to make reasonable comparisons.

In addition to the foregoing current technology, considerable research effort is in progress on the development of quiet propeller

propulsion systems and the results indicate that safe and economical technology should be available, some in the near future and a great deal more by 1980. (Reference Nos. 11 through 17 listed above). Accordingly, the EPA recommends adoption of lower noise compliance levels for future technology standards. In this respect, the EPA assumes that those airplanes shown in Figure 2 with the lowest noise levels have utilized all or at least some of the available noise control technology (engine covers, mufflers, reduced propeller tip speed, increased propeller efficiency, etc.) to achieve those levels. In addition, it may also be assumed that those airplanes meet the appropriate airworthiness standards of the state of registry and are competing economically in the market place with other propeller driven small airplanes with higher noise levels. Since those airplanes more properly reflect the requirements of the Noise Act, the lower noise levels which they have achieved should be used to the extent practicable as the starting point, or upper limit, for future propeller driven small airplanes.

The attached Figure 4 illustrates the noise compliance levels proposed in this rule for current, available, and future noise technologies and are proposed to be applied as follows:

(1) Current. For propeller driven small airplane type designs for which an application for a type certificate is made from October 10, 1973 to January 1, 1975, inclusive, the noise level must not exceed 79 EPNdB for airplane weights up to and including 1320 pounds. The noise level limit increases

from 79 EPNdB at a rate of 1 EPNdB/165 pounds of weight in excess of 1320 pounds for airplane weights greater than 1320 pounds, up to and including 3630 pounds. However, the noise level limit remains constant at 93 EPNdB for airplane weights of 3630 pounds or more, up to and including 12,500 pounds.

(2) Available. For propeller driven small airplane type designs for which an application for a type certificate is made from January 2, 1975 to January 1, 1980, inclusive, and for newly produced propeller driven small airplanes manufactured on or after January 2, 1977, the noise level must not exceed 79 EPNdB for airplane weights up to and including 1320. The noise level limit increases from 79 EPNdB at a rate of 1 EPNdB/165 pounds of weight in excess of 1320 pounds for airplane weights greater than 1320 pounds, up to and including 3300 pounds. However, the noise level limit remains constant at 91 EPNdB for airplane weights of 3300 pounds or more, up to and including 12,500 pounds.

(3) Future. For propeller driven small airplane type designs for which an application for a type certificate is made on or after January 2, 1980, the noise level limit is prescribed by the following formula:

$$EPNL = 89\text{-}15 \log (12.5/W) \qquad (4)$$

Where: W = airplane maximum certificated takeoff weight in thousands of pounds.

H. Economic Considerations.

As previously stated, aircraft noise control regulations must provide protection to the public health and welfare to the highest degree possible within the regulatory constraints of safety, economics and technology. Accordingly, the EPA believes that those regulations are expected to reflect the current and future state of the art of safe technology without a prohibitive impairment of aircraft performance in regard to range, payload, field length, etc. Regulations based upon the foregoing policy are needed to insure that future community noise due to the operation of propeller driven small aircraft will be reduced to the lowest feasible levels and smallest practical areas commensurate with the state of the art.

As proposed, these rules will not require a retrofit of existing propeller driven small airplanes. However, the rules would prohibit any acoustical changes to those airplanes that would increase noise. Additional costs to the aircraft manufacturers for the inclusion of the existing "off the shelf" noise reduction technology into newly designed airplanes, in some cases, may mean only the cost of the addition of mufflers; in others it may mean the cost of decreasing the propeller tip speed and changing or adding propeller blades. In some cases, it may also mean new design changes or the redesign of muffler and exhaust systems and propellers. In the case of turbo-charged engines for which mufflers are not feasible, perhaps smaller diameter, more efficient propellers may be appropriate. An additional cost would also be incurred by the manufacturer for the aircraft type

certification of the particular airplane in accordance with the procedures and standards proposed in this notice.

It is estimated that the cost of the type certification and the modifications needed for compliance with this proposal would range from $300 to $2,500 depending upon the type of airplane and the production run. This increase for an airplane ranging in price from $14,000 to $25,000 appears economically reasonable for the reduced noise benefits to be derived. In this regard, the EPA believes that the existing noise reduction technology included on some airplanes has not had a detrimental impact on the competitiveness of such airplanes.

Although it further appears that, in some cases, compliance with the noise standards contained in this proposal could result in a fuel consumption penalty, the penalty should be minor.

I. Proposed amendments.

Many of the amendments required for the implementation of this proposal are similar to those proposed in NPRM 73-26. The principal elements of the proposal as they appear in these amendments are summarized for convenient reference. However, in order to avoid any misunderstanding, the language of each amendment to the Federal Aviation Regulations is repeated in its entirety.

1. Part 36.

(a) The noise evaluation measure for propeller driven small airplanes would be Effective Perceived Noise Level, EPNL, in units of EPNdB as presently required in Appendix B for large transport

category airplanes and turbojet powered airplanes regardless of category.

(b) The aircraft noise evaluation procedures presently required in Appendix B would remain the standard for converting the noise measured into EPNdB units.

(c) A single point level flight noise certification procedure at maximum continuous power as proposed in NPRM 73-26 is also proposed in this notice. However, a performance correction factor as proposed in Part C of Appendix F would be required and a minimum of six (not four as proposed in NPRM 73-26) level flights would be required for the tests.

(d) The noise compliance levels and the effective dates for their implementation would be changed to conform with current, available and future technology in the following manner:

(1) Current technology as prescribed in proposed §F36.301(b) and depicted in the attached Figure 4 would apply to all type certificate applications filed on or after October 10, 1973.

(2) Available technology as prescribed in §F36.301(c) and depicted in the attached Figure 4 would apply to all type certificate applications filed on or after January 2, 1975, and to newly produced airplanes of older type design manufactured on or after January 2, 1977.

(3) Future technology as prescribed in §F36.301(d) and depicted in the attached Figure 4 would apply to all type certificate applications filed on or after January 2, 1980.

2. Subpart F.

As proposed herein a new Subpart F would also be added to Part 36 to prescribe noise limits for propeller driven small airplanes. The technical details of the proposed noise standards would be placed in a new Appendix F and made mandatory by a reference in proposed §36.501 of the subpart.

Paragraph (c) of §36.501 would, as proposed in NPRM 73-26, also except agricultural and firefighting airplanes from the noise limit requirements of Part D of Appendix F, but not the noise measurement and correction requirements needed to furnish noise levels under §36.1501. An airplane excepted from the foregoing requirement would be required, however, to have a noise abatement operating limitation issued for it under proposed §36.1583(c). This requirement would ensure that the exception of those airplanes from the noise requirements does not create a class of noise-exempt airplanes and thus defeat the purpose of the exception.

The remaining provisions of the new Subpart F as proposed in NPRM 73-26 and for the reasons stated therein are included in this proposal.

3. Appendix F.

As proposed in NPRM 73-26, an Appendix F to Part 36 would contain the detailed noise measurement, data correction, and noise limit requirements for propeller driven small airplanes. As distinguished from the provisions in NPRM 73-26, however, §F36.109 of the Appendix proposed herein would not provide for deviations in the data recording, reporting and approval requirements to reflect the use

of the A-weighted level since EPNL would be the unit of measurement.

Proposed §F36.111 would require at least six level flights over the measuring station instead of 4 flights as proposed in NPRM 73-26.

Part C of the Appendix F proposed herein would contain a revised correction formula recommended by the EPA to compensate for the simplified flyover procedures for propeller driven small airplanes authorized in this proposal.

The noise levels proposed in §F36.301 would be based upon three categories of noise technology and would be applicable to all propeller driven small airplanes, except as provided in Subpart F for agricultural and firefighting airplanes. The noise levels for each category are also graphically depicted (Figure 4).

4. Part 21.

It is to be noted that as proposed herein a new §21.93(b)(3) would also be used to classify the changes in the type design of a propeller driven small airplane which would constitute an "acoustical change" in addition to a minor or major change in the type design. As distinguished from turbojet powered and large transport category airplanes, acoustical changes for propeller driven small airplanes would be expressly limited to such changes as a change to or removal of a muffler or other components designed for noise control. The remaining procedural amendments to Part 21 support the substantive amendments proposed in Part 36 and Appendix F to that Part. Since they do not differ from those contained and discussed in NPRM 73-26, any further discussion of those amendments appears repetitive and unnecessary.

This notice of proposed rulemaking is issued under the authority of Section 313(a), 601, 603, 604, and 611, Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421, 1432, 1424, and 1431 as amended by the Noise Control Act of 1972 (P.L. 92-574); Section 6(c)), Department of Transportation Act (49 U.S.C. 1655(c)); Title I, National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.); Executive Order 11514, March 5, 1970.

Issued in Washington, D.C. on _____, 1974.

Administrator

In consideration of the foregoing it is proposed to amend Parts 21 and 36 of the Federal Aviation Regulations as follows:

PART 21 - CERTIFICATION PROCEDURES

FOR PRODUCTS AND PARTS

A. Part 21 of the Federal Aviation Regulations would be amended as follows:

1. Section 21.17(a) (Introductory clause) would be amended to read as follows:

§21.17 Designation of applicable regulations.

(a) Except as provided in §25.2 and in Part 36 of this Chapter, an applicant for a type certificate must show that the aircraft, engine, or propeller concerned meets -

* * * * *

2. Section 21.25(a) (Introductory clause) would be amended to read as follows:

§21.25 Issue of type certificate: restricted category aircraft.

(a) An applicant is entitled to a type certificate for an aircraft in the restricted category for special purpose operations if he shows compliance with the applicable noise requirements of Part 36 of this Chapter, and if he shows that no feature or characteristic of the aircraft makes it unsafe when it is operated under the limitations prescribed for its intended use, and that the aircraft -

* * * * *

3. Section 21.93(b) would be amended to read as follows:

§21.93 Classification of changes in type design.

* * * * *

(b) For the purpose of complying with Part 36 of this chapter, any voluntary change in the type design of an airplane that may increase the noise levels of that airplane is an "acoustical change" (in addition to being a minor or major change as classified in paragraph (a) of this section) for the following airplanes:

(1) Subsonic transport category large airplanes.

(2) Subsonic turbojet powered airplanes (regardless of category).

(3) Propeller-driven small airplanes in the normal, utility, acrobatic, transport, and restricted categories (except for airplanes that are designed for "agricultural aircraft operations" as defined in §137.3 of this chapter, as effective on January 1, 1966, or for dispensing fire fighting materials, and for which the operating limitation prescribed in §36.1583(c) of this chapter is issued). For those airplanes, "acoustical changes" are limited to the following type design changes:

(i) Any change to, or removal of, a muffler or other component designed for noise control; and

(ii) Any change to, or installation of, a power plant or propeller that increases maximum continuous power or thrust at sea level, or increases the propeller tip speed at that power or thrust, over that previously approved for the airplane.

4. Section 21.101(a) (Introductory clause) would be amended to read as follows:

§21.101 Designation of applicable regulations.

(a) Except as provided in §25.2 and Part 36 of this chapter, an applicant for a change to a type certificate must comply with either -

* * * * *

5. Section 21.115 (section heading and paragraph (a)) would be amended to read as follows:

§21.115 Applicable requirements.

(a) Each applicant for a supplemental type certificate must show that the altered product meets applicable airworthiness requirements as specified in paragraphs (a) and (b) of §21.101 and, in the case of an acoustical change described in §21.93(b), show compliance with the applicable noise requirements of §36.1(c) of this chapter.

* * * * *

6. Section 21.183 would be amended by redesignating paragraph (e) as paragraph (e)(1) and adding a new paragraph (e) and (e)(2) to read as follows:

§21.183 Issue of standard airworthiness certificates for normal, utility, acrobatic, and transport category aircraft.

* * * * *

(e) Noise requirements. Notwithstandanding all other provisions of this section, the following must be complied with for the issuance of a standard airworthiness certificate:

(1) * * * * *

(2) For normal, utility, acrobatic, or transport category propeller driven small airplanes that have not had any flight time before the applicable date specified in Part 36 of this chapter, no standard airworthiness certificate is originally issued under this section unless the applicant shows that the type design complies with the applicable noise requirements of Part 36 of this chapter in addition to the applicable

airworthiness requirements in this section. For import aircraft compliance with this paragraph is shown if the country in which the aircraft was manufactured certifies, and the Administrator finds, that the applicable requirements of Part 36 of this chapter (or the applicable aircraft noise requirements of the country in which the aircraft was manufactured and any other requirements the Administrator may prescribe to provide noise levels no greater than those provided by compliance with the applicable requirements of Part 36 of this chapter) and paragraph (c) of this section are complied with. This subparagraph does not apply to airplanes that are designed for "agricultural aircraft operations" as defined in §137.3 of this chapter, as effective on January 1, 1966, or for dispensing fire fighting materials, and for which the operating limitation prescribed in §36.1583(c) of this chapter is issued.

7. Section 21.185 would be amended by adding a new paragraph (d) to read as follows:

§21.185 Issue of airworthiness certificates for restricted category aircraft.

* * * * *

(d) Noise requirements. For propeller-driven small airplanes (except airplanes designed for "agricultural aircraft operations" as defined in §137.3 of this chapter, as effective on January 1, 1966, or for dispensing fire fighting materials, and for which the operating limitation prescribed in §36.1583(c) is issued) that have not had any flight time before the applicable date specified in Part 36 of this chapter, and notwithstanding the other provisions of this section, no original restricted category airworthiness certificate is issued under this section unless

the Administrator finds that the type design complies with the applicable noise requirements of Part 36 of this chapter in addition to the applicable airworthiness requirements of this section. For import aircraft, compliance with this paragraph is shown if the country in which the aircraft was manufactured certifies, and the Administrator finds, that the applicable requirements of Part 36 of this chapter (or the applicable aircraft noise requirements of the country in which the aircraft was manufactured and any other requirements the Administrator may prescribe to provide noise levels no greater than those provided by compliance with the applicable requirements of Part 36 of this chapter) and paragraph (c) of this section are complied with.

3. Section 21.257 would be amended to read as follows:

§21.257 Type certificates - issue

An applicant is entitled to a type certificate for a product manufactured under a delegation option authorization if the Administrator finds that the product meets the applicable airworthiness and noise requirements (including applicable acoustical change requirements in the case of amended type certificates).

9. A new §21.451(d) would be added to read as follows:

§21.451 Limits of applicability

* * * * *

(d) Notwithstanding any other provision of this subpart, no supplemental type certificate involving the acoustical change requirements of Part 36 of this chapter may be issued until the Administrator finds that those requirements are met.

PART 36 - NOISE STANDARDS: AIRCRAFT TYPE AND AIRWORTHINESS CERTIFICATION

B. Part 36 of the Federal Aviation Regulations would be amended as follows:

1. Section 36.1 would be amended to read as follows:

§36.1 Applicability.

(a) This part prescribes noise standards for the issuance of type certificates and changes to type certificates, and for the issuance of certain airworthiness certificates, for the aircraft specified in paragraph (b) of this section.

(b) In addition to the applicable airworthiness requirements of this chapter, the following provisions of this part must be complied with by each person who applies under Part 21 of this chapter for the issuance of the following certificates:

(1) This subpart, and Subparts B, C, and G of this part must be complied with for the issuance of type certificates for subsonic transport category large airplanes and subsonic turbojet powered airplanes regardless of category.

(2) Each person who applies for the original issue of Standard Airworthiness Certificates under §21.183, must, regardless of date of application, show compliance with this Part (including Appendix C), as effective on December 1, 1969, for airplanes that have not had any flight time before-

(i) December 1, 1973, for airplanes with maximum weights greater than 75,000 lbs., except for airplanes that are powered by Pratt and Whitney Turbo Wasp JT3D series engines;

(ii) December 31, 1974, for airplanes with maximum weights greater than 75,000 lbs. and that are powered by Pratt and Whitney Turbo Wasp JT3D series engines; and

(iii) December 31, 1974, for airplanes with maximum weights of 75,000 lbs. and less.

(3) This subpart, and Subparts F and G of this part must be complied with for the issuance of -

(i) Type certificates for propeller driven small airplanes in the normal, utility, acrobatic, transport, and restricted categories; and

(ii) Standard airworthiness certificates and restricted category airworthiness certificates for propeller-driven small airplanes.

(c) Each person who applies under Part 21 of this chapter for an approval of an acoustical change described in §21.93(b) of this chapter must show that the airplane meets the following requirements in addition to the applicable airworthiness requirements of this chapter:

(1) For subsonic transport category large airplanes and turbojet powered airplanes that can achieve the applicable noise limits prescribed in Appendix C of this part (or lower noise levels) prior to the change in type design, that appendix must be complied with. For airplanes that cannot achieve the applicable noise limits prescribed in Appendix C of this part prior to the change in type design, the noise levels created by the airplane prior to the change in type design, measured and evaluated as prescribed in Appendices A and B of this part, may not be exceeded.

(2) On or after January 2, 1975, for propeller-driven small airplanes in the normal, utility, acrobatic, transport, and restricted

categories that can achieve the applicable noise limit prescribed in Appendix F of this part (or a lower noise level) prior to the change in type design, that limit may not be exceeded. For airplanes that cannot achieve the applicable noise limit prescribed in Appendix F of this part prior to the change in type design, the noise level created by the airplane prior to the change in type design, measured and corrected as prescribed in Parts B and C of Appendix F, may not be exceeded. For the purpose of this subparagraph, the "applicable noise limit prescribed in Appendix F" means -

(i) For airplanes type certificated under Appendix F prior to the type design change, the noise limit that was applied to that approval; and

(ii) For other airplanes, the noise limit prescribed in §F36.301(b).

2. The heading of Subpart B would be amended to read as follows:

Subpart B - Transport Category Large Airplanes
and Turbojet Powered Airplanes

3. A new Subpart F would be added to read as follows:

Subpart F - Propeller Driven Small Airplanes

§36.501 Noise limits.

(a) Compliance with this subpart must be shown for -

(1) Propeller-driven small airplanes for which application for the issuance of a type certificate in the normal, utility, acrobatic, transport, or restricted category is made on or after October 10, 1973 (the effective date of NPRM 73-26); and

(2) Propeller-driven small airplanes for which application is made for the issuance of a standard airworthiness certificate or restricted

category airworthiness certificate, and that have not had any flight time on or after January 2, 1977, regardless of date of application.

(b) Compliance with this subpart must be shown with noise levels measured and corrected as prescribed in Parts B and C of Appendix F, or under approved equivalent procedures.

(c) For airplanes covered by this section, it must be shown that the noise level of the airplane is no greater than the applicable limit prescribed in Part D of Appendix F. This paragraph does not apply to airplanes that are designed for "agricultural aircraft operations" as defined in §137.3 of this chapter as effective on January 1, 1966, or for dispensing fire fighting materials, and for which the operation limitation prescribed in §36.1583(c) is issued.

4. Section 36.1581(a) would be amended to read as follows:

§36.1581 Manuals, markings, and placards.

(a) For airplanes that are required to have an Airplane Flight Manual, the approved portion of that manual must contain the flight procedures, performance information, and noise levels approved under §36.1501. For other airplanes, this data must be furnished in the approved portion of an Airplane Flight Manual or in any combination of approved manual material, markings, and placards.

* * * * *

5. A new §36.1583 would be added to read as follows:

§36.1583 Operating limitations.

(a) Operating limitations prescribed in this section must be furnished in the form and manner prescribed for operating limitations in

the applicable airworthiness regulations of this chapter. Except as provided in this section, no operating limitations are prescribed under this part.

(b) If a weight used in showing compliance with this part is less than a limiting weight established under the applicable airworthiness requirements of this chapter, that lesser weight must be furnished as an operating limitation.

(c) For airplanes that are designed for "agricultural aircraft operation" as defined in §137.3 of this chapter as effective on January 1, 1966, or for dispensing fire fighting materials, and that do not comply with the noise limits in Part D of Appendix F, the following operating limitation must be furnished.

"This airplane does not comply with the applicable noise limits in Part 36 of the Federal Aviation Regulations and may not be operated, for any purpose, except in compliance with a current noise abatement flight plan and noise route approved by the FAA and issued to the operator."

6. A new Appendix F would be added to read as follows:

APPENDIX F - NOISE REQUIREMENTS FOR PROPELLER-DRIVEN SMALL AIRPLANES

PART A - GENERAL

§F35.1. Scope. This appendix prescribes limiting noise levels, and procedures for measuring noise and correcting noise data, for propeller-driven small airplanes.

PART B - NOISE MEASUREMENT

§F36.101. General test conditions. (a) The test area must be surrounded by relatively flat terrain having no excessive sound absorp-

tion characteristics such as those caused by thick, matted, or tall grass, by shrubs, or by wooded areas. No obstructions which significantly influence the sound field from the airplane may exist within a conical space above the measurement position, the cone being defined by an axis normal to the ground and by a half-angle 75° from this axis.

(b) The tests must be carried out under the following atmospheric conditions:

(1) There may be no precipitation.

(2) Relative humidity may not be higher than 90 percent or lower than 30 percent.

(3) Ambient temperature may not be above 86° F or below 41° F at 33' above ground. If the measurement site is within 1 n.m. of an airport thermometer the airport reported temperature may be used.

(4) Reported wind may not be above 10 knots at 33' above ground. If the measurement site is within 1 n.m. of an airport anemometer, the airport reported wind may be used.

(5) There may be no temperature inversion or anomalous wind conditions that would significantly affect the noise level of the airplane when the noise is recorded at the required measuring point.

(6) The flight test procedures, measuring equipment, and noise measurement procedures must be approved by the FAA.

(7) Sound pressure level data for noise evaluation purposes must be obtained with acoustical equipment and measurement procedures that comply with §F36.103 of this appendix.

§F35.103 Acoustical measurement system. The acoustical measurement system must consist of approved equipment equivalent to the following:

(a) A microphone system with frequency response compatible with measurement and analysis system accuracy as prescribed in section F36.105 of this appendix.

(b) Tripods or similar microphone mountings that minimize interference with the sound being measured.

(c) Recording and reproducing equipment characteristics, frequency response, and dynamic range compatible with the response and accuracy requirements of section F36.105 of this appendix.

(d) Acoustic calibrators using sine wave or broad band noise of known sound pressure level. If broad band noise is used, the signal must be described in terms of its average and maximum root-mean-square (rms) value for nonoverload signal level.

§F36.105 Sensing, recording, and reproducing equipment. (a) The noise produced by the airplane must be recorded. A magnetic tape recorder is acceptable.

(b) The characteristics of the system must comply with the recommendations in International Electrotechnical Commission (IEC) Publication No. 179 (as amended) concerning microphone and amplifier characteristics. (Copies of this publication are available for examination at the DOT Branch Library, Federal Office Building, 10A, and at the Office of Environmental Quality, both located at Headquarters, Federal Aviation Administration, 800 Independence Avenue, S.W., Washington,

D.C. 20591. Copies are also available for examination at the Regional Office of the FAA.)

(c) The response of the complete system to a sensibly plane progressive sinusoidal wave of constant amplitude must lie within the tolerance limits specified in IEC Publication No. 179 (as amended) over the frequency range 45 to 11,200 Hz.

(d) If limitations of the dynamic range of the equipment make it necessary, high frequency pre-emphasis must be added to the recording channel with the converse deemphasis on playback. The pre-emphasis must be applied such that the instantaneous recorded sound pressure level of the noise signal between 800 and 11,200 Hz does not vary more than 20 dB between the maximum and minimum one-third octave bands.

(e) The equipment must be acoustically calibrated using facilities for acoustic free-field calibration and electronically calibrated by the method specified in §F36.107(b).

(f) A windscreen must be employed with the microphone during all measurements of aircraft noise when the wind speed is in excess of 6 knots. Corrections for any insertion loss produced by the windscreen, as a function of frequency, must be applied to the measured data and the corrections applied must be reported.

§F36.107. Noise measurement procedures.

(a) The microphones must be oriented so that the maximum sound received arrives as nearly as reasonable in the direction for which the microphones are calibrated. The microphones must be placed so that their sensing elements are approximately 4 feet above ground.

(b) Immediately prior to and after each test, a recorded acoustic calibration of the system must be made in the field with an acoustic calibrator for the two purposes of checking system sensitivity and providing an acoustic reference level for the analysis of the sound level data.

(c) For the purpose of minimizing equipment or operator error, field calibrations must be supplemented with the use of an insert voltage device to place a known signal at the imput of the microphone, just prior to and after recording aircraft noise data.

(d) The ambient noise, including both acoustical background and electrical noise of the measurement system, must be recorded and determined in the test area with the system gain set at levels which will be used for aircraft noise measurements.

§F36.109 Data recording, reporting, and approval.

(a) Data representing physical measurements or corrections to measured data must be recorded in permanent form and appended to the record except that corrections to measurements for normal equipment response deviations need not be reported. All other corrections must be approved. Estimates must be made of the individual errors inherent in each of the operaitons employed in obtaining the final data.

(b) (1) Measured and corrected sound pressure levels must be presented in one-third octave band levels obtained at the time when the tone corrected Perceived Noise Level is maximum using equipment conforming to the standards described in §D36.105.

(2) The type of equipment used for measurement and analysis of all acoustic aircraft performance and meteorological data must be reported.

(c) The following atmospheric environmental data measured immediately before, after, and hourly intervals or less during the test period, at the observation points prescribed in §F 36.101 of this appendix must be reported:

(1) Air temperature in degrees Fahrenheit and relative humidity in percent.

(2) Maximum, minimum, and average wind in knots and their direction.

(3) Atmospheric pressure in inches of mercury.

(d) Comments on local topography, ground cover, and events that might interfere with sound recordings must be reported.

(e) The following airplane information must be reported:

(1) Type, model and serial numbers (if any) of airplanes, engine(s), propeller(s), and muffler(s).

(2) Any modifications or nonstandard equipment likely to affect the noise characteristics of the airplane.

(3) Maximum certificated takeoff weights.

(4) True and indicated airspeed in knots for each overflight of the measuring point.

(5) Engine performance in terms of revolutions per minute, power, manifold pressure, blade pitch, and other relevant parameters for each overflight.

(6) Aircraft height in feet determined by a calibrated altimeter in the aircraft, approved photographic techniques, or approved tracking facilities.

(f) Aircraft speed and position and engine performance parameters must be recorded at an approved sampling rate sufficient to insure compliance with the test procedures and conditions of this Appendix.

§F36.111 Flight procedures. (a) Tests to demonstrate compliance with the noise level requirements of this Appendix must include at least six level flights over the measuring station at a height of 1,000 ± 30' and 10 degrees from the zenith when passing overhead.

(b) Overflight must be performed at the highest propeller rotational speed (rpm) corresponding to rated maximum continuous power, stabilized speed with propellers synchronized and with the airplane in the cruise configuration except that, if the speed at maximum continuous power would exceed the maximum speed authorized in level flight, accelerated flight is acceptable. Accelerated flight must be measured and reported.

PART C - DATA CORRECTION

SECTION F36.201 Correction of data. (a) Aircraft position and performance data and the noise measurements must be corrected to the following noise type certification reference atmospheric conditions:

(1) Sea level pressure of 2116 psf (76 cm mercury),

(2) Ambient temperature of 77 degerees F. (ISA + 10 degrees C.),

(3) Relative humidity of 70 percent,

(4) Zero wind.

(b) The performance correction prescribed in paragraph (c) of this section must be used. It must be determined by the method described in this appendix, and must be added algebriagically to the measured value.

(c) The performance correction must be computed by using the following formula:

$$P = 60\text{-}20 \log [(11500\text{-}D50) \sin \alpha + 50] + 10 \log VH/VY.$$

Where:

P = Correction that must be added algebraically to the effective perceived noise level (EPNL) evaluated under Appendix B, decibels.

D50 = Takeoff distance to 50' at maximum certificated takeoff weight, feet.

R/C = certificated best rate of climb, fpm.

VY = climb speed corresponding to certificated best rate of climb, fpm.

VH = maximum speed in horizontal flight with maximum continuous power or maximum test speed in horizontal flight over the noise measuring point averaged for all test flights, whichever is greater, fpm.

α = arcsine (R/C)/ VY = angle of climb, degrees

(d) When D50 is not listed as approved performance information, it must be taken as 2000 and 3000 feet for single engine and multi-engine airplanes, respectively.

§F36.203 Validity of results. (a) The test results must produce an average EPNdB and its 90 percent confidence limits, the noise level being the arithmetic average of the corrected acoustical measurements for all valid test runs over the measuring point.

(b) The samples must be large enough to establish statistically a 90 percent confidence limit not exceeding $\pm$1.5 EPNdB. The minimum sample size acceptable is six. If more than one acoustical measurement system is used at the measurement location, the resulting data for each test flight must be averaged as a single measurement. No test result may be omitted from the averaging process, unless omission is approved by the Administrator.

PART D - NOISE LIMITS

§F36.301 Aircraft noise limits. (a) Compliance with this section must be shown with noise data measured and corrected as prescribed in Parts B and C of this appendix and evaluated in accordance with Appendix B.

(b) For propeller driven small airplane type designs for which an application for a type certificate is made from October 10, 1973 to January 1, 1975, inclusive, the noise level must not exceed 79 EPNdB for airplane weights up to and including 1320 pounds (560 Kg). The noise level limit increases from 79 EPNdB at a rate of 1 EPNdB/165 pounds (75Kg) of weight in excess of 1320 pounds (599 Kg) for airplane weights greater than 1320 pounds, up to and including 3630 pounds (1647 Kg). However, the noise level limit remains constant at 93 EPNdB for airplane weights of 3630 pounds or more, up to and including 12,500 pounds (5670 Kg).

(c) For propeller driven small airplane type designs for which an application for a type certificate is made from January 2, 1975 to January 1, 1980, inclusive, and for newly produced propeller driven small airplanes manufactured on or after January 2, 1977, the noise level must not exceed 79 EPNdB for airplane weights up to and including 1320 pounds. The noise level limit increases from 79 EPNdB at a rate of 1 EPNdB/165 pounds of weight in excess of 1320 pounds for airplane weights greater than 1320 pounds, up to and including 3300 pounds (1497 Kg). However, the noise level limit remains constant at 91 EPNdB for airplane weights at 3300 pounds or more, up to and including 12,500 pounds.

(d) For propeller driven small airplane type designs for which an application for a type certificate is made on or after January 2, 1980, the noise level limit is prescribed by the following formula:

EPNL = 89-15 log (12.5/W)

Where: W = airplane maximum certificated takeoff weight in thousands of pounds.

(c) This section does not apply to airplanes that are designed for "agricultural aircraft operation" as defined in §137.3 of this chapter as effective on January 1, 1966, or for dispensing fire fighting materials and for which the operating limitation prescribed in §36.1583(c) is issued.

$$C = 60 - 20 \log \left[(11500 - D50) \sin \alpha + 50 \right]$$

WHERE α = ARCSIN $(R/c)/(VY)$

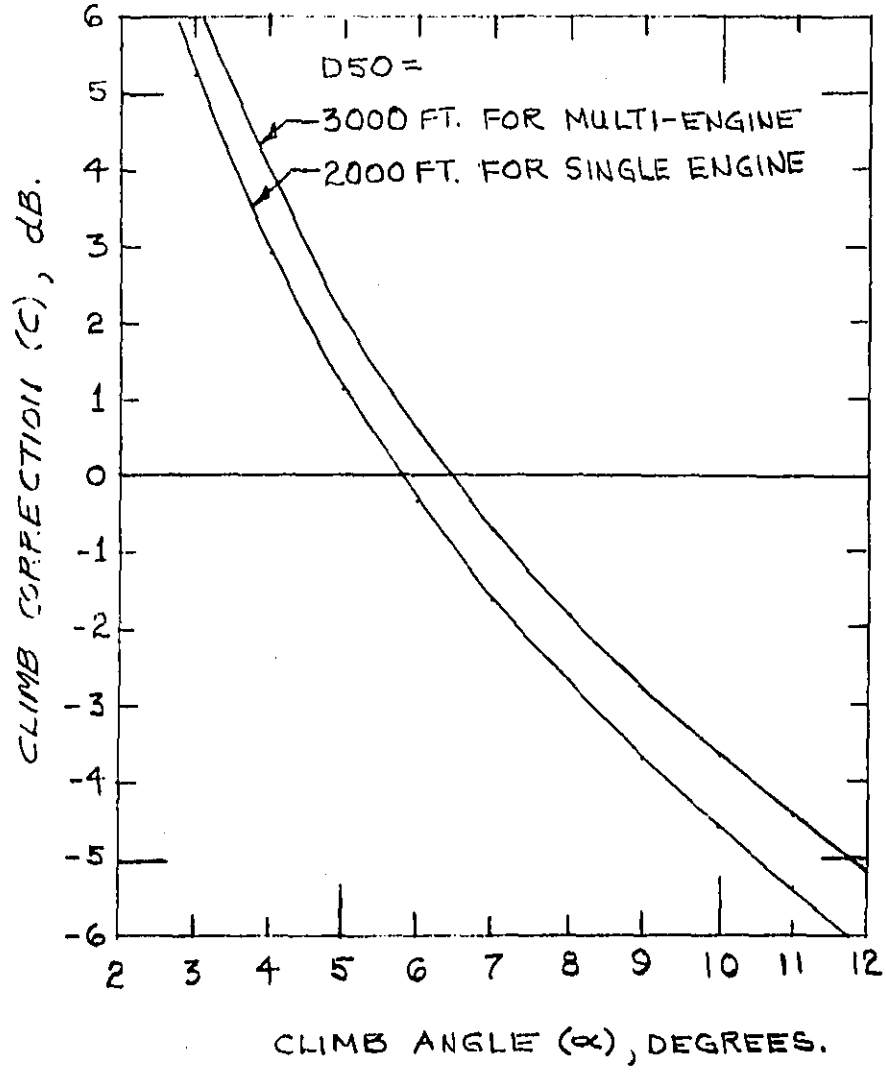

FIGURE 1. CLIMB CORRECTION FOR PROPELLER AIRPLANE NOISE

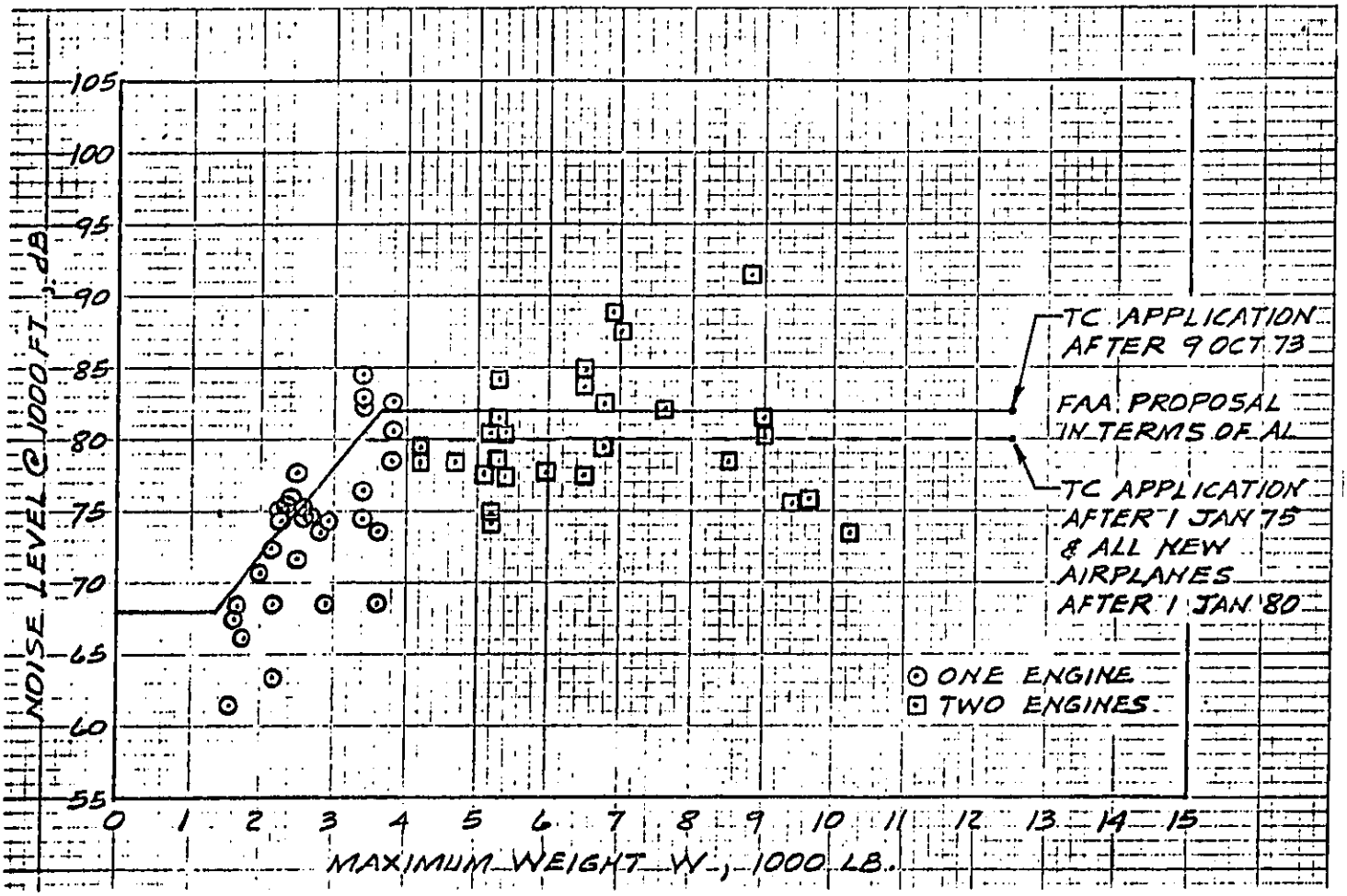

FIGURE 2. NOISE COMPLIANCE LEVELS PROPOSED BY NPRM 73-26 FOR PROPELLER DRIVEN SMALL AIRPLANES.

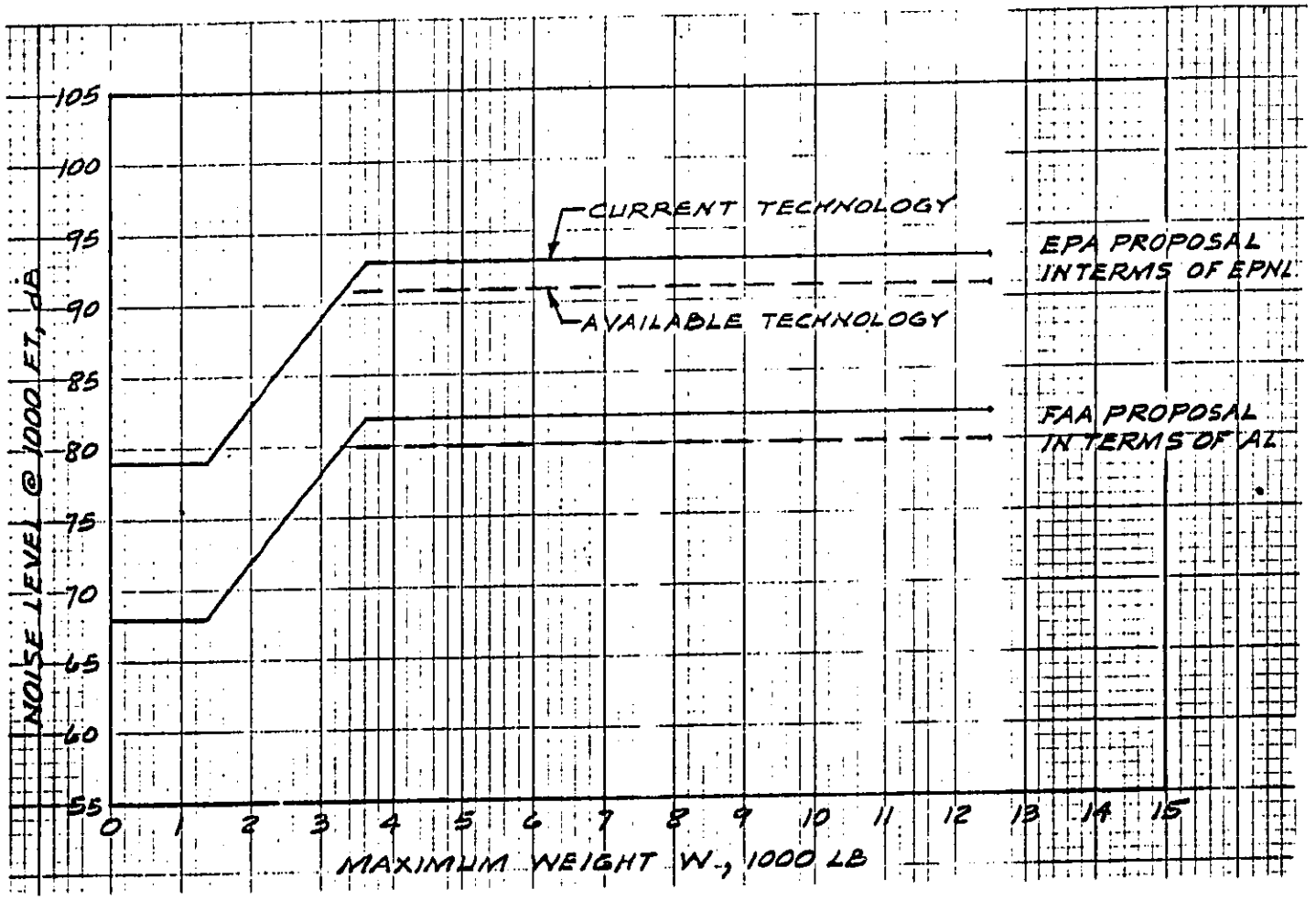

FIGURE 3. NOISE COMPLIANCE LEVELS IN TERMS OF EFFECTIVE PERCEIVED NOISE LEVEL (EPNL) AND A-WEIGHTED LEVEL (AL).

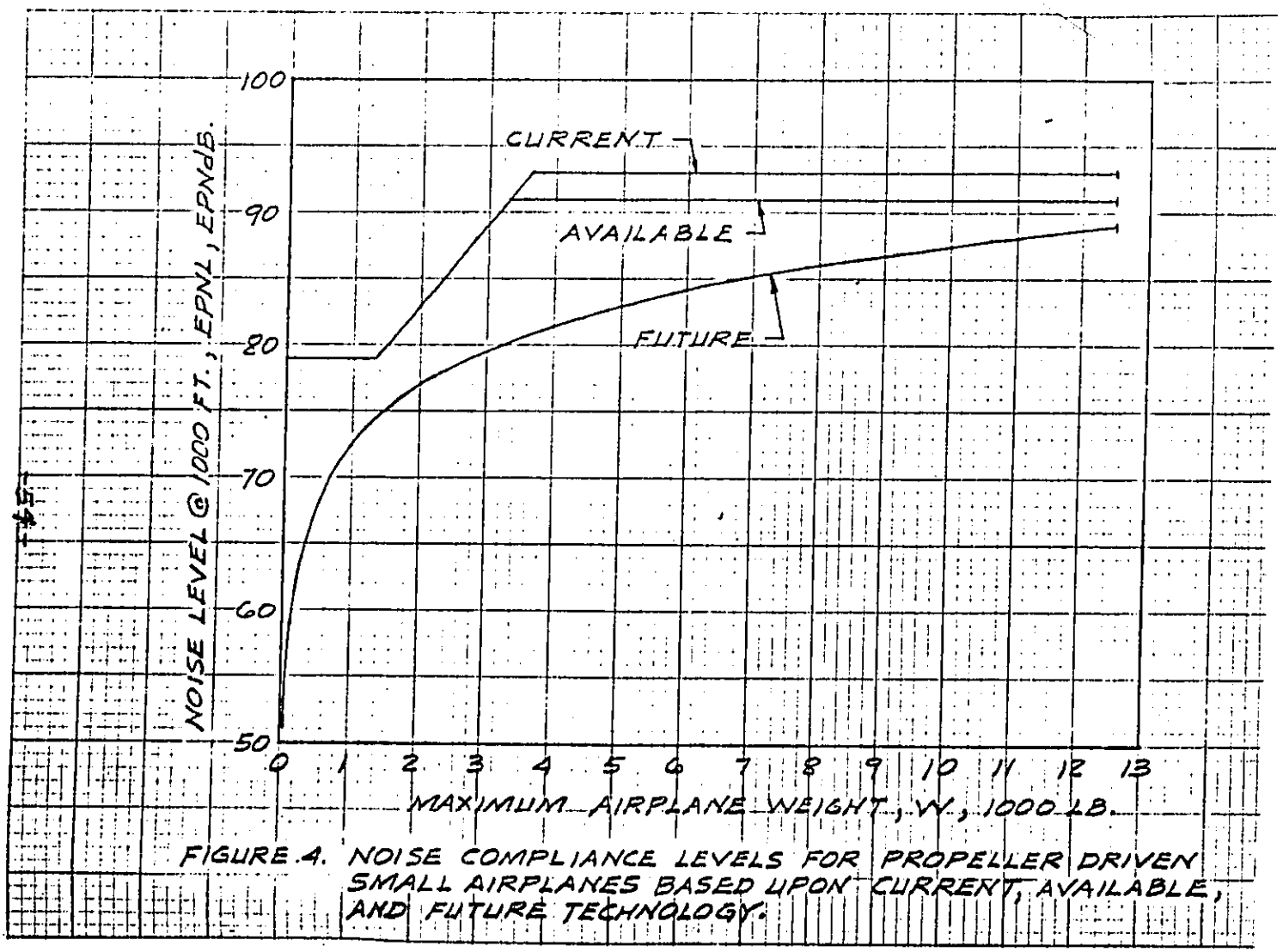

FIGURE 4. NOISE COMPLIANCE LEVELS FOR PROPELLER DRIVEN SMALL AIRPLANES BASED UPON CURRENT, AVAILABLE, AND FUTURE TECHNOLOGY.