Franklin

ALPA NOISE ABATEMENT HANDBOOK

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ALPA NOISE ABATEMENT COMMITTEE

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NOISE ABATEMENT COMMITTEE

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SECTION 1

INTRODUCTION

INTRODUCTION

The advent of turbo jet-powered aircraft has been a stimulant to the commercial airline industry making air travel faster, smoother and easier. This expansion has not come without detractions such as an increase in noise levels at airports around the world. Airport neighbors have protested about this unwanted intruder and over the years some improvement has been accomplished. With the advent of deregulation much of the improvement has vanished and in some cases the impact has worsened. While noise-impacted residents are becoming more vocal and influential, there seems to be little left that can be done by ALPA to substantially lessen the impact. The communities, the airline companies, the airport operators, and the Federal Government, through the FAA and Congress, have all wrestled with this never-ending problem for years. We, as pilots, find ourselves caught in the middle of an on-going dispute. Because of increased pressures from outside forces, communities, companies, FAA and etc., we find that we are being asked to do more and more to alleviate aircraft noise in various ways. It is our desire to be as helpful as possible while at the same time defending steadfastly any compromise in air safety.

ALPA was founded on, and still bases it's actions and beliefs on air safety. It is on this theme that the ALPA Noise Abatement Committee has worked. We believe that aircraft noise reduction should be accomplished by aircraft engineering and design, not by marginally safe and questionably effective flight techniques. We also believe that in most cases any noise relief that can be attained is by "fine tuning" existing procedures, and is probably minimal at best.

The purpose of this handbook is to aquaint the user, be he airline pilot, airport manager, or private, concerned citizen, with the Air Line Pilots Association (ALPA) policies and positions on aircraft noise abatement. These ALPA policies, statements and positions have been developed with long and careful consideration to various factors. These factors include the broad mix of aircraft, engines and pilot qualifications, diverse route structures and segments, differing airport layouts, capabilities and capacities, the constraints of air traffic control and airspace restrictions, varying terrain factors, and finally, the concern for the need for effective, standardized and safe procedures.

Since some of the contents included here are ALPA policy while others may be ALPA positions, directives or technical committee positions, and since these statements and positions may change with time, care must be exercised in the use of such material. As an explanation, the definitions of ALPA policy, position, directives etc. are included in Section 2 and will be so identified in the text. This handbook is intended as a guide in addressing aircraft noise related matters, and is not a hard and fast position. The user should consult with a member of the ALPA Noise Abatement Committee or other appropriate Air Safety personnel when clarification, or further detailed information on any statement or section of this handbook, is wanted or required.

SECTION 2

ALPA POSITIONS, POLICIES, AND DIRECTIVES

NOISE ABATEMENT COMMITTEE

The Committee's purpose is to study and analyze all airline/aircraft related noise abatement problems and procedures; to develop safe and standardized operating procedures taking into account the aircraft performance and the human factors involved; and to correlate all procedures with other ALPA Committees, industry and government to achieve compliance with ALPA safety policies.

The following relates to ALPA Policy, Directives, and Positions of interest to the Committee and the positions the Committee has taken on air safety issues.

ALPA POLICY

1. Airport Curfews

   ALPA opposes the imposition of curfews at airports where air carriers operate because of the detrimental effect such curfews can have on flight safety. (Board 1982) (See ALPA DIRECTIVES)

2. Noise Abatement Policy

   Noise Abatement procedures continue to be proposed throughout the country without regard to safety of operation; therefore, the Association maintains that aircraft noise should be reduced by engineering and design and not by marginally safe flying techniques. ALPA shall refuse to endorse or accept Noise Abatement procedures which require:

   a. Clearances which include a heading change below 600 feet for noise abatement purposes unless terrain or airspace restrictions dictate that a turn at lower altitude would be more prudent. Departure flight paths which do not comply with the engine-out obstacle clearance requirements of the Federal Aviation Regulations must have published emergency procedures for engine failure which meet these obstacle clearance requirements.

b. Reduction of power earlier or to a greater extent than good operating practice would dictate.

c. Climbs at airspeeds less than maneuvering speeds for the existing flap configuration.

d. Use of noise abatement approach procedures when weather is below 1,000' - 3 miles.

e. Approaches to be conducted above glide slope for noise abatement purposes.

f. Communications other than those required for standard traffic separation during takeoff and approach. Pilot judgment will remain as the overriding factor in determining whether or not noise abatement policy will be followed based upon flight conditions incurred.
(Board 1980)

3. Preferential Runway Noise Abatement Policy

Runways must not be designated as "preferential" for noise abatement purposes unless they meet the following minimum safe criteria:

a. Runway surface must be clear and dry.

b. Weather must be basic VFR.

c. Maximum tailwind component must not exceed five knots.

d. Total wind velocity must not exceed fifteen knots.

e. Opposite direction takeoff and landings from single and/or parallel runways (head to head) must be provided a minimum of eight miles horizontal separation.

Should a Captain's authority in such matters be abrogated, he will receive the full support of ALPA in his defense.
(Board 1980)

4. Safety Aspects of Noise Abatement Takeoff and Landing Patterns at Air Carrier Airports

The President will make public proclamation of unsafe procedures, such as in effect at Los Angeles International Airport (LAX), through a vigorous public relations program. He will exercise the full authority of his office to resolve such problems in conformance with the Association's "Noise Abatement" and "Preferential Runway" policies, and through contact with appropriate government agencies bring about implementation of rule making that will resolve existing problems and preclude future

repetition. Further, he shall encourage and solicit the support of other labor and management groups to assist, if necessary, in support of this position.
(Ex. Bd., Nov. 1973; Board 1980)

5. Local Noise Procedures

ALPA supports and encourages federal preemption of local airport control of noise standards and procedures and encourages the FAA to develop and adopt federal standards and procedures for local noise control. (Ex. Bd., Nov. 1977; Board 1980)

6. ALPA Standard Takeoff Procedure

a. Takeoff. Normal takeoff thrust used until reaching V_2f (zero flap speed).

b. Initial Climb. Initial climb attitude following rotation is a predetermined pitch attitude which will produce V_2 + 10 - 20 IAS (each aircraft type will have its V_2 + number calculated by the operator. The two engine types will generally have a higher climb speed).

c. Acceleration. After climbing through 400' but no later than 1000' A.F.L. (unless restricted by obstacles), allow aircraft to accelerate, continuing takeoff thrust until initial flap retract speed is attained. Retract flaps per schedule.

d. Quiet Climb. After airspeed reaches V_2f (zero flap speed) reduce thrust to the pre-computed quiet power (EPR) which is that required for maintenance of certificated engine out climb gradient. Continue climb with this reduced power until clear of noise sensitive areas. 3000-4000' A. F. L. (above field level) is recommended prior to resuming normal climb power.

e. Normal Climb. After passing noise sensitive areas, slowly apply normal climb thrust. Allow the aircraft to accelerate to normal climb speed (approximate rate of climb during acceleration 500 - 1000 FPM). Proceed on normal departure schedule.

NOTES: The ALPA Engineering and Air Safety Department staff will provide, on request, information and data to assist MEC and air safety representatives in developing the required charts that will provide the takeoff information for each aircraft type; i.e., DC-9-10, DC-10, etc. The information will include pitch attitudes, thrust requirements for each segment of the climb, and airspeeds for each segment.

Each MEC Chairman shall immediately seek the cooperation of his individual airline management in implementing the ALPA Takeoff Procedure as an industry-wide standard. Any additional technical information required in this endeavor will be supplied by the ALPA Engineering and Air Safety Department.

(Executive Board, May 1977)

ALPA DIRECTIVES

1. Noise Abatement

ALPA shall initiate the necessary actions to form a coalition initially composed of ALPA, AOCI, and ATA to form a joint strategy toward the goal of a national noise abatement policy, regulations and legislation. (Executive Board, May 1983)

2. Airport Curfews

The President shall take appropriate action to oppose airport curfews. (Board 1982) (See ALPA POLICY)

ALPA POSITIONS - None

COMMITTEE POSITIONS

1. Necessity for Minimum Aircraft Noise Impact on Communities

It is extremely important that pilots cooperate with efforts to reduce the noise impact of airline operations on the communities they serve. Noise has become a significant source of community irritation to the point that a danger exists of curtailment of or limitations on flight operations; therefore, any aid the line pilot can offer would be of benefit. However, each pilot must remember the need to assure that any noise abatement procedure used does not require unsafe operation of the aircraft or create a threat to safety of flight.

2. Available Noise Abatement Techniques

The Committee endorses and encourages community use of Comprehensive Zoning Ordinances and Land Use Plans which minimize aircraft noise impact. Sound proofing of noise-impacted structures is also encouraged. Use of safe, proven, uniform noise abatement flight procedures is encouraged; however, the only procedure which currently meets these criteria is the ALPA Noise Abatement Takeoff Procedure.

3. The Committee strongly opposes the following:

a. Limitations on the use of reverse thrust for noise abatement.

b. Use of two-segment glide slope procedures. This technique eliminates the safety advantage of a stabilized approach, increases vulnerability to wake vortices, and results in higher noise levels at the point of glide slope transition.

c. Curfews. Operating curfews reduce the availability of emergency, divert fields, create the potential for rushing to meet curfew limits and thus deviating from normal operational patterns, and the likelihood of diversions to unfamiliar or unprepared airfields.

SECTION 3

AVIATION SAFETY AND NOISE ABATEMENT ACT OF 1979

AVIATION SAFETY AND NOISE ABATEMENT ACT OF 1979

(P.L. 96-193, 96th Congress, HR 2440, February 5, 1980, effective February 18, 1980)

AN ACT to provide assistance to airport operators to prepare and carry out noise compatibility programs, to provide assistance to assure continued safety in aviation, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That this Act may be cited as the "Aviation Safety and Noise Abatement Act of 1979".

TITLE I

SEC. 101. For purposes of this title —

(1) the term "airport" means any air carrier airport whose projects for airport development are eligible for terminal development costs under section 20(b) of the Airport and Airway Development Act of 1970 (49 U.S.C. 1720(b));

(2) the term "airport operator" means any person holding a valid certificate issued pursuant to section 612 of the Federal Aviation Act of 1958 (49 U.S.C. 1432) to operate an airport; and

(3) the term "Secretary" means the Secretary of Transportation.

SEC. 102. Not later than the last day of the twelfth month which begins after the date of enactment of this Act, the Secretary, after consultation with the Administrator of the Environmental Protection Agency and such other Federal, State, and interstate agencies as he deems appropriate, shall by regulation —

(1) establish a single system of measuring noise, for which there is a highly reliable relationship between projected noise exposure and surveyed reactions of people to noise, to be uniformly applied in measuring the noise at airports and the areas surrounding such airports;

(2) establish a single system for determining the exposure of individuals to noise which results from the operations of an airport and which includes, but is not limited to, noise intensity, duration, frequency, and time of occurrence; and

(3) identify land uses which are normally compatible with various exposures of individuals to noise.

SEC. 103. (a)(1) After the effective date of the regulations promulgated in accordance with section 102 of this title, any airport operator of an airport may submit to the Secretary a noise exposure map, prepared in consultation with any public agencies and planning agencies in the area surrounding such airport, which sets forth, in accordance with the regulations promulgated pursuant to section 102, the noncompatible uses in each area of the map, as of the date of submission of such map, a description of the projected aircraft operations at such airport during 1985, and the ways, if any, in which such operations will affect such map.

(2) If, after the submission to the Secretary of a noise exposure map under paragraph (1), any change in the operation of an airport would create any substantial new noncompatible use in any area surrounding such airport, the operator of such airport shall submit a revised noise exposure map showing such new noncompatible use.

(b)(1) Section 11 of the Airport and Airway Development Act of 1970 (49 U.S.C. 1711) is amended by renumbering paragraphs (6) through (21), and all references thereto, as paragraphs (7) through (22), respectively, and by adding immediately after paragraph (5) the following new paragraph:

"(6) 'Airport noise compatibility planning' means the development for planning purposes of information necessary to prepare and submit (A) the noise exposure map and related information pursuant to section 103 the Aviation Safety and Noise Abatement Act of 197 including any cost associated with obtaining such information, or (B) a noise compatibility program for submission pursuant to section 104 of such Act."

(2)(A) Section 13(a) of the Airport and Airway Development Act of 1970 (49 U.S.C. 1713) is amended by —

(i) inserting "(1)" immediately before the first sentence thereof; and

(ii) adding at the end thereof the following new paragraph:

"(2) In order to promote the development of an effective noise compatibility program, for fiscal years beginning after September 30, 1979, the Secretary may make grants of funds for airport noise compatibility planning to sponsors of those air carrier airports whose projects for airport development are eligible for terminal development costs under section 20(b) of this title."

(B) Section 13(b) of such Act is amended to read as follows:

"(b) AMOUNT AND LIMITATION OF GRANTS. — (1) The award of grants under subsection (a)(1) of this section is subject to the following limitations:

"(A) The total funds obligated for grants under section (a)(1) of this section may not exceed $150,000,000, and the amount obligated in any one fiscal year may not exceed $15,000,000.

"(B) The United States share of any airport master planning grant under this section shall be that per centun

for which a project for airport development at that airport would be eligible under section 17 of this Act. In the case of any airport system planning grant under this section, the United States share shall be 75 percent.

"(C) No more than 10 percent of the funds made available under subsection (a)(1) of this section in any fiscal year may be allocated for projects within a single State, the Commonwealth of Puerto Rico, the Virgin Islands, American Samoa, the Trust Territory of the Pacific Islands, or Guam. Grants for projects encompassing an area located in two or more States shall be charged to each State in the proportion which the number of square miles the project encompasses in each State bears to the square miles encompassed by the entire project.

"(2)(A) The total funds obligated for grants under subsection (a)(2) of this section may not exceed $15,000,000.

"(B) The United States share of any airport noise compatibility planning grant under this section shall be that percent for which a project for airport development at that airport would be eligible under section 17 of this Act.".

SEC. 104. (a) Any airport operator who has submitted a noise exposure map and the related information pursuant to section 103(a)(1) may, after consultation with the officials of any public agencies and planning agencies in the area surrounding such airport, the Federal officials having local responsibility for such airport, and any air carriers using such airport, submit a noise compatibility program to the Secretary. Such program shall set forth the measures which such operator has taken or proposes for the reduction of existing noncompatible uses and the prevention of the introduction of additional noncompatible uses within the area covered by the noise exposure map submitted by such operator. Such measures may include, but are not limited to —

(1) the implementation of any preferential runway system;

(2) the implementation of any restriction on the use of such airport by any type or class of aircraft based on the noise characteristics of such aircraft;

(3) the construction of barriers and acoustical shielding including the soundproofing of public buildings;

(4) the use of flight procedures to control the operation of aircraft to reduce exposure of individuals to noise in the area surrounding the airport; and

(5) acquisition of land and interests therein, including, but not limited to, air rights, easements, and development rights, so as to assure the use of property for purposes which are compatible with airport operations.

(b) The Secretary shall approve or disapprove any program submitted to him pursuant to subsection (a) (other than as such program relates to flight procedures referred to in subsection (a)(4) of this section) within one hundred and eighty days after it is received by him. The Secretary shall approve such program (other than as such program relates to flight procedures referred to in subsection (a)(4) of this section) (A) if the measures to be undertaken in carrying out such program (i) do not create an undue burden on interstate or foreign commerce, and (ii) are reasonably consistent with obtaining the goal of reducing existing noncompatible uses and preventing the introduction of additional noncompatible uses, and (B) if the program provides for its revision made necessary by any revised noise exposure map submitted under section 103(a)(2) of this title. Failure of the Secretary to approve or disapprove such program (other than as such program relates to flight procedures referred to in subsection (a)(4) of this section) within such time period shall be deemed to be an approval of such program. With respect to any part of such program which relates to such flight procedures, the Secretary shall provide such part of such program to the Administrator of the Federal Aviation Administration who shall either approve or disapprove such part of such program.

(c)(1) The Secretary is authorized to incur obligations to make grants under this Act from funds made available under subsection (e) of this section for any project to carry out a noise compatibility program or parts thereof not disapproved under subsection (b) of this section. Grants under this Act may be made to operators of airports submitting noise compatibility programs and to units of local government in the area surrounding such airports if the Secretary determines such units have the capability to carry out projects for which grant applications are made in accordance with such noise compatibility programs. Such airport operator may in turn agree to make the grant available to public agencies in the area surrounding such airports if the Secretary determines such agencies have the capability to carry out projects for which grant applications are made in accordance with such noise compatibility programs. The Federal share of any project for which a grant is made under this subsection shall be 80 percent of the cost of the project. All of the provisions of the Airport and Airway Development Act of 1970 applicable to grants made under the Act (except section 17 of those provisions relating to apportionment) shall be applicable to any grant made under this Act, unless the Secretary determines that any provision of such Act of 1970 is inconsistent with, or unnecessary to carry out, the purposes of this Act.

(2) The Secretary, further, is authorized under this section to make grants to operators of airports and to units of local government referred to in paragraph (1) for any project to carry out a noise compatibility program developed prior to the enactment of this Act or the promulgation of its implementing regulations if the Secretary determines that such prior program is substantially consistent with the purposes of reducing existing uses and preventing the introduction of additional noncompatible uses and that the purposes of this Act would be furthered by prompt implementation of such program.

(d) The United States shall not be liable for damages resulting from aviation noise by reason of any action taken by the Secretary or the Administrator of the Federal Aviation Administration under this section.

(e) The Secretary shall obligate from funds available for expenditure under section 14(a)(3) of the Airport and Airway Development Act of 1970, not less than $25,000,000, for the fiscal year ending September 30, 1980, for making grants under subsection (c) of this section.

SEC. 105. The Secretary, acting through the Administrator of the Federal Aviation Administration, after consultation with the officials of any public agencies or planning agencies in the area surrounding such airport, shall prepare and publish a noise exposure map and a noise compatibility program for the airport established by the Act of June 29, 1940 (54 Stat. 686), and the airport the construction of which was authorized by the Act of September 7, 1950 (64 Stat. 770). Such map and program shall be prepared and published in accordance with the requirements of this Act no later than 1 year after the effective date of the regulations promulgated in accordance with section 102 of this Act.

SEC. 106. No part of any noise exposure map or related information described in section 103(a) submitted to, or prepared by, the Secretary and no part of the list of land uses identified by the Secretary as land uses which are normally compatible with various exposures of individuals to noise shall be admitted as evidence, or used for any other purpose, in any suit or action seeking damages or other relief for the noise that results from the operation of an airport.

SEC. 107. (a) No person who acquires property or an interest therein after the date of enactment of this Act in an area surrounding an airport with respect to which a noise exposure map has been submitted under section 103 of this title shall be entitled to recover damages with respect to the noise attributable to such airport if such person had actual or constructive knowledge of the existence of such noise exposure map unless, in addition to any other elements for recovery of damages, such person can show that —

(1) a significant change in the type or frequency of aircraft operations at the airport; or

(2) a significant change in the airport layout; or

(3) a significant change in the flight patterns; or

(4) a significant increase in nighttime operations;

occurred after the date of the acquisition of such property or interest therein and that the damages for which recovery is sought have resulted from any such change or increase.

(b) For purposes of this section, constructive knowledge shall be imputed, at a minimum, to any person who acquires property or an interest therein in an area surrounding an airport after the date of enactment of this Act if —

(1) prior to the date of such acquisition, notice of the existence of a noise exposure map for such area was published at least three times in a newspaper of general circulation in the county in which such property is located; or

(2) a copy of such noise exposure map is furnished to such person at the time of such acquisition.

SEC. 108. The Secretary shall study (1) airport noise compatibility planning carried out with grants made under section 13 of the Airport and Airway Development Act of 1970, and (2) airport noise compatibility programs carried out with grants made under this title, to determine to what extent such planning and programs are achieving the goals of reducing existing noncompatible uses of land around airports and preventing the introduction of new noncompatible uses around airports. Not later than January 1, 1981, the Secretary shall submit a report to Congress setting forth the determinations made pursuant to such studies together with legislative recommendations, if any, which the Secretary determines necessary.

TITLE II

SEC. 201. (a) Paragraph (3) of subsection (a) of section 14 of the Airport and Airway Development Act of 1970 (49 U.S.C. 1714) is amended by striking out "$525,000,000 for fiscal year 1980," and inserting in lieu thereof "$569,000,000 for fiscal year 1980,".

(b) Paragraph (4) of subsection (a) of section 14 of the Airport and Airway Development Act of 1970 is amended by striking out "$85,000,000 for fiscal year 1980," and inserting in lieu thereof "$98,000,000 for fiscal year 1980,".

(c) The last sentence of paragraph (2) of subsection (b) of section 14 of the Airport and Airway Development Act of 1970 is hereby repealed.

(d) Subsection (e) of section 14 of the Airport and Airway Development Act of 1970 is amended by adding at the end thereof the following new sentence: "If in fiscal year 1980, or in any subsequent fiscal year, the total amount obligated under subsection (c) of this section in such fiscal year is less than the minimum amount made available for obligation under such subsection for such fiscal year, the amount available for obligation or expenditure as determined under the preceding sentence of this subsection shall be reduced by an amount equal to the difference between the amount made available under section (c) for such fiscal year and the total amount obligated under such subsection (c) for such fiscal year."

(e) Subsections (a), (c), and (d) of section 14 of the Airport and Airway Development Act of 1970 are amended by inserting the phrase "or more than" immediately after the words "not less than" each time those words appear therein.

SEC. 202. (a) Paragraph (4) of subsection (a) of section 15 of the Airport and Airway Development Act of 1970 (49 U.S.C. 1715(a)(4)) is amended by striking out "and minus $15,000,000 in the case of each of the fiscal years 1977 through 1980," and inserting in lieu thereof "and minus $15,000,000 in the case of fiscal years 1977 through 1979, and minus $20,000,000 in the case of fiscal year 1980,".

(b) Paragraph (4) of subsection (a) of section 15 of the Airport and Airway Development Act of 1970 is further amended by striking out "and $15,000,000 of the amount made available for each of the other fiscal years" and inserting in lieu thereof "$15,000,000 of the amount made available for each of the fiscal years 1977 through 1979, and $20,000,000 of the amount made available for fiscal year 1980".

SEC. 203. Paragraph (2)(A) of subsection (a) of section 17 of the Airport and Airway Development Act of 1970 (49 U.S.C. 1717) is amended by striking out "1980," and inserting in lieu thereof "shall be 90 per centum of the allowable project costs in the case of projects from funds for fiscal year 1980,".

SEC. 204. Subparagraph (A) of section 208(f)(1) of the Airport and Airway Revenue Act of 1970, as amended (49 U.S.C. 1742(f)(1)(A)) is amended by striking out all after "1976" and inserting in lieu thereof "or of the Aviation Safety and Noise Abatement Act of 1979 (as such Acts were in effect on the date of enactment of the Aviation Safety and Noise Abatement Act of 1979);".

SEC. 205. Subsection (c) of section 16 of the Airport and Airway Development Act of 1970 (49 U.S.C. 1716(c)) is amended by adding at the end thereof the following new paragraph:

"(5) Notwithstanding any other provision of law, the Secretary may approve an application for an airport development project (other than an airport development project to which subsection (d)(1) applies) at an existing airport without requiring the preparation of an environmental impact statement with respect to noise for such project if:

"(A) completion of the project would allow existing aircraft operations at the airport that involve aircraft that do not comply with the noise standards prescribed for 'stage 2' aircraft in 14 CFR 36.1 to be replaced by aircraft operations involving aircraft that do comply with such standards;

"(B) the project complies with all other statutory and administrative requirements imposed under this Act.".

SEC. 206. Part II of the Airport and Airway Development Act of 1970 (49 U.S.C. 1711 et seq.) is amended by adding at the end thereof the following new section:

"SEC. 31. Notwithstanding any other provision of this title, no airport development project involving the construction or extension of any runway may be approved by the Secretary at any general aviation airport located astride a line separating two counties within a single State if, before the submission of such project to the Secretary, such project has not been approved by the governing body of any village incorporated under the laws of that State which is located entirely within five miles of the nearest boundary of such airport.".

TITLE III

DEFINITIONS

SEC. 301. For purposes of this title —

(1) the term "noncomplying aircraft" means any civil subsonic turbojet powered aircraft (A) which (i) has a maximum certificated takeoff weight of 75,000 pounds or more, and (ii) in the case of an aircraft registered in the United States, has a standard airworthiness certificate issued pursuant to section 603(c) of the Federal Aviation Act of 1958 (49 U.S.C. 1423), and (B) which does not comply with the noise standards prescribed for new subsonic aircraft in regulations issued by the Secretary, acting through the Administrator of the Federal Aviation Administration (14 CFR part 36), as such regulations were in effect on January 1, 1977; and

(2) the term "Secretary" means the Secretary of Transportation.

COMPLIANCE FOR INTERNATIONAL CARRIERS

SEC. 302. (a) If, by January 1, 1980, the International Civil Aviation Organization (hereafter referred to as "ICAO") does not reach an agreement (1) which adopts the noise standards prescribed for new subsonic aircraft in regulations issued by the Secretary, acting through the Administrator of the Federal Aviation Administration (14 CFR part 36), as such regulations were in effect on January 1, 1977, or (2) on noise standards and an international schedule for compliance with ICAO Noise Standards (annex 16) which are substantially compatible with the standards set forth in such regulations issued by the Secretary (14 CFR parts 36 and 91), the Secretary, acting through the Administrator, shall commence a rulemaking to require all air carriers and foreign air carriers engaging in foreign air transportation to comply with the noise standards set forth in such regulations (14 CFR parts 36 and 91) or with ICAO Noise Standards (annex 16) which are substantially compatible with the standards set forth in such regulations issued by the Secretary (14 CFR parts 36 and 91) during the 5-year period thereafter, at a phased rate of compliance similar to that in effect for aircraft registered in the United States. The requirement applied to air carriers engaging in foreign air transportation shall not be more stringent than those applied to foreign air carriers. Such rulemaking shall be concluded within 120 days.

(b) If, prior to January 1, 1980, the International Civil Aviation Organization reaches an agreement on noise standards that complies with clause (a)(1) or (a)(2) of this section, the Secretary, acting through the Administrator of the Federal Aviation Administration, shall immediately commence a rulemaking to require all air carriers and foreign air carriers engaging in foreign air transportation to comply with the noise standards set forth in such agreement at a phased rate of compliance similar to that in effect for aircraft registered in the United States. The requirement applied to air carriers engaging in foreign air transportation shall not be more stringent than those applied to foreign air carriers. Such rulemaking shall be concluded within 120 days.

NEW TECHNOLOGY AIRCRAFT INCENTIVE

SEC. 303. (a) The Secretary shall provide an exemption from applicable noise standards to permit the operation of any noncomplying three-engine aircraft, but not beyond January 1, 1985, if (1) the operator of such aircraft has a plan for the replacement of such aircraft which has been approved by the Secretary, and (2) the operator of such aircraft has entered into a binding contract by January 1, 1983, for delivery prior to January 1, 1985, of a replacement aircraft which meets, at a minimum, the noise standards for new type certificated aircraft set forth in regulations issued by the Secretary, acting through the Administrator of the Federal Aviation Administration, on March 2, 1978 (F.R. Vol. 43, p. 8722, et seq.).

(b) The Secretary shall provide an exemption from applicable noise standards to permit the operation of any noncomplying two-engine aircraft, but not beyond January 1, 1986, if (1) the operator of such aircraft has a plan for the replacement of such aircraft which has been approved by the Secretary, and (2) the operator of such aircraft has entered into a binding contract by January 1,

1983, for delivery prior to January 1, 1986, of a replacement aircraft which meets, at a minimum, the noise standards for new type certificated aircraft set forth in regulations issued by the Secretary, acting through the Administrator of the Federal Aviation Administration, on March 2, 1978 (F.R. Vol. 43, p. 8722, et seq.).

SMALL COMMUNITY SERVICE EXEMPTION

SEC. 304. (a) The Secretary shall provide an exemption from applicable noise standards to any person operating a noncomplying two-engine aircraft to permit such person to operate such aircraft.

(b) Any exemption issued pursuant to this section shall terminate on whichever of the following dates first occurs:

(1) in the event such operator sells or otherwise disposes of such aircraft to another person on or after January 1, 1983, on the date such aircraft is delivered to such other person;

(2) in the case of an aircraft with a seating configuration of 100 passenger seats or less, on January 1, 1988; or

(3) in the case of an aircraft with a seating configuration of more than 100 passenger seats, on January 1, 1985.

(c) For the purposes of subsection (b) of this section, the seating configuration of an aircraft shall be the seating configuration that existed on such aircraft on December 1, 1979, or such earlier date as the Secretary may establish in individual cases.

TRADEOFF ALLOWANCE

SEC. 305. Notwithstanding any other provision of law or any rule, regulation, or order issued pursuant thereto, the tradeoff provisions contained in appendix C of part 36 of title 14 of the Code of Federal Regulations shall apply in determining whether any aircraft complies with the provisions of subpart E of part 91 of title 14 of the Code of Federal Regulations.

TITLE IV

SEC. 401. Not later than 90 days after the date of enactment of this Act, and each January 31 thereafter, until implementation of collision avoidance systems in the national air traffic control system, the Secretary of Transportation shall submit to the Congress a report on the status of the development of such systems. Such reports shall set forth proposed timetables for the implementation of such systems. The Secretary of Transportation's report shall include proposals for any legislation needed to implement such systems.

SEC. 402. Section 1112 of the Federal Aviation Act of 1958 is amended to read as follows:

"STATE OR SUBDIVISION INCOME TAX ON COMPENSATION PAID TO INTERSTATE AIR CARRIER EMPLOYEES

"SEC. 1112. (a) No part of the compensation paid by an air carrier to an employee who performs his regularly assigned duties as such an employee on an aircraft in more than one State, shall be subject to the income tax laws of any State or subdivision thereof other than the State or subdivision thereof of such employee's residence and the State or subdivision thereof in which such employee earns more than 50 per centum of the compensation paid by the carrier to such employee.

"(b) For the purposes of subsection (a), an employee shall be deemed to have earned 50 per centum of his compensation in any State or subdivision in which his scheduled flight time in such State or subdivision is more than 50 per centum of his total scheduled flight time in the calendar year while so employed.

"(c) For the purposes of this section the term 'State' also means the District of Columbia and any of the possessions of the United States; and the term 'compensation' shall mean all moneys received for services rendered by the employee in the performance of his duties and shall include wages and salary.".

SEC. 403. That portion of the table of contents contained in the first section of the Federal Aviation Act of 1958 which appears under the heading

"TITLE XI — MISCELLANEOUS" . .

is amended by striking the item designated as "Sec. 1112" and inserting in lieu thereof:

"Sec. 1112. State or subdivision income tax on compensation paid to interstate air carrier employees.".

TITLE V

SEC. 501. (a) The Administrator of the Federal Aviation Administration (hereinafter referred to as the "Administrator") shall, within 90 days after the date of enactment of this Act, promulgate regulations for airports operated by the Administration to regulate access to public areas by individuals or by religious and nonprofit organizations (as defined in section 501(c)(3) of the Internal Revenue Code of 1954) for the purpose of soliciting funds or distributing materials.

(b) In promulgating regulations under this section the Administrator shall consider requiring any individual or organization described in subsection (a) to submit an application for a permit to engage in the soliciting of funds or the distribution of materials. In considering such an application the Administrator may require that —

(1) a responsible individual representative of the applicant shall be designated to represent the organization,

(2) each individual participating in any solicitation or distribution will display a proper identification approved by the Administrator,

(3) the number of individuals engaged in any solicitation or distribution at any one time shall not exceed a reasonable number, in keeping with the need for free movement in and operation of the airports as provided for by the permit,

(4) the solicitation or distribution be confined to limited areas and times, and

(5) no individual or organization which holds a permit under this section shall be permitted to —

(A) use sound amplification or display signs (other than signs approved by the Administrator);

(B) intentionally interfere with users of the airport;

(C) engage in the use of indecent or obscene remarks or conduct; or

(D) engage in the use of loud, threatening, or abusive language intended to coerce, intimidate or disturb the peace.

(c)(1) The Administrator shall consider requiring that a copy of a permit (if such is required) be conspicuously posted in the area in which any solicitation or distribution is permitted.

(2) The Administrator shall consider whether revocation of approval for any permit if required and approved under this section should occur for any violation of any rule or regulation promulgated hereunder.

(d) Regulations intended to be promulgated under this section shall be submitted to Congress within 30 days after the date of enactment of this Act.

SEC. 502. (a) Paragraph (1) of section 902(1) of the Federal Aviation Act of 1958 (49 U.S.C. 1472(l)(1)) is amended to read as follows:

"(1) With respect to any aircraft in, or intended for operation in air transportation or intrastate air transportation, whoever —

"(A) while aboard, or while attempting to board such aircraft has on or about his person or his property a concealed deadly or dangerous weapon which is, or could be, accessible to such person in flight;

"(B) has placed, attempted to place, or attempted to have placed a loaded firearm aboard such aircraft in baggage or other property which is not accessible to passengers in flight; or

"(C) has on or about his person, or who placed, attempted to place, or attempted to have placed aboard such aircraft any bomb or similar explosive or incendiary device;

shall be fined not more than $1,000 or imprisoned not more than one year, or both.".

(b) Paragraph (3) of section 902(l) of the Federal Aviation Act of 1958 is amended —

(1) by striking out "This subsection" and by inserting in lieu thereof "Paragraph (1)(A) of this subsection";

(2) by inserting "officers or employees of" before "the Federal Government"; and

(3) by inserting "(other than loaded firearms)" after "persons transporting weapons".

(c) Section 902(l) of the Federal Aviation Act of 1958 is amended by adding at the end thereof the following new paragraph:

"(4) For purposes of this subsection —

"(A) the term 'firearm' means any starter gun and any weapon which is designed to or has been converted to expel any projectile by the action of an explosive; and

"(B) the term 'loaded firearm' means any firearm which has a cartridge, a detonator, or powder in the chamber, magazine, cylinder, or clip of such firearm.".

SEC. 503. (a) Except as provided in subsection (c), notwithstanding any other provision of law, neither the Secretary of Transportation, the Civil Aeronautics Board, nor any other officer or employee of the United States shall issue, reissue, amend, revise, or otherwise modify (either by action or inaction) any certificate or other authority to permit or otherwise authorize any person to provide the transportation of individuals, by air, as a common carrier for compensation or hire between Love Field, Texas, and one or more points outside the State of Texas, except (1) charter air transportation not to exceed ten flights per month, and (2) air transportation provided by commuter airlines operating aircraft with a passenger capacity of 56 passengers or less.

(b) Except as provided in subsections (a) and (c), notwithstanding any other provision of law, or any certificate or other authority heretofore or hereafter issued thereunder, no person shall provide or offer to provide the transportation of individuals, by air, for compensation or hire as a common carrier between Love Field, Texas, and one or more points outside the State of Texas, except that a person providing service to a point outside of Texas from Love Field on November 1, 1979, may continue to provide service to such a point.

(c) Subsections (a) and (b) shall not apply with respect to, and it is found consistent with the public convenience and necessity to authorize, transportation of individuals, by air, on a flight between Love Field, Texas, and one or more points within the States of Louisiana, Arkansas, Oklahoma, New Mexico, and Texas by an air carrier, if (1) such air carrier does not offer or provide any through service or ticketing with another air carrier or foreign air carrier, and (2) such air carrier does not offer for sale transportation to or from, and the flight or aircraft does not serve, any point which is outside any such State. Nothing in this subsection shall be construed to give authority not otherwise provided by law to the Secretary of Transportation, the Civil Aeronautics Board, any other officer or employee of the United States, or any other person.

(d) This section shall not take effect if enacted after the enactment of the International Air Transportation Competition Act of 1979.

Approved February 15, 1980.

SECTION 3A

PART 36

[Amdt. 36-9, 45 FR 60182, Sept. 11, 1980]

PART 36—NOISE STANDARDS: AIRCRAFT TYPE AND AIRWORTHINESS CERTIFICATION

SPECIAL FEDERAL AVIATION REGULATION

SFAR No. 41 [Note]

Subpart A—General

AUTHORITY: Secs. 313(a), 601, 603, and 611; 49 U.S.C. 1354, 1421, 1423, and 1431; sec. 6(c) (49 U.S.C. 1655(c)), unless otherwise noted.

SOURCE: Docket No. 9237, 34 FR 18364, Nov. 18, 1969, unless otherwise noted.

SPECIAL FEDERAL AVIATION REGULATION

SFAR No. 41

NOTE: For the text of SFAR No. 41 see Part 21 of this chapter.

Subpart A—General

§ 36.1 Applicability and definitions.

(a) This part prescribes noise standards for the issue of the following certificates:

(1) Type certificates, and changes to those certificates, and standard airworthiness certificates, for subsonic transport category large airplanes, and for subsonic turbojet powered airplanes regardless of category.

(2) Type certificates and changes to those certificates, standard airworthiness certificates, and restricted category airworthiness certificates, for propeller-driven, small airplanes, except those airplanes that are designed for "agricultural aircraft operations" (as defined in § 137.3 of this chapter, as effective on January 1, 1966) or for dispersing fire fighting materials to which § 36.1583 of this part does not apply.

(3) A type certificate and changes to that certificate, and standard airworthiness certificates, for Concorde airplanes.

(b) Each person who applies under Part 21 of this chapter for a type of airworthiness certificate specified in this part must show compliance with the applicable requirements of this part, in addition to the applicable airworthiness requirements of this chapter.

(c) Each person who applies under Part 21 of this chapter for approval of an acoustical change described in § 21.93(b) of this chapter must show that the airplane complies with the applicable provisions of § 36.7 or § 36.9 of this part in addition to the applicable airworthiness requirements of this chapter.

(d) Each person who applies for the original issue of a standard airworthiness certificate for a transport category large airplane or for a turbojet powered airplane under § 21.183 must, regardless of date of application, show compliance with the following provisions of this part (including Appendix C):

(1) The provisions of this part in effect on December 1, 1969, for subsonic airplanes that have not had any flight time before—

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

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

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

(2) The provisions of this part in effect on October 13, 1977, including the stage 2 noise limits, for Concorde airplanes that have not had flight time before January 1, 1980.

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

(e) Each person who applies for the original issue of a standard airworthiness certificate under § 21.183, or for the original issue of a restricted category airworthiness certificate under § 21.185, for a propeller driven small airplane that has not had any flight time before January 1, 1980, must show compliance with the applicable provisions of this part.

(f) For the purpose of showing compliance with this part for transport category large airplanes and turbojet powered airplanes regardless of category, the following terms have the following meanings:

(1) A "Stage 1 noise level" means a takeoff, sideline or approach noise level greater than the Stage 2 noise limits prescribed in section C36.5(a)(2) of Appendix C of this part.

(2) A "Stage 1 airplane" means an airplane that has not been shown under this part to comply with the takeoff, sideline, and approach noise levels required for Stage 2 or Stage 3 airplanes.

(3) A "Stage 2 noise level" means a noise level at or below the Stage 2 noise limits prescribed in section C36.5(a)(2) of Appendix C of this part but higher than the Stage 3 noise limits prescribed in section C36.5(a)(3) of Appendix C of this part.

(4) A "Stage 2 airplane" means an airplane that has been shown under this part to comply with Stage 2 noise levels prescribed in section C36.5 of Appendix C of this part (including use of the applicable tradeoff provisions) and that does not comply with the requirements for a Stage 3 airplane.

(5) A "Stage 3 noise level" means a noise level at or below the Stage 3 noise limits prescribed in section C36.5(a)(3) of Appendix C of this part.

(6) A "Stage 3 airplane" means an airplane that has been shown under this part to comply with Stage 3 noise levels prescribed in section C36.5 of Appendix C of this part (including use of the applicable tradeoff provisions).

(7) A "subsonic airplane" means an airplane for which the maximum operating limit speed, M_{mo}, does not exceed a Mach number of 1.

(8) A "supersonic airplane" means an airplane for which the maximum operating limit speed, M_{mo}, exceeds a Mach number of 1.

(Title I of the National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.); and EO 11514, Mar. 5, 1970; secs. 307, 313(a), 601(a), 603, 611, Federal Aviation Act of 1958, as amended (49 U.S.C. 1348, 1354(a), 1421(a), 1423, and 1431); sec. 6(c), Dept. of Transportation Act (49 U.S.C. 1655(c)))

[Doc. No. 13213, Amdt. 36-4, 40 FR 1034, Jan. 6, 1975 as amended by Amdt. 36-7, 42 FR 12370, Mar. 3, 1977; Amdt. 36-10, 43 FR 28410, June 29, 1978; Amdt. 36-11, 45 FR 67068, Oct. 9, 1980]

§ 36.2 Special retroactive requirements.

(a) Notwithstanding § 21.17 of this chapter, and irrespective of the date of application, each person who applies for a type certificate for an airplane covered by this part must show compliance with the applicable provisions of this part.

(b) Notwithstanding § 21.101(a) of this chapter, each person who applies for an acoustical change to a type design specified in § 21.93(b) of this chapter must show compliance with the applicable provisions of this part.

(Secs. 307, 313(a), 601(a), 603, 611, Federal Aviation Act of 1958, as amended (49 U.S.C. 1348, 1354(a), 1421(a), 1423, and 1431); sec. 6(c), Dept. of Transportation Act (49 U.S.C. 1655(c)); Title I, National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.); EO 11514, Mar. 5, 1970)

[Doc. No. 9237, 34 FR 18364, Nov. 18, 1969 and Amdt. 36-10, 43 FR 28430, June 29, 1978]

§ 36.3 Compatibility with airworthiness requirements.

It must be shown that the airplane meets the airworthiness regulations constituting the type certification basis of the airplane under all conditions in which compliance with this part is shown, and that all procedures used in complying with this part, and all procedures and information for the flight crew developed under this part, are consistent with the airworthiness

regulations constituting the type certification basis of the airplane.

§ 36.5 Limitation of part.

Pursuant to 49 U.S.C. 1431(b)(4), the noise levels in this part have been determined to be as low as is economically reasonable, technologically practicable, and appropriate to the type of aircraft to which they apply. No determination is made, under this part, that these noise levels are or should be acceptable or unacceptable for operation at, into, or out of, any airport.

§ 36.6 Incorporations by reference.

(a) *General.* This part prescribes certain standards and procedures which are not set forth in full text in the rule. Those standards and procedures are contained in published material which is reasonably available to the class of persons affected and has been approved for incorporation by reference by the Director of the Federal Register under 5 U.S.C. 552 (a) and 1 CFR Part 51.

(b) *Incorporated matter.* (1) Each publication, or part of a publication, which is referenced but not set forth in full text in this part and which is identified in paragraph (c) of this section is hereby incorporated by reference and made a part of Part 36 of this chapter with the approval of the Director of the FEDERAL REGISTER.

(2) Incorporated matter which is subject to subsequent change is incorporated by reference according to the specific reference and to the identification statement. Adoption of any subsequent change in incorporated matter is made under Part 11 of this chapter and 1 CFR Part 51.

(c) *Identification statement.* The complete title or description which identifies each published matter incorporated by reference in this part is as follows:

(1) *International Electrotechnical Commission (IEC) Publications.* (i) IEC Publication No. 179, entitled "Precision Sound Level Meters," dated 1973.

(ii) IEC Publication No. 225, entitled "Octave, Half-Octave, Third Octave Band Filters Intended for the Analysis of Sounds and Vibrations," dated 1966.

(2) *Society of Automotive Engineers (SAE) Publications.* (i) SAE ARP 866A, entitled "Standard Values at Atmospheric Absorption as a Function of Temperature and Humidity for Use in Evaluating Aircraft Flyover Noise," dated March 15, 1975.

(d) *Availability for purchase.* Published material incorporated by reference in this part may be purchased at the price established by the publisher or distributor at the following mailing addresses:

(1) *IEC publications.* (i) The Bureau Central de la Commission Electrotechnique, Internationale, 1, rue de Varembe, Geneva, Switzerland.

(ii) American National Standard Institute, 1430 Broadway, New York City, New York 10018.

(2) *SAE publications.* Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrentown, Pennsylvania 15096.

(e) *Availability for inspection.* A copy of each publication incorporated by reference in this part is available for public inspection at the following locations:

(1) *FAA Office of the Chief Counsel, Rules Docket,* Room 916, Federal Aviation Administration Headquarters Building, 800 Independence Avenue, SW., Washington, D.C.

(2) Department of Transportation, Branch Library, Room 930, Federal Aviation Administration Headquarters Building, 800 Independence Avenue, SW., Washington, D.C.

(3) The respective Regional Offices of the Federal Aviation Administration as follows:

(i) New England Regional Office, 12 New England Executive Park, Burlington, Massachusetts.

(ii) Eastern Regional Office, Federal Building, John F. Kennedy (JFK) International Airport, Jamaica, New York.

(iii) Southern Regional Office, 3400 Whipple Street, East Point, Georgia.

(iv) Great Lakes Regional Office, 2300 East Devon, Des Plaines, Illinois.

(v) Central Regional Office, 601 East Twelfth Street, Kansas City, Missouri.

(vi) Southwest Regional Office, 4400 Blue Mound Road, Fort Worth, Texas.

(vii) Rocky Mountain Regional Office, 10255 East 25th Avenue, Aurora, Colorado.

(viii) Northwest Regional Office, FAA Building, 9010 East Marginal Way South, King County International Airport (Boeing Field), Seattle, Washington.

(ix) Western Regional Office, 15000 Aviation Boulevard, Hawthorne, California.

(x) Alaskan Regional Office, 632 Sixth Avenue, Anchorage, Alaska.

(xi) Pacific-Asia Regional Office, 1833 Kalakaua Avenue, Honolulu, Hawaii.

(xii) European Regional Office, Tour Madou Building, 1, Place Madou, 1020 Brussels, Belgium.

(4) The Office of the Federal Register, Room 8401, 1100 "L" Street, N.W., Washington, D.C.

(Secs. 307, 313(a), 601(a), 603, 611, Federal Aviation Act of 1958, as amended (49 U.S.C. 1248, 1354(a), 1421(a), 1423, and 1431); sec. 6(c), Dept. of Transportation Act (49 U.S.C. 1655(c)); Title I, National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.); EO 11514, Mar. 5, 1970)

[Amdt. 36-9, 43 FR 8739, Mar. 3, 1978]

§ 36.7 Acoustical change: Transport category large airplanes and turbojet powered airplanes.

(a) *Applicability.* This section applies to all transport category large airplanes and turbojet powered airplanes for which an acoustical change approval is applied for under § 21.93(b) of this chapter.

(b) *General requirements.* Except as otherwise specifically provided, for each airplane covered by this section, the acoustical change approval requirements are as follows:

(1) In showing compliance, noise levels must be measured and evaluated in accordance with the applicable procedures and conditions prescribed in Appendices A and B of this part.

(2) Compliance with the noise limits prescribed in section C36.5 of Appendix C must be shown in accordance with the applicable provisions of sections C36.7 and C36.9 of Appendix C of this part.

(c) *Stage 1 airplanes.* For each Stage 1 airplane prior to the change in type design, in addition to the provisions of paragraph (b) of this section, the following apply:

(1) If an airplane is a Stage 1 airplane prior to the change in type design, it may not, after the change in type design, exceed the noise levels created prior to the change in type design. The tradeoff provisions of section C36.5(b) of Appendix C of this part may not be used to increase the Stage 1 noise levels.

(2) In addition, for an airplane for which application is made after September 17, 1971—

(i) There may be no reduction in power or thrust below the highest airworthiness approved power or thrust, during the tests conducted before and after the change in type design; and

(ii) During the takeoff and sideline noise tests conducted before the change in type design, the quietest airworthiness approved configuration available for the highest approved takeoff weight must be used.

(d) *Stage 2 airplanes.* If an airplane is a Stage 2 airplane prior to the change in type design, in addition to the provisions of paragraph (b) of this section, the following apply:

(1) *Applications before November 5, 1975.* For an airplane for which an application for acoustical change approval is made before November 5, 1975, the airplane may not be a Stage 1 airplane after the change in type design.

(2) *Applications on or after November 5, 1975, and before October 28, 1976.* For an airplane for which an application for acoustical change approval is made on or after November 5, 1975, and before October 28, 1976—

(i) The airplane may not be a Stage 1 airplane after the change in type design; and

(ii) During the takeoff and sideline noise tests conducted before the change in type design, the quietest airworthiness approved configuration available for the highest approved takeoff weight must be used.

(3) *Applications on or after October 28, 1976.* For an airplane for which an application for acoustical change approval is made on or after October 28, 1976, the following apply:

(i) *Airplanes with high bypass ratio turbofan engines.* For an airplane that has turbojet engines with a bypass ratio of 2 or more before a change in type design—

(A) The airplane after the change in type design may not exceed either (1) the Stage 3 noise limit by more than 3 EPNdB, or (2) the Stage 2 noise limit, whichever is lower;

(B) The tradeoff provisions of section C36.5(b) of Appendix C of this part may be used in determining compliance under this paragraph with re-

spect to the Stage 2 noise limit or to the Stage 3 plus 3 EPNdB noise limits, as applicable; and

(C) During the takeoff and sideline noise test conducted before the change in type design, the quietest airworthiness approved configuration available for the highest approved takeoff weight must be used.

(ii) *Airplanes that do not have high bypass ratio turbojet engines.* For an airplane that does not have turbojet engines with a bypass ratio of 2 or more before a change in type design, compliance must be shown under the requirements of paragraphs (d)(2) (i) and (ii) of this section.

(e) *Stage 3 airplanes.* If an airplane is a Stage 3 airplane prior to the change in type design, in addition to the provisions of paragraph (b) of this section, the following apply:

(1) *Applications before May 5, 1976.* For an airplane for which an application for acoustical change approval is made before May 5, 1976, the airplane may not be a Stage 1 airplane after the change in the type design.

(2) *Applications on or after May 5, 1976.* For an airplane for which an application for acoustical change approval is made on or after May 5, 1976, the following apply:

(i) If compliance with Stage 3 noise levels is not required before the change in type design, the airplane must—

(A) Be a Stage 2 airplane after the change in type design and compliance must be shown under the provisions of paragraph (d)(3) (i) or (ii) of this section, as appropriate; and

(B) Remain a Stage 3 airplane after the change in type design and compliance must be shown under the provisions of paragraph (e)(2)(ii) of this section.

(ii) If compliance with Stage 3 noise levels is required before the change in type design, the airplane must be a Stage 3 airplane after the change in type design.

(Secs. 307, 313(a), 601(a), 603, 611, Federal Aviation Act of 1958, as amended (49 U.S.C. 1348, 1354(a), 1421(a), 1423, and 1431); sec. 6(c), Dept. of Transportation Act (49 U.S.C. 1655(c)); Title I, National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.); EO 11514, Mar. 5, 1970)

(Amdt. 36-7, 42 FR 12371, Mar. 3, 1977; Amdt. 36-8, 43 FR 8730, Mar. 2, 1978; Amdt. 36-10, 43 FR 28420, June 29, 1978; Amdt. 36-12, 46 FR 33404, June 29, 1981)

§ 36.9 Acoustical change: Propeller-driven small airplanes.

For propeller driven small airplanes in the normal, utility, acrobatic, transport, and restricted categories for which an acoustical change approval is applied for under § 21.93(b) of this chapter after January 1, 1975, the following apply:

(a) If the airplane was type certificated under Appendix F of this part prior to the change in type design, it may not, after the change in type design, exceed the noise limit that was applied to that approval.

(b) If the airplane was not type certificated under Appendix F but can achieve the noise limits prescribed in section F36.301(b) of that appendix prior to the change in type design, it may not exceed those limits, measured and corrected as prescribed in Appendix F, after the change in type design.

(c) If the airplane cannot achieve the noise limits prescribed in section F36.301(b) of Appendix F prior to the change in type design, it may not, after the change in type design, exceed the noise levels created prior to the change in type design, measured and corrected as prescribed in Appendix F.

(Secs. 313(a), 601, 603, and 611, 49 U.S.C. 1354(a), 1421, 1423, and 1431; sec. 6(c), 49 U.S.C. 1655(c); Title I of the National Environmental Policy Act of 1969 (U.S.C. 4321 et seq.); and EO 11514, Mar. 5, 1970)

(Doc. No. 13243, Amdt. 36-4, 40 FR 1034, Jan. 6, 1975. 40 FR 2707, Jan. 6, 1975. Redesignated by Amdt. 36-7, 42 FR 12371, Mar. 3, 1977)

Subpart B—Noise Measurement and Evaluation for Transport Category Large Airplanes and Turbojet Powered Airplanes

§ 36.101 Noise measurement.

For transport category large airplanes and turbojet powered airplanes the noise generated by the airplane must be measured under Appendix A of this part or under an approved equivalent procedure.

(Secs. 307, 313(a), 601(a), 603, 611, Federal Aviation Act of 1958, as amended (49 U.S.C. 1348, 1354(a), 1421(a), 1423, and 1431); sec. 6(c), Dept. of Transportation Act (49 U.S.C. 1655(c); Title I, National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.); EO 11514, Mar. 5, 1970)

(Doc. No. 9337, 34 FR 18364, Nov. 18, 1969, as amended by Amdt. 36-10, 43 FR 28420, June 29, 1978)

§ 36.103 Noise evaluation.

For transport category large airplanes and turbojet powered airplanes noise measurement information obtained under § 36.101 must be evaluated under Appendix B of this part or under an approved equivalent procedure.

(Secs. 307; 313(a), 601(a), 603, 611, Federal Aviation Act of 1958, as amended (49 U.S.C. 1348, 1354(a), 1421(a), 1423, and 1431); sec. 6(c), Dept. of Transportation Act (49 U.S.C. 1655(c)); Title I, National Environmental Policy Act of 1969 (42 U.S.C. et seq.); EO 11514, Mar. 5, 1970)

(Doc. No. 9337, 34 FR 18364, Nov. 18, 1969, as amended by Amdt. 36-10, 43 FR 28420, June 29, 1978)

Subpart C—Noise Limits for Subsonic Transport Category Large Airplanes and Subsonic Turbojet Powered Airplanes

§ 36.201 Noise limits.

(a) For Subsonic transport category large airplanes and subsonic turbojet powered airplanes compliance with this section must be shown with noise levels measured and evaluated as prescribed in Subpart B of this part, and demonstrated at the measuring points, and in accordance with the flight test conditions under sections C36.7 and C36.9 (or an approved equivalent procedure), prescribed under Appendix C of this part.

(b) *Airplanes with high bypass ratio turbojet engines.* For airplanes that have turbojet engines with bypass ratios of 2 or more, the noise limit requirements are as follows:

(1) *Applications before January 1, 1967.* If application is made before January 1, 1967, it must be shown that the noise levels of the airplane are no greater than the Stage 2 noise limits prescribed in section C36.5(a)(2) of Appendix C of this part, or are reduced to the lowest levels that are economically reasonable, technologically practicable, and appropriate to the particular type design.

(2) *Applications on or after January 1, 1967, and before November 5, 1975.* If application is made on or after January 1, 1967, and before November 5, 1975, it must be shown that the noise levels of the airplane are no greater than the Stage 2 noise limits prescribed in section C36.5(a)(2) of Appendix C of this part.

(3) *Applications on or after November 5, 1975.* If application is made on or after November 5, 1975, it must be shown that the noise levels of the airplanes are no greater than the Stage 3 noise limits prescribed in section C36.5(a)(3) of Appendix C of this part.

(c) *Airplanes that do not have high bypass ratio turbojet engines.* For airplanes that do not have turbojet engines with a bypass ratio of 2 or more, the noise limit requirements are as follows:

(1) *Applications before December 1, 1969.* If application is made before December 1, 1969, it must be shown that the lowest noise levels, reasonably obtainable through the use of procedures and information developed for the flight crew under § 36.1501, are determined;

(2) *Applications on or after December 1, 1969, and before November 5, 1975.* If application is made on or after December 1, 1969, and before November 5, 1975, it must be shown that the noise levels of the airplane are no greater than the Stage 2 noise limits prescribed in section C36.5(a)(2) of Appendix C of this part.

(3) *Applications after November 5, 1975.* If application is made on or after November 5, 1975, it must be shown that the noise levels of the airplane are no greater than the Stage 3 noise limits prescribed in section C36.5(a)(3) of Appendix C of this part.

(d) For aircraft to which paragraph (b)(1) of this section applies and that do not meet Appendix C of this part, a time period will be placed on the type certificate. The type certificate will specify that, upon [illegible] expiration of

this time period, the type certificate will be subject to suspension or modification under section 611 of the Federal Aviation Act of 1958 (49 U.S.C. 1431) unless the type design of aircraft produced under that type certificate on and after the expiration date is modified to show compliance with Appendix C. With respect to any possible suspensions or modifications under this paragraph, the certificate holder shall have the same notice and appeal rights as are contained in section 609 of the Federal Aviation Act of 1958 (49 U.S.C. 1429).

(Secs. 307, 313(a), 601, 603, and 611, 49 U.S.C. 1348, 1354(a), 1421, 1423, and 1431; sec. 6(c), 49 U.S.C. 1655(c); Title I of the National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.); and EO 11514, Mar. 5, 1970)

[Doc. No. 9237, 34 FR 18364, Nov. 18, 1969, as amended by Amdt. 36-7, 42 FR 12271, Mar. 3, 1977; Amdt. 36-8, 43 FR 8730, Mar. 2, 1978; Amdt. 36-10, 43 FR 28420, June 29, 1978; Amdt. 36-12, 46 FR 33464, June 29, 1981]

Subpart D—Noise Limits for Supersonic Transport Category Airplanes

§ 36.301 Noise limits: Concorde.

(a) *General.* For the Concorde airplane, compliance with this subpart must be shown with noise levels measured and evaluated as prescribed in Subpart B of this part, and demonstrated at the measuring points prescribed in Appendix C of this part.

(b) *Noise limits.* It must be shown, in accordance with the provisions of this part in effect on October 13, 1977, that the noise levels of the airplane are reduced to the lowest levels that are economically reasonable, technologically practicable, and appropriate for the Concorde type design.

(Secs. 307, 313(a), 601(a), 603, 611, Federal Aviation Act of 1958, as amended (49 U.S.C. 1348, 1354(a), 1421(a), 1423, and 1431); sec. 6(c) of the Dept. of Transportation Act (49 U.S.C. 1655(c)); Title I, National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.); EO 11514, Mar. 5, 1970)

[Amdt. 36-10, 43 FR 28420, June 29, 1978]

Subpart E—[Reserved]

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, 1972; and

(2) Propeller driven small airplanes for which application is made for the original issuance of a standard airworthiness certificate or restricted category airworthiness certificate, and that have not had any flight time before January 1, 1980 (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.

(Title I of the National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.); and EO 11514, Mar. 5, 1970)

[Doc. No. 13243, 40 FR 1034, Jan. 6, 1975]

Subpart G—Operating Limitations and Information

§ 36.1501 Procedures and other information.

All procedures, and other information for the flight crew, that are employed for obtaining the noise reductions prescribed in this part must be developed. This must include noise levels achieved during type certification.

(Title I of the National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.); and EO 11514, Mar. 5, 1970)

[Doc. No. 13243, 40 FR 1035, Jan. 6, 1975]

§ 36.1581 Manuals, markings, and placards.

(a) If an Airplane Flight Manual is approved, the approved portion of the Airplane Flight Manual must contain procedures and other information, and as applicable under § 36.1503 of this part. If an Airplane Flight Manual is not approved, the procedures and information must be furnished in any combination of approved manual material, markings, and placards.

(b) The following statement must be furnished near the listed noise levels:

No determination has been made by the Federal Aviation Administration that the noise levels of this airplane are or should be acceptable or unacceptable for operation at, into, or out of, any airport.

(c) For transport category large airplanes and turbojet powered airplanes, for which the weight used in meeting the takeoff or landing noise requirements of this Part is less than the maximum weight or design landing weight, respectively, established under the applicable airworthiness requirements, those lesser weights must be furnished, as operating limitations, in the operating limitations section of the Airplane Flight Manual.

(d) For propeller driven small airplanes for which the weight used in meeting the flyover noise requirements of this Part is less than the maximum weight by an amount exceeding the amount of fuel needed to conduct the test, that lesser weight must be furnished, as an operating limitation, in the operating limitations section of an approved Airplane Flight Manual, in approved manual material, or on an approved placard.

(e) Except as provided in paragraphs (c) and (d) of this section, no operating limitations are furnished under this part.

(Secs. 307, 313(a), 601(a), 603, 611, Federal Aviation Act of 1958, as amended (49 U.S.C. 1348, 1354(a), 1421(a), 1423, and 1431); sec. 6(c), Dept. of Transportation Act (49 U.S.C. 1655(c)); Title I, National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.); EO 11514, Mar. 5, 1970)

[Doc. 13243, 40 FR 1035, Jan. 6, 1975 as amended by Amdt. 36-10, 43 FR 28420, June 29, 1978; Amdt. 36-11, 46 FR 57866, Oct. 9, 1980]

§ 36.1583 Noncomplying agricultural and fire fighting airplanes.

(a) This section applies to propeller driven, small airplanes that—

(1) Are designed for "agricultural aircraft operations" as defined in § 137.3 of this chapter, effective January 1, 1966) or for dispensing fire fighting materials; and

(2) Have not been shown to comply with the noise levels prescribed in Appendix F of this part—

(i) For which application is made for the original issue of a standard airworthiness certificate and that do not have any flight time before January 1, 1980; or

(ii) For which application is made for an acoustical change approval, for airplanes which have a standard airworthiness certificate after the change in the type design, and that do not have any flight time in the change configuration before January 1, 1980.

(b) For airplanes covered by this section an operating limitation reading as follows must be furnished in the manner prescribed in § 36.1581:

Noise abatement: This airplane has not been shown to comply with the noise limits in FAR Part 36 and must be operated in accordance with the noise operating limitations prescribed under FAR § 91.58.

[Amdt. 36-11, 45 FR 57866, Oct. 9, 1980]

Appendix A—Aircraft Noise Measurement Under § 36.101

Sec.

A36.1 *Noise certification test and measurement conditions.*
A36.3 *Measurement of aircraft noise received on the ground.*
A36.5 *Reporting and correcting measured data.*
A36.7 *Symbols and units.*
A36.9 *Atmospheric attenuation of sound.*
A36.11 *Detailed correction procedures.*

Section A36.1 *Noise certification test and measurement conditions.*

(a) *General.* This section prescribes the conditions under which aircraft noise certification tests must be conducted and the measurement procedures that must be used to measure aircraft noise during each test conducted on or after April 3, 1978.

(b) *Test site requirements.* (1) Tests to show compliance with established aircraft noise certification levels must consist of a

series of takeoffs and approaches during which measurements must be taken at noise measuring stations located at the measuring points prescribed in section C36.3 of Appendix C of this part.

(2) During each test takeoff, simultaneous measurements should be made at the sideline noise measuring stations on each side of the runway and also at the takeoff noise measuring station. However, if test site conditions make it impractical to simultaneously measure takeoff and sideline noise, and if each of the other sideline measurement requirements is met, independent measurements may be made of the sideline noise under simulated flight path techniques. If the reference flight path includes a power cutback before the maximum possible sideline noise level is developed, the reduced sideline noise level which is the maximum value developed by the simulated flight path technique must be the certificated sideline noise value.

(3) If the height of the ground at a noise measuring station differs from that of the nearest point on the runway by more than 20 feet, corrections must be made as prescribed in section A36.5(d) of this appendix.

(4) The location of each noise measuring station must be surrounded by relatively flat terrain having no excessive sound absorption characteristics, such as might be caused by thick, matted, or tall grass, shrubs, or wooded areas.

(5) An airport tower, or other facility, used to obtain required measurements of meteorological conditions at the test site must be approved in accordance with section A36.9(b)(1) of this appendix.

(6) During the period when the flyover noise/time record indicates the noise measurement is within 10 dB of PNLTM, no obstruction that significantly influences the sound field from the aircraft may exist—

(i) For a takeoff, approach, or sideline measuring station, within a conical space above the measuring position (the point on the ground vertically below the microphone), the cone being defined by an axis normal to the ground and by a half-angle 80 degrees from this axis; and

(ii) For a sideline noise measuring station, above the line of sight between the microphone and the aircraft.

(7) A minimum of four sideline noise measuring stations must be used to define the maximum sideline noise with respect to location and level as required by section C36.3 of Appendix C of this part. One of the microphones must be placed symmetrically with respect to one of the other microphones so that the maximum noise on either side of the aircraft can be determined analytically.

(c) W[illegible] restrictions. The tests must be co[illegible]der the following atmospheric co[illegible]

(1) No rain or other precipitation.

(2) Ambient air temperature between 36 degrees F and 95 degrees F (2.2 degrees C and 35 degrees C), inclusively, over that portion of the sound propagation path between the aircraft and a point 10 meters above the ground at the noise measuring station.

(3) Relative humidity and ambient temperature over that portion of the sound propagation path between the aircraft and a point 10 meters above the ground at the noise measuring station is such that the sound attenuation in the one-third octave band centered at 8 kHz is not greater than 12 dB/100 meters and the relative humidity is between 20 percent and 95 percent, inclusively.

(4) Airport reported wind velocity 10 meters above ground does not exceed 10 knots and the crosswind component does not exceed 5 knots.

(5) No anomalous wind conditions (including turbulence) which will significantly affect the noise level of the aircraft when the noise is recorded at each noise measuring station.

(d) *Aircraft testing procedures.*—(1) The aircraft testing procedures and noise measurements must be conducted and processed in an approved manner which yields the noise evaluation measure designated as Effective Perceived Noise Level (EPNL) in units of EPNdB, as prescribed in Appendix B of this part.

(2) The aircraft height and lateral position relative to the extended centerline of the runway must be determined by an FAA approved method which is independent of normal flight instrumentation, such as radar tracking, theodolite triangulation, laser trajectography, or photographic scaling techniques.

(3) The aircraft position along the flight path must be related to the noise recorded at the noise measuring stations by means of synchronizing signals at an approved sampling rate. The position of the aircraft must be recorded relative to the runway during the entire time period in which the recorded signal is within 10 dB of PNLTM. Measuring and sampling equipment must be approved by the FAA.

(4) Each takeoff test must meet the conditions of section C36.7 of Appendix C of this part.

(5) If a takeoff test series is conducted at weights other than the maximum takeoff weight for which noise certification is requested, the following additional requirements apply:

(i) At least one takeoff test must be conducted at a weight at, or above, the maximum certification weight.

(ii) Each test weight must be within [illegible] percent or −10 percent of the max[illegible] certification weight.

(iii) Approved data must be used to determine the variation of EPNL with weight for *takeoff test conditions.*

(6) Each approach test must be conducted with the aircraft stabilized and following a 3.0 degree ±0.5 degree approach angle and must meet the requirements of section *C36.9 of Appendix C of* this part.

(7) If an approach test series is conducted at weights other than the maximum landing weight for which certification is requested, the following additional requirements apply:

(i) At least one approach test must be conducted at a weight at, or above, the maximum *landing weight.*

(ii) Each test weight must exceed 90 percent of the maximum landing weight.

(iii) Approved data must be used to determine the variation of EPNL with weight for *approach test conditions.*

(8) Aircraft performance data sufficient to make the correction required under section A36.5 of this appendix must be recorded at an approved sampling rate using FAA approved equipment.

Section A36.3 *Measurement of aircraft noise received on the ground.*

(a) *General.* (1) The measurements prescribed in this section provide the data for determining the one-third octave band noise produced by aircraft during testing at specific noise measuring stations, as a function of time.

(2) Sound pressure level data for aircraft noise certification purposes must be obtained with approved acoustical equipment and measurement practices.

(3) Paragraphs (b), (c), and (d) of this section prescribe the required equipment specifications. Paragraphs (e) and (f) prescribe the calibration and measurement procedures required for each certification test *series.*

(b) *Measurement system.* The acoustical measurement system must consist of approved equipment equivalent to the following:

(1) A microphone system with frequency response and directivity which are compatible with the measurement and analysis system accuracy prescribed in paragraph (c) *of this section.*

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

(3) Recording and reproducing equipment whose characteristics, frequency response, and dynamic range are compatible with the response and accuracy requirements of paragraph (c) of this section.

(4) Calibrators using sine wave, or pink noise, of known levels. When pink noise (defined in paragraph (e)(1) of this section) is used, the signal must be described in terms of its root-mean-square (rms) value.

(5) Analysis equipment with the respon[illegible] and accuracy which meets or exceeds the [illegible] quirements of paragraph (d) of this sectio[illegible]

(6) Attenuators used for range changi[illegible] in sensing, recording, reproducing, or an[illegible] lyzing aircraft sound must be capable [illegible] being operated in equal-interval decib[illegible] steps with no error between any two s[illegible] things which exceeds 0.2 dB.

(c) *Sensing, recording, and reproducti[illegible] equipment.* (1) The sound produced by t[illegible] aircraft must be recorded in such a way th[illegible] the complete information, including th[illegible] history, is retained. A magnetic tape recor[illegible] er is acceptable.

(2) The microphone must be a pressur[illegible] sensitive capacitive type, or its approve[illegible] equivalent, such as a free-field type with i[illegible] cidence corrector.

(3) The variation of microphone an[illegible] preamplifier system sensitivity within a[illegible] angle of ±20 degree of grazing (70-110 d[illegible] grees from the normal to the diaphragm[illegible] must not exceed ±2.0 dB for any frequenc[illegible] within the range of 44 Hz to 11,200 Hz. Th[illegible] variation of microphone sensitivity in t[illegible] plane of the diaphragm must not exceed ±0.5 dB over the same frequency range.

(4) The overall free-field frequency r[illegible] sponse at 90 degrees (grazing incidence) [illegible] the combined microphone (including inc[illegible] dence corrector, if applicable) preamplifie[illegible] and windscreen must be determined b[illegible] using (A) an electrostatic calibrator in con[illegible] bination with manufacturer-provided co[illegible] rections, or (B) an anechoic free-field facili[illegible] ty. The calibration unit must include pur[illegible] tones at each preferred one-third octave fr[illegible] quency from 50 Hz to 10,000 Hz. The fr[illegible] quency response (after corrections based o[illegible] that determination) must be flat within th[illegible] following tolerances:

44-3540 Hz	±0.25 d[illegible]
3550-7099 Hz	±0.5 d[illegible]
7,100-11,200 Hz	±1.0 d[illegible]

(iii) Specifications concerning sensitivit[illegible] to environmental factors such as temperi[illegible] ture, relative humidity, and vibration mus[illegible] be in conformity with the recommendation [illegible] of International Electrotechnical Commis[illegible] sion (IEC) Publication No. 179, entitle[illegible] "Precision Sound Level Meters" (as incorpo[illegible] rated by reference under § 36.6 of this part

(iv) If the wind speed exceeds 6 knots, [illegible] windscreen must be employed with the m[illegible] crophone during each measurement of ai[illegible] craft noise. Correction for any insertion los[illegible] produced by the windscreen as a function o[illegible] frequency, must be applied to the measure[illegible] data and any correction applied must be re[illegible] ported.

(5) If a magneti[illegible] recorder is used t[illegible] store data for [illegible] analysis, th[illegible]

record/replay system (including tape) must conform to the following:

(i) The electric background noise produced by the system in each one-third octave must be at least 25 dB below the standard recording level, which is defined as that level which is either 10 dB below the 3 percent harmonic distortion level for direct recording or ±40 percent deviation for frequency modulation (FM) recording.

(ii) At the standard recording level, the corrected frequency response in each selected one-third octave band between 44 Hz and 180 Hz must be flat within ±0.75 dB, and in each band between 180 Hz and 11,200 Hz must be flat within ±0.25 dB.

(iii) If the overall system satisfies the requirements of paragraph (c)(2)(ii) of this section, and if the limitations of the dynamic range of the equipment are insufficient to obtain adequate spectral information, high frequency pre-emphasis may be added to the recording channel with the converse de-emphasis on playback. If pre-emphasis is added, the instantaneously recorded sound-pressure level between 800 Hz and 11,200 Hz of the maximum measured noise signal must not vary more than 20 dB between the levels of the maximum and minimum one-third octave bands.

(d) *Analysis equipment.* (1) A frequency analysis of the acoustic signal must be performed using one-third octave filters which conform to the recommendations of International Electrotechnical Commission (IEC) Publication No. 225, entitled "Octave, Half-Octave, and Third-Octave Band Filters Intended for Analysis of Sounds and Vibrations" (as incorporated by reference under § 36.6 of this part).

(2) A set of 24 consecutive one-third octave filters must be used. The first filter of the set must be centered at a geometric mean frequency of 50 Hz and the last filter at 10,000 Hz. The output of each filter must contain less than 0.5 dB ripple.

(3) The analyzer indicating device may be either analog or digital, or a combination of both. The preferred sequence of signal processing is:

(i) Squaring the one-third octave filter outputs;

(ii) Averaging or integrating; and

(iii) Converting linear formulation to logarithmic.

(4) Each detector must operate over a minimum dynamic range of 60 dB and perform as a true-mean-square device for sinusoidal tone bursts having crest factors of at least 3 over the following dynamic range:

(i) Up to 20 dB below full-scale reading must be accurate within ±0.5 dB;

(ii) Between 20 dB and 40 dB below full-scale reading must be accurate within ±1.0 dB; and

(iii) In excess of 40 dB below full scale reading must be accurate within ±2.5 dB.

(5) The dynamic response of the analyzer to input signals in both full-scale, and 20 dB less than full-scale, amplitude must conform to the following requirements:

(i) When a sinusoidal pulse of 500 millisecond duration at the geometrical mean frequency of each one-third octave band is applied to the input, the maximum output value must read 4.0 dB (within +0.5 or −1.0 dB) less than the value obtained for a steady state sinusoidal signal of the same frequency and amplitude.

(ii) When a steady state sinusoidal signal at the geometrical mean frequency of each one-third octave band is suddenly applied to the analyzer input and held constant, the maximum output value must exceed the final steady state value by 0.5 ±0.5 dB.

(iii) When a steady state signal is interrupted, an output value of 2.5 ±1.0 dB below the initial steady-state response must be achieved within 500 milliseconds after the interruption.

(6) A single value of the root-mean-square (rms) level must be provided every 500±5 milliseconds for each of the 24 one-third octave bands. The levels for all of the 24 one-third octave bands must be obtained within a 50 millisecond period. No more than 9 milliseconds of data from any 500 millisecond period may be excluded from the measurement.

(7) The amplitude resolution of the analyzer must be a least 0.25 dB.

(8) After all systematic errors have been eliminated, each output level from the analyzer must be accurate within ±1.0 dB of the level of the input signal. The total systematic errors for each of the output levels must not exceed ±3.0 dB. For contiguous filter systems, the systematic correction between adjacent one-third octave channels must not exceed 4.0 dB.

(9) The dynamic range capability of the analyzer for display of a single aircraft noise event (in terms of the difference between full-scale output level and the maximum noise level of the analyzer equipment) must be at least 60 dB.

(e) *Calibrations.* (1) Within the five days before the beginning of each test series, the complete electronic system (as installed in the field, including cables) must be electronically calibrated for frequency and amplitude by the use of a pink noise signal of known amplitudes covering the range of signal levels furnished by the microphone. For purposes of this section, a "pink noise" means a noise whose noise-power/unit-frequency is inversely proportional to frequency at frequencies within the range of 44 Hz to 11,200 Hz. The signal used must be described in terms of its average root-mean-square (rms) values for a nonoverload signal level. This system calibration must be repeated within five days of the end of each test series, or as required by the FAA.

(2) Immediately before and after each day's testing, a recorded acoustic calibration of the system must be made in the field with an acoustic calibrator to check the system sensitivity and provide an acoustic reference level for the analysis of the sound level data. The performance of equipment in the system will be considered satisfactory if, during each day's testing, the variation does not exceed 0.5 dB.

(3) A normal incidence pressure calibration of the combined microphone/preamplifier must be performed with pure tones at each preferred one-third octave frequency from 50 Hz to 10,000 Hz. This calibration must be completed within the 60 days before the beginning of each test series.

(4) Each reel of magnetic tape must:

(i) Be platonphone calibrated; and

(ii) At its beginning and end, carry a calibration signal consisting of at least a 15 second burst of pink noise, as defined in paragraph (e)(1) of this section.

(5) Data obtained from tape recorded signals are not considered reliable if the difference between the pink noise signal levels, before and after the tests in each one-third octave band, exceeds 0.75 dB.

(6) The one-third octave filters must have been demonstrated to be in conformity with the recommendations of IEC Publication 225 (as incorporated by reference under § 36.6 of this part) during the six calendar months preceding the beginning of each test series. However, the correction for effective bandwidth relative to the center frequency response may be determined for each filter—

(i) By measuring the filter response to sinusoidal signals at a minimum of twenty frequencies equally spaced between the two adjacent preferred one-third octave frequencies; or

(ii) By using an approved alternative technique.

(7) A performance calibration analysis of each piece of calibration equipment, including platonphones, reference microphones, and voltage insert devices, must have been made during the 12 calendar months preceding the beginning of each day's test series. Each calibration must be traceable to the National Bureau of Standards.

(f) *Noise measurement procedures.* (1) Each microphone must be oriented so that the diaphragm is substantially in the plane defined by the flight path of the aircraft and the measuring station. The microphone located at each noise measuring station must be placed so that its sensing element is approximately 4 feet above ground.

(2) Immediately before and immediately after each series of test runs and each day's testing, a recorded acoustic calibration of the system prescribed in section A36.3(e)(2) of this appendix must be made in the field to check the acoustic reference level for the analysis of the sound level data. Ambient noise must be recorded for at least 10 seconds and be representative of the acoustical background, including systemic noise, that exists during the flyover test run. During that recorded period, each component of the system must be set at the gain-levels used for aircraft noise measurement.

(3) The mean background noise spectrum must contain the sound pressure levels, which, in each preferred third octave band in the range of 50 Hz to 10,000 Hz, are the averages of the energy of the sound pressure levels in every preferred third octave. When analyzed in PNL, the resulting mean background noise level must be at least 20 PNdB below the maximum PNL of the aircraft.

(4) Corrections for recorded levels of background noise are allowed, within the limits prescribed in § A36.5(d)(2) of this appendix.

Section A36.5 Reporting and correcting measured data.

(a) *General.* Data representing physical measurements, or corrections to measured data, including corrections to measurements for equipment response deviations, must be recorded in permanent form and appended to the record. Each correction must be reported and is subject to FAA approval. An estimate must be made of each individual error inherent in each of the operations employed in obtaining the final data.

(b) *Data reporting.* (1) Measured and corrected sound pressure levels must be presented in one-third octave band levels obtained with equipment conforming to the standards prescribed in section A36.2 of this appendix.

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

(3) The atmospheric environmental data required to demonstrate compliance with section A36.4(c) of this appendix, measured throughout the test period under section A36.5(b)(3) of this appendix, must be reported.

(4) Conditions of local topography, ground cover, or events which may interfere with sound recording must be reported.

(5) The following aircraft information must be reported:

(i) Type, model, and serial numbers (if any) of aircraft engines.

(ii) Gross dimensions of aircraft and location of engines.

(iii) Aircraft gross weight for each test run.

(iv) Aircraft configuration, including flap and landing gear positions.

(v) Airspeed in knots.

(vi) Engine performance in pounds of net thrust, engine pressure ratios, exhaust temperatures, and fan or compressor shaft rotational speeds, as determined from aircraft instruments and manufacturer's data.

(vii) Aircraft flight path (above ground level in feet) determined by an FAA approved method which is independent of normal flight instrumentation, such as radar tracking, theodolite triangulation, laser trajectography, or photographic scaling techniques.

(8) Aircraft speed and position, and engine performance parameters must be recorded at an approved sampling rate sufficient to correct to the noise certification reference conditions prescribed in paragraph (c) of this section. Lateral position relative to the extended centerline of the runway, configuration, and gross weight must be reported.

(c) *Noise certification reference conditions*—(1) *Meteorological conditions.* Aircraft position and performance data and the noise measurements must be corrected to the following noise certification reference atmospheric conditions:

(i) Sea level pressure of 2116 psf (76 cm mercury).

(ii) Ambient temperature of 77 degrees F (25 degrees C).

(iii) Relative humidity of 70 percent.

(iv) Zero wind.

(2) *Aircraft conditions.* The reference condition for takeoff is the maximum weight, except as provided in § 36.125(b) of this part. The reference conditions for approach tests consist of—

(i) Design landing weight, except as provided in § 36.125(b) of this part;

(ii) Approach angle of 3 degrees; and

(iii) Aircraft height of 394 feet above the ground at the noise measuring station.

(d) *Data corrections.* (1) Aircraft position and performance data and the noise measurement must be corrected to the noise certification reference conditions as prescribed in paragraph (c) of this section. The measured atmospheric conditions must be those obtained in accordance with section A36.1(c) of this appendix and paragraph (b)(3) of this section. Atmospheric attenuation sound corrections must be made under section A36.9 of this appendix.

(2) The measured flight path must be corrected by an amount equal to the difference between the applicants predicted flight path for the certification reference conditions and the measured flight path at the test conditions. Necessary corrections relating to aircraft flight path or performance may be derived from approved data other than certification test data. The source noise must be corrected from approved data for the difference between measured and reference engine conditions, together with appropriate allowances for sound attenuation with distance. The Effective Perceived Noise Level (EPNL) correction must be less than 2.0 EPNdB for any combination of the following:

(i) The aircraft's not passing vertically above the measuring station.

(ii) Any difference between 394 feet and the actual minimum distance of the aircraft's ILS antenna from the approach measuring station.

(iii) Any difference between the actual approach angle and the noise certification reference approach flight path.

(iv) Any correction of the measured noise levels which accounts for any difference between the test engine thrust or power and the reference engine thrust or power.

Detailed correction requirements are prescribed in section A36.11 of this appendix.

(3) Aircraft sound pressure levels within the 10 dB-down points (described in section H36.9 of Appendix H) must exceed the mean background sound pressure levels determined under section A36.3(f)(2) by at least 5 dB in each one-third octave band (or be corrected under an FAA approved method) to be included in the computation of the overall noise level of the aircraft. An EPNL may not be computed or reported from data from which more than four one-third octave bands in any spectrum within the 10 dB-down points have been excluded under this paragraph.

(e) *Validity of results.* (1) The test results must produce three average EPNL values within the 90 percent confidence limits, each value consisting of the arithmetic average of the corrected noise measurements for all valid test runs at the takeoff, approach, and sideline measuring stations, respectively. If more than one noise measurement system is used at any single measuring station, the resulting data for each test run (after correction) must be averaged as a single measurement. If more than one test site or noise measuring station location is used, each valid test run must be included in the computation of the average EPNL values and their confidence limits.

(2) The minimum sample size acceptable for each of the three certification measurements (takeoff, approaches, and sideline) is six. The number of samples must be large enough to establish statistically for each of the three average noise certification levels a 90 percent confidence limit which does not exceed ±1.5 EPNdB. No test result may be omitted from the averaging process, unless otherwise specified by the FAA.

(3) The average EPNL values and their 90 percent confidence limits obtained by the procedure described in this paragraph must be those by which the noise emission of the aircraft is assessed against the noise certification criteria, and must be reported.

Section A36.7 *Symbols and units.*

(a) *General.* The symbols used in Appendixes A and B of this part have the following meanings.

Symbol	Unit	Meaning
anti		*Antilogarithm to the Base 10*
C(k)	dB	*Tone Correction.* The factor to be added to PNH(k) to account for the presence of spectral irregularities such as tones at the k-th increment of time.
d	Sec	*Duration Time.* The length of the significant noise time history being the time interval between the limits of t(1) and t(2) to the nearest second
D	dB	*Duration Correction.* The factor to be added to PNLM to account for the duration of the noise
EPNL	EPNdB	*Effective Perceived Noise Level.* The value of PNL adjusted for both the presence of discrete frequencies and the time history. (The unit EPNdB is used instead of the unit dB.)
f(n) or fn	Hz	*Frequency.* The geometrical mean frequency for the n-th one third octave band
F(n,k)	dB	*Delta dB.* The difference between the original and background sound pressure levels in the n-th one third octave band at the k-th interval of time.
h	dB	*dB Down.* The level to be subtracted from PNLTM that defines the duration of the noise
H	%	*Relative Humidity.* The ambient atmospheric relative humidity
i) or i		*Frequency Band Index.* The numerical indicator that denotes any one of the 24 one third octave bands with geometrical mean frequencies from 50 to 10,000 Hz.
k		*Time Increment Index.* The numerical indicator that denotes the number of equal time increments that have elapsed from a reference zero
log		*Logarithm to the Base 10*
log n (s)		*May Maximum Coordinate.* The log n value of the intersection point of the straight lines representing the variation of SPL with log n
M(b), M(c)		*May Inverse Slope.* The reciprocals of the slopes of the straight lines representing the variation of SPL with log n.

Symbol	Unit	Meaning
n	may	*Perceived Noisiness.* The perceived noisiness at any instant of time that occurs in a specified frequency range
n(k, k)	may	*Perceived Noisiness.* The perceived noisiness at the k-th instant of time that occurs in the i-th one third octave band
n(k)	may	*Maximum Perceived Noisiness.* The maximum value of all of the 24 values of n(k) that occurs at the k-th instant of time.
N(k)	may	*Total Perceived Noisiness.* The total perceived noisiness at the k-th instant of time calculated from the 24 instantaneous values of n(k, k)
p(k), p(c)		*May Slope.* The slopes of the straight lines representing the variation of SPL with log n
PNL	PNdB	*Perceived Noise Level.* The perceived noise level at any instant of time (the unit PNdB is used instead of the unit dB)
PNL (k)	PNdB	*Perceived Noise Level.* The perceived noise level calculated from the 24 values of SPL (i, k) at the k-th increment of time (the unit PNdB is used instead of the unit dB)
PNLM	PNdB	*Maximum Perceived Noise Level.* The maximum value of PNL(k) that occurs during the aircraft flyover. (The unit PNdB is used instead of the unit dB.)
PNLT	PNdB	*Tone Corrected Perceived Noise Level.* The value of PNL adjusted for the presence of spectral irregularities (discrete frequencies) at any instant of time (The unit PNdB is used instead of the unit dB.)
PNLT(k)	PNdB	*Tone Corrected Perceived Noise Level.* The value of PNL(k) adjusted for the presence of discrete frequencies that occurs at the k-th increment of time (The unit PNdB is used instead of the unit dB.)
PNLTM	PNdB	*Maximum Tone Corrected Perceived Noise Level.* The maximum value of PNLT(k) that occurs during the aircraft flyover. (The unit PNdB is used instead of the unit dB.)
s(i, k)	dB	*Slope of Sound Pressure Level.* The change in level between adjacent one third octave band sound pressure levels of the i-th band at the k-th instant of time

Symbol	Unit	Meaning
$\Delta s(i, k)$	dB	*Change in Slope of Sound Pressure Level*
$s'(i, k)$	dB	*Adjusted Slope of Sound Pressure Level* The change in level between adjacent adjusted one-third octave band sound pressure levels at the i-th band for the k-th instant of time.
$s(i, k)$	dB	*Average Slope of Sound Pressure Level*
SPL	dB re 0.0002 microbar.	*Sound Pressure Level* The sound pressure level at any instant of time that occurs in a specified frequency range
SPL (a)	dB re 0.002 microbar.	*Any Discontinuity Coordinate* The SPL value at the intersection point of the straight lines representing the variation of SPL with log n.
SPL (b) SPL (c)	dB re 0.002 microbar.	*Any Intercept* The intercepts on the SPL-axis of the straight lines representing the variation of SPL with log n.
$SPL(i, k)$	dB re 0.002 microbar.	*Sound Pressure Level* The sound pressure level at the k-th instant of time that occurs in the i-th one-third octave band.
$SPL'(i, k)$	dB re 0.002 microbar.	*Adjusted Sound Pressure Level* The first approximation to background level in the i-th one-third octave band for the k-th instant of time.
$SPL''(i, k)$	dB re 0.002 microbar.	*Background Sound Pressure Level* The final approximation to background level in the i-th one-third octave band for the k-th instant of time.
SPLI	dB re 0.002 microbar.	*Maximum Sound Pressure Level* The sound pressure level that occurs in the i-th one-third octave band of the spectrum for PNL-TM
SPLic	dB re 0.002 microbar.	*Corrected Maximum Sound Pressure Level* The sound pressure level that occurs in the i-th one-third octave band of the spectrum for PNLTM corrected for atmospheric sound absorption.
t	Sec	*Elapsed Time* The length of time measured from a reference zero.
t(1), t(2)	Sec	*Time Limit* The beginning and end of the significant noise time history defined by it
Δt	Sec	*Time Increment* The equal increments of time for which PNL(k) and PNLT (k) are calculated.
T	Sec	*Normalizing Time Constant* The length of time used as a reference in the integration method for computing duration corrections.
T	°F	*Temperature* The ambient atmospheric temperature
a_i	dB/ft	*Test Atmospheric Absorption*
a_i'	dB/1000 ft	The atmospheric attenuation of sound that occurs in the i-th one third octave band for the measured atmospheric temperature and relative humidity.
a_{ic}	dB/ft	*Reference Atmospheric Absorption* The atmospheric attenuation of sound that occurs in the i-th one third octave band for the reference atmospheric temperature and relative humidity
α_{ic}'	dB/1000 ft	
β	Degrees	*Test Constant Climb Angle*
β	Degrees	*Second Constant Climb Angle*
δ	Degrees	*Thrust Cutback Angle*
ϵ	Degrees	*The angles* defining the points on the takeoff flight path at which thrust reduction is started and ended respectively
η	Degrees	*Approach Angle*
θ	Degrees	*Takeoff Noise Angle* The angle between the flight path and nose path for takeoff operation it is identical for both measured and corrected flight paths
μ	Degrees	*Approach Noise Angle* The angle between the flight path and the nose path for approach operation it is identical for both measured and corrected flight paths.
ΔI	EPNdB	*PNLT Correction* The correction to be added to the EPNL calculated from measured data to account for noise level changes due to differences in atmospheric absorption and noise path length between reference and test conditions.
$\Delta 2$	EPNdB	*Noise Path Duration Correction* The correction to be added to the EPNL calculated from measured data to account for noise level changes due to the noise duration because of differences in flyover altitude between reference and test condition.
$\Delta 3$	EPNdB	*Weight Correction* The correction to be added to the EPNL calculated from measured data to account for noise level changes due to differences between maximum and test aircraft weights
$\Delta 4$	EPNdB	*Approach Angle Correction* The correction to be added to the EPNL calculated from measured data to account for noise level changes due to differences between 3° and the test approach angle

Symbol	Unit	Meaning
ΔAll	Feet	(1)
$\Delta\beta$	Degrees	(1)
$\Delta\gamma$	Degrees	(1)
$\Delta\delta$	Degrees	(1)
$\Delta\epsilon$	Degrees	(1)
$\Delta\eta$	Degrees	(1)

(1) *Takeoff Noise Changes* The changes in the basic parameters defining the takeoff profile due to differences between reference and test conditions.

Flight Profile Identification Positions

Position	Description
A	Start of takeoff roll
B	Liftoff.
C	Start of first constant climb
D	Start of thrust reduction
E	Start of second constant climb
Ec	Start of second constant climb on corrected flight path.
F	End of noise certification takeoff flight path
Fc	End of second constant climb on corrected flight path.
G	Start of noise certification approach flight path.
Gr	Start of noise certification approach on reference flight path
H	Position on approach path directly above noise measuring station
I	Start of level off
Ir	Start of level off on reference approach flight path.
J	Touchdown
K	Takeoff noise measuring station
L	Sideline noise measuring station (not on flight track)
M	End of noise type certification takeoff flight track.
N	Approach noise measuring station
O	Threshold of approach end of runway
P	Start of noise type certification approach flight track.
Q	Position on measured takeoff flight path corresponding to PNLTM at station K.
Qc	Position on corrected takeoff flight path corresponding to PNLTM at station K.
R	Position on measured takeoff flight path nearest to station K.
Rc	Position on corrected takeoff flight path nearest to station K.
S	Position on measured approach flight path corresponding to PNLTM at station H
Sr	Position on reference approach flight path corresponding to PNLTM at station H
T	Position on measured approach flight path nearest to station H.
Tr	Position on reference approach flight path nearest to station H
X	Position on measured takeoff flight path corresponding to PNLTM at station L
Xc	Position on corrected takeoff flight path corresponding to PNLTM at station L

Flight Profile Distances

Distance	Unit	Meaning
AU	feet	*Length of Takeoff Roll* The distance along the runway between the start of takeoff roll and lift off
AK	feet	*Takeoff Measurement Distance* The distance from the start of roll to the takeoff noise measurement station along the extended centerline of the runway
AM	feet	*Takeoff Flight Track Distance* The distance from the start of roll to the takeoff flight track position along the extended centerline of the runway to which the position of the aircraft must be longer be tracked
KQ	feet	*Measured Takeoff Noise Path* The distance from station K to the measured aircraft position Q
KQc	feet	*Corrected Takeoff Noise Path* The distance from station K to the corrected aircraft position Qc
Klt	feet	*Measured Takeoff Maximum Distance* The distance from station K to point It on the measured flight path.
Kltc	feet	*Corrected Takeoff Maximum Distance* The distance from station K to point Itc on the corrected flight path
LX	feet	*Measured Sideline Noise Path* The distance from station L to the measured aircraft position X
LXc	feet	*Corrected Sideline Noise Path* The distance from station L to the corrected aircraft position Xc
hH	feet	*Aircraft Approach Height* The vertical distance between the aircraft and the approach measuring station
HS	feet	*Measured Approach Noise Path* The distance from station H to the measured aircraft position S
HSr	feet	*Reference Approach Noise Path* The distance from station H to the reference aircraft position Sr.
HT	feet	*Measured Approach Maximum Distance* The distance from station H to point T on the measured flight path
HTr	feet	*Reference Approach Maximum Distance* The distance from station H to point Tr on the corrected flight path; it equals 394 feet
OH	feet	*Approach Measurement Distance* The distance from the runway threshold to the approach measurement station along the extended centerline of the runway

FLIGHT PROFILE DISTANCES—Continued

Distance	Unit	Meaning
DP	feet	*Approach Flight Track Distance.* The distance from the runway threshold to the approach flight track position along the extended centerline of the runway for which the position of the aircraft need no longer be recorded.

Section A36.9 *Atmospheric attenuation of sound.*

(a) *General.* The measured values of the one-third octave band spectra must conform, or be corrected, to the reference-day conditions listed in section A36.5(c) of this appendix. Each correction must account for any differences in the atmospheric attenuation of sound between the test-day conditions and the reference-day conditions along the sound propagation path between the aircraft and the microphone. Unless the meteorological conditions conform to those prescribed in section A36.4(c) of this appendix, the test data are not acceptable.

(b) *Meteorological measurements.* (1) The location of an airport, or other facility, used for meteorological measurements must be approved for use as representative of those atmospheric conditions existing near the surface over the geographical area in which aircraft noise measurements are made. However, for the purpose of making corrections under this section, the wind velocity, temperature, and relative humidity must be measured in the vicinity of the microphones at the takeoff, approach, and sideline measuring stations.

(2) The temperature and relative humidity must be measured from a point 10 meters above the surface at the measuring stations to the altitude of the aircraft, using previously approved equipment and methods.

(3) Meteorological measurements must be obtained within 25 minutes of each noise test measurement. Meteorological data must be interpolated to actual times of each noise measurement.

(c) *Attenuation rates.* The atmospheric attenuation rates of sound with distance for each one-third octave band from 50 Hz to 10,000 Hz must be determined in accordance with the formulations and tabulations of SAE ARP 866A, entitled "Standard Values of Atmospheric Absorption as a Function of Temperature and Humidity for Use in Evaluating Aircraft Flyover Noise" (as incorporated by reference under § 36.6 of this part).

(d) *Correction for atmospheric attenuation.* EPNL values calculated for measurements must be corrected by the methods prescribed in section A36.11(d) of this appendix whenever—

(1) The ambient atmospheric conditions of temperature and relative humidity do not conform to the reference conditions (77 degrees F. and 70 percent, respectively), or

(ii) The measured takeoff and approach flight paths do not conform to the reference flight paths.

(2) If the atmospheric absorption coefficients do not vary over the sound propagation path by more than ±0.7 dB/1000 feet in the 3150 Hz one-third octave band from the value of the absorption coefficients derived from the meteorological measurement obtained at 10 meters above the surface of the noise measuring station, the measurements prescribed in paragraph (b)(2) of this section may be used to determine the atmospheric attenuation rates for each one-third octave band.

The resulting atmospheric attenuation rate may be used to compute the PNLT correction under section A36.11(d) of this appendix.

(3) If the conditions do not conform to those prescribed in paragraph (d)(2) of this section, the corrections for atmospheric attenuation must be determined by the following layered-atmosphere procedure:

(i) The sound propagation path must be divided into increments no greater than 100 feet in altitude, and the average temperature and relative humidity that exists within each increment at the time of the test must be calculated from the meteorological data required under paragraph (b) of this section.

(ii) Atmospheric attenuation rates must be determined under paragraph (c) of this section for each one-third octave band in each altitude increment.

(iii) The mean attenuation rate over the complete sound propagation path from the aircraft to the microphone must be computed for each one-third octave band from 50 Hz to 10,000 Hz. These rates must be used in computing the corrections required in section A36.11(d) of this appendix.

Section A36.11 *Detailed correction procedures.*

(a) *General.* If the test conditions do not conform to those prescribed as noise certification reference conditions under section A36.5 of this appendix, the following correction procedure and requirements apply:

(1) If a positive value results from any difference between reference and test conditions, and appropriate positive correction must be made to the EPNL calculated from the measured data. Conditions which can result in a positive value include:

(i) Atmospheric absorption of sound under test conditions which is greater than the reference;

(ii) Test flight path at an altitude which is higher than the reference; or

(iii) Test weight which is less than maximum certification weight.

(2) If a negative value results from any difference between reference and test conditions, no correction may be made to the EPNL calculated from the measured data, unless the difference results from:

(i) An atmospheric absorption of sound under test conditions which is less than the reference; or

(ii) A test flight path at an altitude which is lower than the reference.

(3) The following correction procedures may produce one or more possible correction values which must be added algebraically to the EPNL calculated as if the tests were conducted completely under the noise certification reference conditions:

(i) The flight profiles must be determined for both takeoff and approach, and for both reference and test conditions. The procedures require noise and flight path recording with a synchronized time signal from which the test profile can be delineated, including the aircraft position for which PNLTM is observed at the noise measuring station. For takeoff, the flight profile corrected to reference conditions may be derived from FAA approved manufacturer's data; however, for approach, the reference profile is prescribed under paragraph (c)(2) of this section.

(ii) The sound propagation paths to the microphone from the aircraft position corresponding to PNLTM are determined for both the test and reference profiles. The SPL values in the spectrum of PNLTM must then be corrected for the effects of—

(A) Change in atmospheric sound absorption;

(B) Atmospheric sound absorption on the change in sound propagation path length; and

(C) Inverse square law on the change in sound propagation path length. The corrected values of SPL are then converted to PNLT from which must be subtracted PNLTM. The resulting difference represents the correction which must be added algebraically to the EPNL calculated from the measured data.

(iii) The minimum distances from both the test and reference profiles to the noise measuring station must be calculated and used to determine a noise duration correction due to any change in the altitude of aircraft flyover. The duration correction must be added algebraically to the EPNL calculated from the measured data.

(iv) From approved data in the form of curves or tables giving the variation of EPNL with engine thrust or test speed, corrections are determined and must be added to the EPNL (which is calculated from the measured data) to account for noise level changes due to differences between test and reference conditions.

(v) From approved data in the form of curves or tables giving the variation of EPNL with approach angle, corrections are determined and must be added algebraically to the EPNL (which is calculated from the measured data) to account for noise level changes due to differences between 3 degrees and the test approach angle.

(b) *Takeoff profiles.* (1) Figure A1 illustrates a typical takeoff profile.

(i) The aircraft begins the takeoff roll at point A, lifts off at point B, and initiates a first constant climb at point C at an angle. The noise abatement thrust cutback is started at point D and completed at point E where the second constant climb is defined by the angle γ (usually expressed in terms of the gradient in percent). The end of the noise certification takeoff flight path is represented by aircraft position F whose vertical projection on the flight track (extended centerline of the runway) is point M. The position of the aircraft must be recorded for the entire interval during which the measured aircraft noise level is within 10 dB of PNLTM. Position K is the takeoff noise measuring station whose distance AK is specified as 21,325 feet (6,500 meters). However, if it is necessary to reduce AK to less than 21,325 feet, the procedures prescribed in paragraph (f) of this section must be followed. Position L is the sideline noise measuring station located on a line parallel to and the prescribed distance from, the runway centerline where the noise level during takeoff is greatest.

(ii) The takeoff profile is defined by five parameters—(A) AB, the length of takeoff roll; (B) β the first constant climb angle; (C) γ, the second constant climb angle; and (D) δ, and ε, the thrust cutback angles. These five parameters are functions of the aircraft performance and weight, and the atmospheric conditions of temperature, pressure and wind velocity and direction.

(2) If the test conditions do not conform to those prescribed as reference conditions under section A36.5 of this appendix, the corresponding test and reference profile parameters will be different, as shown in Figure A2. The profile parameter changes identified as ΔAB, Δβ, Δγ, Δδ, and Δε may be derived from the manufacturer's data (if approved by the FAA) and may be used to define the flight profile corrected to the reference conditions. The relationships between the measured and corrected takeoff flight profiles may then be used to determine the corrections, which, if positive, must be applied to the EPNL calculated from the measured

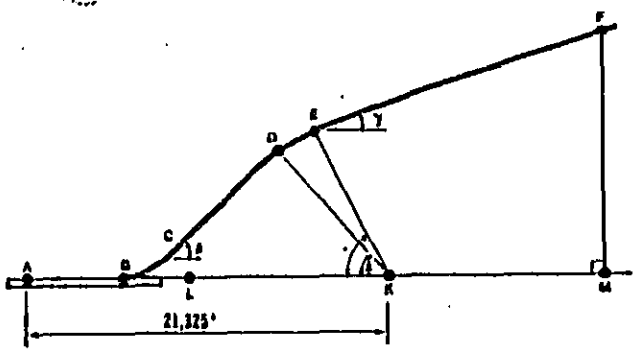

Figure A1. MEASURED TAKEOFF PROFILE

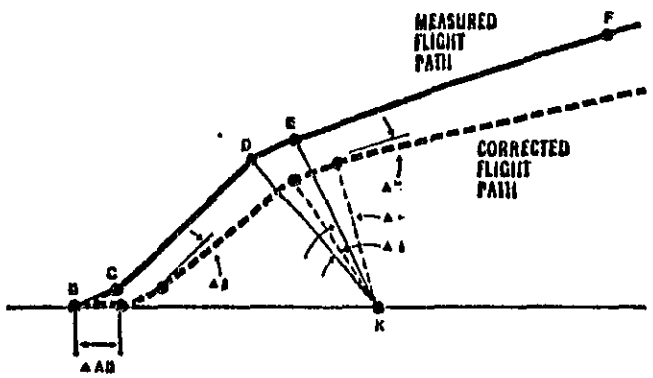

Figure A2. COMPARISON OF MEASURED AND CORRECTED TAKEOFF PROFILES

Note: Under reference atmospheric conditions and with maximum takeoff weight, the gradient of the second constant climb angle (γ) may not be less than 4 percent. However, the actual gradient will depend upon the test atmospheric conditions, assuming maximum takeoff weight and the parameters characterizing engine performance are constant (rpm, epr, or any other parameter used by the pilot).

(3) Figure A3 illustrates portions of the measured and corrected takeoff flight paths including the significant geometrical relationships influencing sound propagation. EP represents the measured second constant flight path with climb angle γ, and Ec'c represents the corrected second constant flight path at reduced climb angle γ−Δγ. Position Q represents the aircraft location on the measured takeoff flight path for which PNLTM is observed at the noise measuring station K, and Qc is the corresponding position on the corrected flight path. The measured and corrected sound propagation paths are KQ and KQc, respectively, which form the same angle ϕ with their flight paths. Position R represents the point on the measured takeoff flight path nearest the noise measuring station K, and Rc is the corresponding position on the corrected flight path. The minimum distance to the measured and corrected flight paths are indicated by the lines KR and KRc, respectively, which are normal to their flight paths.

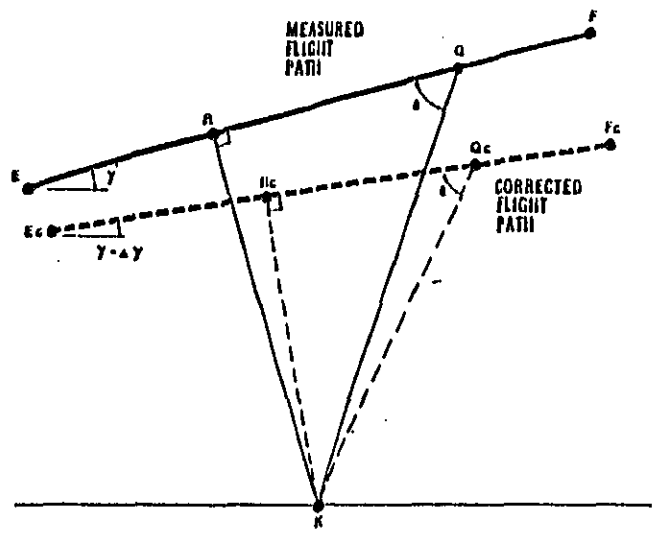

Figure A3. TAKEOFF PROFILE CHARACTERISTICS INFLUENCING SOUND PROPAGATION

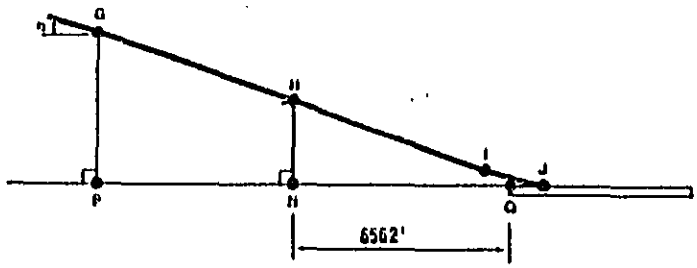

Figure A4. MEASURED APPROACH PROFILE

(c) *Approach profiles.* (1) Figure A4 illustrates a typical approach profile.

(i) The beginning of the noise certification approach profile is represented by aircraft position Q whose vertical projection on the *flight track (extended centerline of the* runway) is point P. The position of the aircraft should be recorded for a distance OP from the runway threshold O to ensure recording of the entire interval during which the measured aircraft noise is within 10 dB *of PNLTM.*

(ii) The aircraft approaches at an angle passes vertically over the noise measuring station N at a height of NH, begins the level off at position I, and touches down at position J. The distance ON is prescribed as 6,562 feet (2,000 meters).

(iii) The approach profile is defined by the approach angle and the height NH which are functions of the aircraft operating conditions controlled by the pilot. If the measured approach profile parameters do not conform to the corresponding reference approach parameters (3 degrees and 394 feet, respectively, as shown in Figure A5), corrections, if positive, must be applied to the EPNL calculated from the measured data.

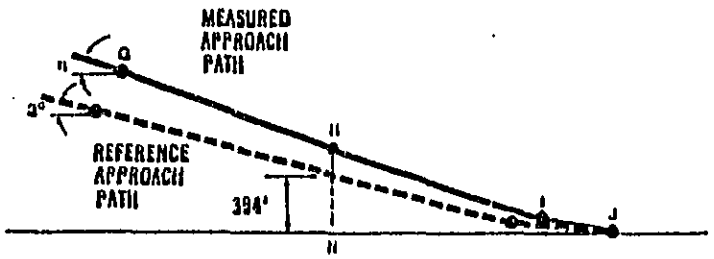

Figure A5. COMPARISON OF MEASURED AND CORRECTED APPROACH PROFILES

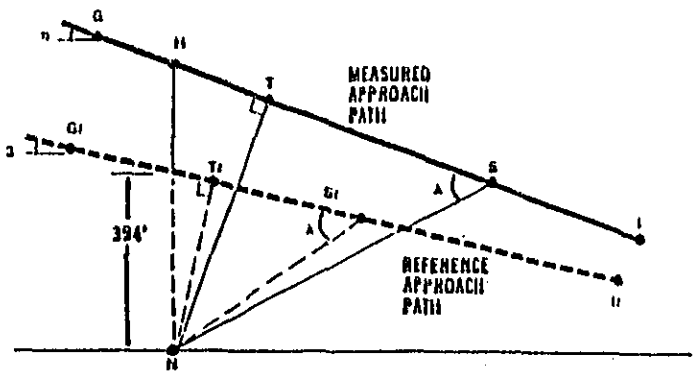

Figure A6. APPROACH PROFILE CHARACTERISTICS INFLUENCING SOUND PROPAGATION

(2) Figure A6 illustrates portions of the measured and reference approach flight paths, including the significant geometrical relationships influencing sound propagation. Gl represents the measured approach path with approach angle —, and Grlr represents the reference approach flight path at lower altitude and approach angle of 3 degrees. Position S represents the aircraft location on the measured approach flight path for which PNLTM is observed at the noise measuring station N, and Sr is the corresponding position on the reference approach flight path. The measured and corrected sound propagation paths are NS and NSr, respectively, which form the same angle A with their flight paths. Position T represents the point on the measured approach flight path nearest the noise measuring station N, and Tr is the corresponding point on the reference approach flight path. The minimum distances to the measured and reference flight paths are indicated by the lines NT and NTr, respectively, which are normal to their flight paths. NOTE: The reference approach flight path is defined by *—=3 degrees and NH=394 feet.* Consequently NTr can also be defined; NTr=303 feet to the nearest foot and is, therefore, considered to be one of the reference parameters.

(d) *PNLT corrections.* If the ambient atmospheric conditions of temperature and relative humidity are not those prescribed as reference conditions under § A36.5(c) of this appendix (77 degrees F and 70 percent, respectively), corrections to the EPNL values must be calculated from the measured data under paragraph (a) of this section as follows:

(1) *Takeoff flight path.* For the takeoff flight path shown in Figure A3, the spectrum of PNLTM observed at station K for the aircraft at position Q is decomposed into its individual SPLi values.

(i) *Step 1.* A set of corrected values are then computed as follows:

$$SPLic = SPLi + \begin{cases} (a_i - a_{io})KQ \\ a_{io}(KQ - KQc) \\ 20\log(KQ/KQc) \end{cases}$$

where SPLi and SPLic are the measured and corrected sound pressure levels, respectively, in the i-th one-third octave band. The first correction term accounts for the effects of change in atmospheric sound absorption where a_i and a_{io} are the sound absorption coefficients for the i-th (determined under section A36.9(d)) and reference atmospheric conditions, respectively, for the i-th one-third octave band and KQ is the measured takeoff sound propagation path. The second correction term accounts for the

effects of atmospheric sound absorption on the change in the sound propagation path length where ΔQc is the corrected takeoff sound propagation path. The third correction term accounts for the effects of the inverse square law on the change in the sound propagation path length.

(ii) *Step 2.* The corrected values of SPILc are then converted to PNLT and a correction term calculated as follows:

$$\Delta 1 = PNLT - PNLTM$$

which represents the correction to be added algebraically to the EPNL calculated from the measured data.

(2) *Approach flight path.*

(i) The procedure prescribed in paragraph (d)(1) of this section for takeoff flight paths is also used for the approach flight path, except that the value for ΔPILc relate to the approach sound propagation paths shown in Figure A6 as follows:

$$\Delta PILc - \Delta PIL = +(a_1 - a_{1c})\,NS + a_{1c}(NS - NSr) + 20\log(NS/NSr)$$

where NS and NSr are the measured and reference approach sound propagation paths, respectively.

(ii) The remainder of the procedure is the same as that prescribed in paragraph (d)(1)(ii) of this section, regarding takeoff flight path.

(3) *Sideline flight path.* The procedure prescribed in paragraph (d)(1) of this section for takeoff flight paths is also used for the sideline flight path, except that the values of SPILc relate only to the measured sideline sound propagation path as follows:

$$\Delta PILc - \Delta PIL = +(a_l - a_{lc})\,LX + a_{lc}(LX - LXc) + 20\log(LX/LXc)$$

where LX is the measured sideline sound propagation path from station L (Figure A1) to position X of the aircraft for which PNLTM is observed at station L and LXc is the corrected sideline sound propagation path.

(e) *Duration corrections.* If the measured takeoff and approach flight paths do not conform to those prescribed as the corrected and reference flight paths, respectively, under section A36.5(d)(2) it will be necessary, or desirable, to apply duration corrections to the EPNL values calculated from the measured data. Such corrections must be calculated as follows:

(1) *Takeoff flight path.* For the takeoff flight path shown in Figure A2, the correction term is calculated using the formula—

$$\Delta 2 = -10\log(KR/KRc)$$

which represents the correction which must be added algebraically to the EPNL calculated from the measured data. The lengths KR and KRc are the measured and corrected takeoff minimum distances from the noise measuring station K to the measured and the corrected flight paths, respectively. A negative sign indicates that, for the particular case of a duration correction, the EPNL calculated from the measured data must be reduced if the measured flight path is at a greater altitude than the corrected flight path.

(2) *Approach flight path.* For the approach flight path shown in Figure A6, the correction term is calculated using the formula—

$$\Delta 2 = -10\log(NT/393)$$

where NT is the measured approach minimum distance from the noise measuring station N to the measured flight path and 393 feet is the minimum distance from station N to the reference flight path.

(3) *Sideline flight path.* For the sideline flight path, the correction term is calculated using the formula—

$$\Delta 2 = -10\log(LX/LXc)$$

where LX and LXc are the measured and corrected sideline noise measuring distances, respectively, from the noise measuring station L to the aircraft position X or X_c, respectively on the takeoff flight path.

(f) *Nonstandard takeoff location correction.* All takeoff noise measurements must be conducted at the takeoff noise measurement point prescribed in section 36.1 of Appendix C, except where it is necessary to bring the measuring station to a point closer to the start of takeoff roll to ensure recording the complete flyover noise history required by section B36.9 of Appendix B of this part (i.e., a flyover noise/time record which includes the required period before and after the 10 dB-down points from PNLTM). The EPNL value computed from these measurements must be corrected to the value that would have occurred at the 21,325 foot reference measuring point under one of the following procedures:

(1) *Simplified procedure.* Unless the correction factor exceeds 3.0 dB, or the correction results in a final EPNL value which is within 1.5 dB of the noise levels prescribed in Appendix C of this part, the correction procedure prescribed in paragraphs (d) and (e) of this section may be used. Since this procedure accounts for extrapolation of the PNLTM from the close-in-measurement station to the 21,325 foot reference point, corrections for differences between test and reference thrust and air speed must be made after the EPNL has been corrected to the 21,325 foot reference point.

(2) *Integrated procedure.* If the correction factor exceeds 3.0 dB, or the correction results in a final EPNL value which is within 1.5 dB of the noise levels prescribed in Appendix C of this part, the following correction procedure must be used:

(i) Each ½ second spectrum measured during a flyover at a noise measuring station which is closer to the flight path than the prescribed reference distance must be adjusted under a procedure similar to that prescribed under paragraph (d)(1) of this section, regarding PNLT corrections. However, the distances which must be used are those values of KQ and KQc for the sound propagation path (and hence value of θ) for PNLTM which represents the actual, measured sound propagation path (and path angle), and the corresponding sound propagation path (and path angle) as if the measurements had been made at the 21,325 foot measuring point under reference acoustic day conditions.

(ii) After the measured ½-second spectra have been corrected to the 21,325 foot reference point, the remaining noise evaluation must be conducted under the procedures prescribed in Appendix B of this part, including the appropriate reference thrust and air speed corrections.

[Amdt. 36-9, 43 FR 2739, Mar. 2, 1978, as amended at 44 FR 3031, Jan. 15, 1979]

Appendix B—Aircraft Noise Evaluation Under § 36.103

Sec.
B36.1 *General.*
B36.3 *Perceived noise level.*
B36.5 *Correction for spectral irregularities.*
B36.7 *Maximum tone corrected perceived noise level.*
B36.9 *Duration correction.*
B36.11 *Effective perceived noise level.*
B36.13 *Mathematical formulation of noy tables.*

Section B36.1 *General.* The procedures in this appendix must be used to determine the noise evaluation quantity designated as effective perceived noise level, EPNL, under § 36.103. These procedures, which use the physical properties of noise measured as prescribed by Appendix A of this part, consist of the following:

(a) The 24 one-third octave bands of sound pressure level are converted to perceived noisiness by means of a noy table. The noy values are combined and then converted to instantaneous perceived noise levels, PNL(k).

(b) A tone correction factor, C(k), is calculated for each spectrum to account for the subjective response to the presence of the maximum tone.

(c) The tone correction factor is added to the perceived noise level to obtain tone corrected perceived noise levels, PNLT(k), at each one-half second increment of time. The instantaneous values of tone corrected perceived noise level are noted with respect to time and the maximum value, PNLTM, is determined.

$$PNLT(k) = PNL(k) + C(k)$$

(d) A duration correction factor, D, is computed by integration under the curve of tone corrected perceived noise level versus time.

(e) Effective perceived noise level, EPNL, is determined by the algebraic sum of the maximum tone corrected perceived noise level and the duration correction factor.

$$EPNL = PNLTM + D$$

Section B36.3 *Perceived noise level.* Instantaneous perceived noise levels, PNL(k), must be calculated from instantaneous one-third octave band sound pressure levels, SPL(i,k), as follows:

(a) *Step 1.* Convert each one-third octave band SPL(i,k), from 50 to 10,000 Hz, to perceived noisiness, n(i,k), by reference to Table B1, or to the mathematical formulation of the noy table given in § B36.13 of this appendix.

(b) *Step 2.* Combine the perceived noisiness values, n(i,k), found in step 1 by the following formula:

$$N(k) = n(k) + 0.15\left[\left(\sum_{i=1}^{24} n(i,k)\right) - n(k)\right]$$

$$n(i,k) = n(k) - 0.85$$

$$n(K) = 0.15\sum_{i=1}^{24} n(i,k)$$

where n(k) is the largest of the 24 values of n(i,k) and N(k) is the total perceived noisiness.

(c) *Step 3.* Convert the total perceived noisiness, N(k), into perceived noise level, PNL(k), by the following formula:

$$PNL(k) = 40.0 + 33.22\log N(k)$$

which is plotted in Figure B1. PNL(k) may also be obtained by choosing N(k) in the 1,000 Hz column of Table B1 and then reading the corresponding value of SPL(i,k) which, at 1,000 Hz, equals PNL(k).

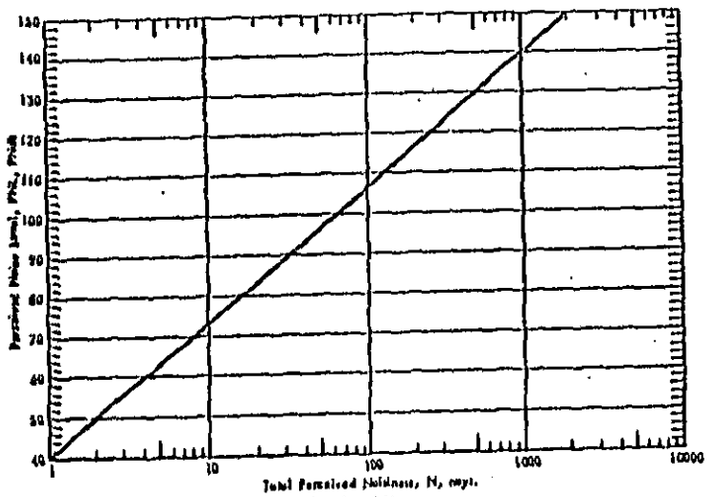

Figure B1. Perceived Noise Level as a Function of Noys.

3-22

TABLE B1 PERCEIVED NOISINESS (NOYS) AS A FUNCTION OF SOUND PRESSURE LEVEL

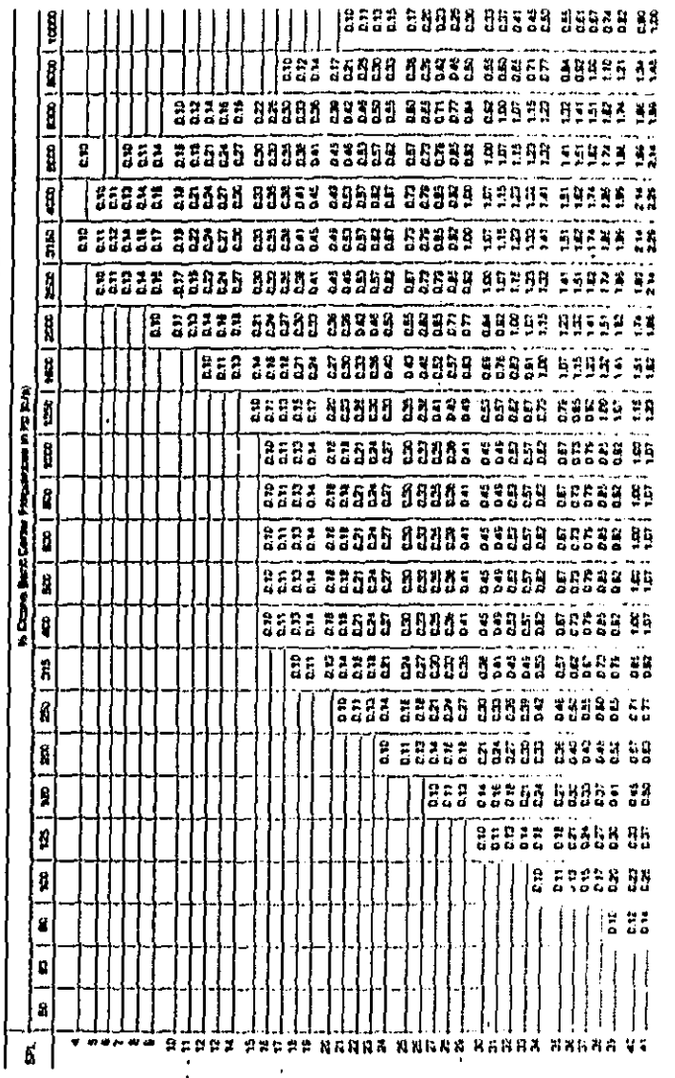

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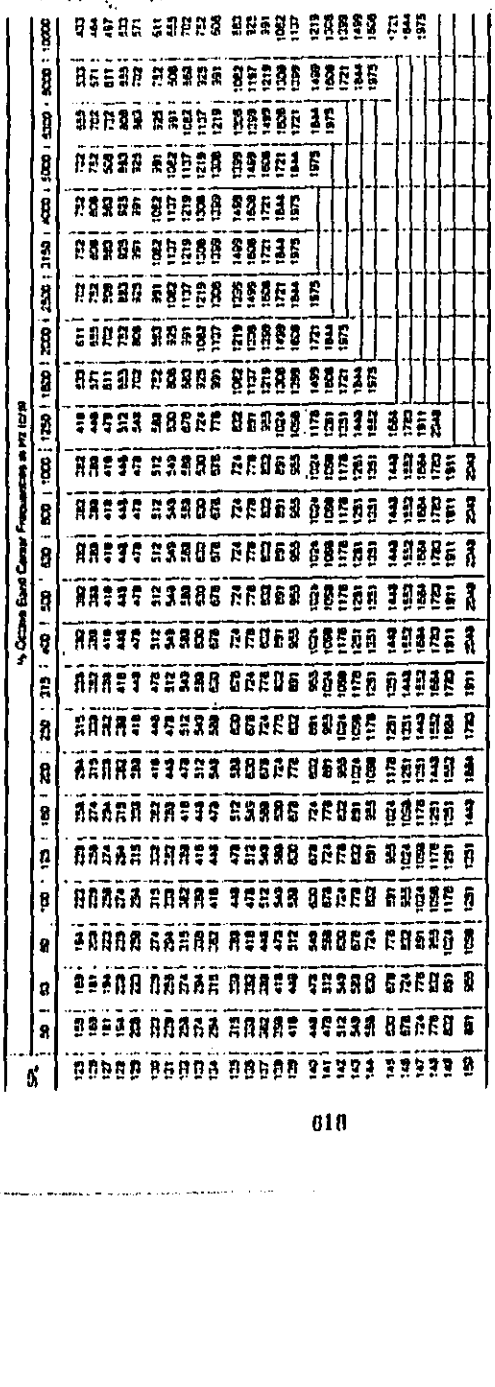
TABLE B1 PERCEIVED NOISINESS (NOYS) AS A FUNCTION OF SOUND PRESSURE LEVEL—Continued

SPL	⅓ Octave Band Center Frequencies in Hz (c/s)																							
	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000
42			0.16	0.30	0.41	0.55	0.69	0.84	1.00	1.15	1.15	1.15	1.15	1.15	1.32	1.74	1.99	2.29	2.45	2.45	2.29	2.14	1.53	1.12
43			0.19	0.33	0.45	0.61	0.76	0.92	1.07	1.23	1.23	1.23	1.23	1.23	1.41	1.86	2.14	2.45	2.63	2.63	2.45	2.29	1.73	1.21
44		0.10	0.22	0.37	0.50	0.67	0.83	1.00	1.15	1.32	1.32	1.32	1.32	1.32	1.52	1.99	2.29	2.63	2.81	2.81	2.63	2.45	1.99	1.34
45		0.12	0.26	0.42	0.55	0.74	0.91	1.08	1.24	1.41	1.41	1.41	1.41	1.41	1.62	2.14	2.45	2.81	3.02	3.02	2.81	2.63	2.14	1.48
46		0.14	0.30	0.46	0.61	0.82	1.00	1.16	1.33	1.52	1.52	1.52	1.52	1.52	1.74	2.29	2.63	3.02	3.23	3.23	3.02	2.81	2.29	1.63
47		0.16	0.34	0.52	0.67	0.90	1.08	1.25	1.42	1.62	1.62	1.62	1.62	1.62	1.87	2.45	2.81	3.23	3.46	3.46	3.23	3.02	2.45	1.79
48		0.19	0.39	0.58	0.74	1.00	1.17	1.34	1.53	1.74	1.74	1.74	1.74	1.74	2.00	2.63	3.02	3.46	3.71	3.71	3.46	3.23	2.63	1.98
49	0.10	0.22	0.44	0.65	0.82	1.08	1.26	1.45	1.64	1.87	1.87	1.87	1.87	1.87	2.14	2.81	3.23	3.71	3.97	3.97	3.71	3.46	2.81	2.18
50	0.12	0.26	0.49	0.72	0.90	1.17	1.36	1.56	1.76	2.00	2.00	2.00	2.00	2.00	2.30	3.02	3.46	3.97	4.26	4.26	3.97	3.71	3.02	2.40
51	0.14	0.30	0.55	0.80	1.00	1.26	1.47	1.68	1.89	2.14	2.14	2.14	2.14	2.14	2.46	3.23	3.71	4.26	4.56	4.56	4.26	3.97	3.23	2.63
52	0.17	0.34	0.62	0.90	1.09	1.36	1.58	1.80	2.03	2.30	2.30	2.30	2.30	2.30	2.64	3.46	3.97	4.56	4.89	4.89	4.56	4.26	3.46	2.81
53	0.21	0.39	0.70	1.00	1.18	1.47	1.71	1.94	2.17	2.46	2.46	2.46	2.46	2.46	2.83	3.71	4.26	4.89	5.24	5.24	4.89	4.56	3.71	3.02
54	0.25	0.45	0.79	1.09	1.28	1.58	1.85	2.09	2.33	2.64	2.64	2.64	2.64	2.64	3.03	3.97	4.56	5.24	5.61	5.61	5.24	4.89	3.97	3.23
55	0.30	0.51	0.89	1.18	1.39	1.71	2.00	2.25	2.50	2.83	2.83	2.83	2.83	2.83	3.25	4.26	4.89	5.61	6.01	6.01	5.61	5.24	4.26	3.46
56	0.34	0.59	1.00	1.29	1.50	1.85	2.16	2.42	2.69	3.03	3.03	3.03	3.03	3.03	3.48	4.56	5.24	6.01	6.44	6.44	6.01	5.61	4.56	3.71
57	0.39	0.67	1.09	1.40	1.63	2.00	2.33	2.61	2.88	3.25	3.25	3.25	3.25	3.25	3.73	4.89	5.61	6.44	6.90	6.90	6.44	6.01	4.89	3.97
58	0.45	0.77	1.18	1.53	1.77	2.16	2.51	2.81	3.10	3.48	3.48	3.48	3.48	3.48	4.00	5.24	6.01	6.90	7.39	7.39	6.90	6.44	5.24	4.26
59	0.51	0.87	1.29	1.66	1.92	2.33	2.71	3.03	3.32	3.73	3.73	3.73	3.73	3.73	4.29	5.61	6.44	7.39	7.92	7.92	7.39	6.90	5.61	4.56
60	0.59	1.00	1.40	1.81	2.09	2.51	2.93	3.26	3.57	4.00	4.00	4.00	4.00	4.00	4.59	6.01	6.90	7.92	8.49	8.49	7.92	7.39	6.01	4.89
61	0.67	1.10	1.53	1.97	2.27	2.71	3.16	3.51	3.83	4.29	4.29	4.29	4.29	4.29	4.92	6.44	7.39	8.49	9.09	9.09	8.49	7.92	6.44	5.24
62	0.77	1.21	1.66	2.15	2.46	2.93	3.41	3.79	4.11	4.59	4.59	4.59	4.59	4.59	5.28	6.90	7.92	9.09	9.74	9.74	9.09	8.49	6.90	5.61
63	0.87	1.32	1.81	2.34	2.65	3.16	3.69	4.08	4.41	4.92	4.92	4.92	4.92	4.92	5.66	7.39	8.49	9.74	10.4	10.4	9.74	9.09	7.39	6.01
64	1.00	1.45	1.97	2.54	2.88	3.41	3.98	4.39	4.73	5.28	5.28	5.28	5.28	5.28	6.06	7.92	9.09	10.4	11.2	11.2	10.4	9.74	7.92	6.44
65	1.11	1.60	2.15	2.77	3.12	3.69	4.30	4.71	5.08	5.66	5.66	5.66	5.66	5.66	6.50	8.49	9.74	11.2	12.0	12.0	11.2	10.4	8.49	6.90
66	1.22	1.75	2.34	3.01	3.39	3.98	4.64	5.07	5.45	6.06	6.06	6.06	6.06	6.06	6.96	9.09	10.4	12.0	12.8	12.8	12.0	11.2	9.09	7.39
67	1.35	1.92	2.54	3.28	3.68	4.30	5.01	5.46	5.85	6.50	6.50	6.50	6.50	6.50	7.46	9.74	11.2	12.8	13.8	13.8	12.8	12.0	9.74	7.92
68	1.49	2.11	2.77	3.57	3.99	4.64	5.41	5.88	6.27	6.96	6.96	6.96	6.96	6.96	8.00	10.4	12.0	13.8	14.7	14.7	13.8	12.8	10.4	8.49
69	1.65	2.32	3.01	3.89	4.33	5.01	5.84	6.33	6.73	7.46	7.46	7.46	7.46	7.46	8.57	11.2	12.8	14.7	15.8	15.8	14.7	13.8	11.2	9.09
70	1.82	2.55	3.28	4.23	4.69	5.41	6.31	6.81	7.23	8.00	8.00	8.00	8.00	8.00	9.19	12.0	13.8	15.8	16.9	16.9	15.8	14.7	12.0	9.74
71	2.02	2.79	3.57	4.60	5.09	5.84	6.81	7.33	7.75	8.57	8.57	8.57	8.57	8.57	9.85	12.8	14.7	16.9	18.1	18.1	16.9	15.8	12.8	10.4
72	2.23	3.07	3.89	5.01	5.52	6.31	7.36	7.90	8.32	9.19	9.19	9.19	9.19	9.19	10.6	13.8	15.8	18.1	19.4	19.4	18.1	16.9	13.8	11.2
73	2.46	3.37	4.23	5.46	5.99	6.81	7.94	8.50	8.93	9.85	9.85	9.85	9.85	9.85	11.3	14.7	16.9	19.4	20.8	20.8	19.4	18.1	14.7	12.0
74	2.72	3.70	4.60	5.94	6.50	7.36	8.57	9.15	9.59	10.6	10.6	10.6	10.6	10.6	12.1	15.8	18.1	20.8	22.3	22.3	20.8	19.4	15.8	12.8
75	3.01	4.06	5.01	6.46	7.05	7.94	9.19	9.85	10.3	11.3	11.3	11.3	11.3	11.3	13.0	16.9	19.4	22.3	23.9	23.9	22.3	20.8	16.9	13.8
76	3.32	4.46	5.46	7.03	7.65	8.57	9.85	10.6	11.0	12.1	12.1	12.1	12.1	12.1	13.9	18.1	20.8	23.9	25.6	25.6	23.9	22.3	18.1	14.7
77	3.67	4.89	5.94	7.66	8.29	9.19	10.6	11.3	11.8	13.0	13.0	13.0	13.0	13.0	14.9	19.4	22.3	25.6	27.4	27.4	25.6	23.9	19.4	15.8
78	4.06	5.37	6.46	8.33	9.00	9.85	11.3	12.1	12.7	13.9	13.9	13.9	13.9	13.9	16.0	20.8	23.9	27.4	29.4	29.4	27.4	25.6	20.8	16.9
79	4.49	5.90	7.03	9.07	9.76	10.6	12.1	13.0	13.6	14.9	14.9	14.9	14.9	14.9	17.1	22.3	25.6	29.4	31.5	31.5	29.4	27.4	22.3	18.1
80	4.96	6.48	7.66	9.85	10.6	11.3	13.0	13.9	14.6	16.0	16.0	16.0	16.0	16.0	18.4	23.9	27.4	31.5	33.7	33.7	31.5	29.4	23.9	19.4
81	5.48	7.11	8.33	10.6	11.3	12.1	13.9	14.9	15.7	17.1	17.1	17.1	17.1	17.1	19.7	25.6	29.4	33.7	36.1	36.1	33.7	31.5	25.6	20.8
82	6.06	7.81	9.07	11.3	12.1	13.0	14.9	16.0	16.9	18.4	18.4	18.4	18.4	18.4	21.1	27.4	31.5	36.1	38.7	38.7	36.1	33.7	27.4	22.3
83	6.70	8.57	9.87	12.1	13.0	13.9	16.0	17.1	18.1	19.7	19.7	19.7	19.7	19.7	22.6	29.4	33.7	38.7	41.5	41.5	38.7	36.1	29.4	23.9
84	7.41	9.41	10.7	13.0	13.9	14.9	17.1	18.4	19.4	21.1	21.1	21.1	21.1	21.1	24.3	31.5	36.1	41.5	44.4	44.4	41.5	38.7	31.5	25.6
85	8.19	10.3	11.7	13.9	14.9	16.0	18.4	19.7	20.9	22.6	22.6	22.6	22.6	22.6	26.0	33.7	38.7	44.4	47.6	47.6	44.4	41.5	33.7	27.4
86	9.05	11.3	12.7	14.9	16.0	17.1	19.7	21.1	22.4	24.3	24.3	24.3	24.3	24.3	27.9	36.1	41.5	47.6	51.0	51.0	47.6	44.4	36.1	29.4
87	10.0	12.1	13.9	16.0	17.1	18.4	21.1	22.6	24.0	26.0	26.0	26.0	26.0	26.0	29.9	38.7	44.4	51.0	54.7	54.7	51.0	47.6	38.7	31.5
88	11.1	13.0	14.9	17.1	18.4	19.7	22.6	24.3	25.9	27.9	27.9	27.9	27.9	27.9	32.0	41.5	47.6	54.7	58.6	58.6	54.7	51.0	41.5	33.7
89	12.2	13.9	16.0	18.4	19.7	21.1	24.3	26.0	27.7	29.9	29.9	29.9	29.9	29.9	34.3	44.4	51.0	58.6	62.7	62.7	58.6	54.7	44.4	36.1
90	13.5	14.9	17.1	19.7	21.1	22.6	26.0	27.9	29.7	32.0	32.0	32.0	32.0	32.0	36.8	47.6	54.7	62.7	67.2	67.2	62.7	58.6	47.6	38.7
91	14.9	16.0	18.4	21.1	22.6	24.3	27.9	29.9	31.8	34.3	34.3	34.3	34.3	34.3	39.4	51.0	58.6	67.2	72.0	72.0	67.2	62.7	51.0	41.5
92	16.0	17.1	19.7	22.6	24.3	26.0	29.9	32.0	34.2	36.8	36.8	36.8	36.8	36.8	42.2	54.7	62.7	72.0	77.2	77.2	72.0	67.2	54.7	44.4
93	17.1	18.4	21.1	24.3	26.0	27.9	32.0	34.3	36.7	39.4	39.4	39.4	39.4	39.4	45.3	58.6	67.2	77.2	82.7	82.7	77.2	72.0	58.6	47.6
94	18.4	19.7	22.6	26.0	27.9	29.9	34.3	36.8	39.4	42.2	42.2	42.2	42.2	42.2	48.5	62.7	72.0	82.7	88.6	88.6	82.7	77.2	62.7	51.0
95	19.7	21.1	24.3	27.9	29.9	32.0	36.8	39.4	42.2	45.3	45.3	45.3	45.3	45.3	52.0	67.2	77.2	88.6	94.9	94.9	88.6	82.7	67.2	54.7
96	21.1	22.6	26.0	29.9	32.0	34.3	39.4	42.2	45.3	48.5	48.5	48.5	48.5	48.5	55.7	72.0	82.7	94.9	102	102	94.9	88.6	72.0	58.6
97	22.6	24.3	27.9	32.0	34.3	36.8	42.2	45.3	48.5	52.0	52.0	52.0	52.0	52.0	59.7	77.2	88.6	102	109	109	102	94.9	77.2	62.7
98	24.3	26.0	29.9	34.3	36.8	39.4	45.3	48.5	52.0	55.7	55.7	55.7	55.7	55.7	64.0	82.7	94.9	109	117	117	109	102	82.7	67.2
99	26.0	27.9	32.0	36.8	39.4	42.2	48.5	52.0	55.7	59.7	59.7	59.7	59.7	59.7	68.6	88.6	102	117	125	125	117	109	88.6	72.0
100	27.9	29.9	34.3	39.4	42.2	45.3	52.0	55.7	59.7	64.0	64.0	64.0	64.0	64.0	73.5	94.9	109	125	134	134	125	117	94.9	77.2
101	29.9	32.0	36.8	42.2	45.3	48.5	55.7	59.7	64.0	68.6	68.6	68.6	68.6	68.6	78.8	102	117	134	144	144	134	125	102	82.7
102	32.0	34.3	39.4	45.3	48.5	52.0	59.7	64.0	68.6	73.5	73.5	73.5	73.5	73.5	84.4	109	125	144	154	154	144	134	109	88.6
103	34.3	36.8	42.2	48.5	52.0	55.7	64.0	68.6	73.5	78.8	78.8	78.8	78.8	78.8	90.5	117	134	154	165	165	154	144	117	94.9
104	36.8	39.4	45.3	52.0	55.7	59.7	68.6	73.5	78.8	84.4	84.4	84.4	84.4	84.4	97.0	125	144	165	177	177	165	154	125	102
105	39.4	42.2	48.5	55.7	59.7	64.0	73.5	78.8	84.4	90.5	90.5	90.5	90.5	90.5	104	134	154	177	189	189	177	165	134	109
106	42.2	45.3	52.0	59.7	64.0	68.6	78.8	84.4	90.5	97.0	97.0	97.0	97.0	97.0	111	144	165	189	203	203	189	177	144	117
107	45.3	48.5	55.7	64.0	68.6	73.5	84.4	90.5	97.0	104	104	104	104	104	119	154	177	203	217	217	203	189	154	125
108	48.5	52.0	59.7	68.6	73.5	78.8	90.5	97.0	104	111	111	111	111	111	128	165	189	217	233	233	217	203	165	134
109	52.0	55.7	64.0	73.5	78.8	84.4	97.0	104	111	119	119	119	119	119	137	177	203	233	249	249	233	217	177	144
110	55.7	59.7	68.6	78.8	84.4	90.5	104	111	119	128	128	128	128	128	147	189	217	249	267	267	249	233	189	154
111	59.7	64.0	73.5	84.4	90.5	97.0	111	119	128	137	137	137	137	137	158	203	233	267	286	286	267	249	203	165
112	64.0	68.6	78.8	90.5	97.0	104	119	128	137	147	147	147	147	147	169	217	249	286	307	307	286	267	217	177
113	68.6	73.5	84.4	97.0	104	111	128	137	147	158	158	158	158	158	181	233	267	307	329	329	307	286	233	189
114	73.5	78.8	90.5	104	111	119	137	147	158	169	169	169	169	169	194	249	286	329	352	352	329	307	249	203
115	78.8	84.4	97.0	111	119	128	147	158	169	181	181	181	181	181	208	267	307	352	377	377	352	329	267	217
116	84.4	90.5	104	119	128	137	158	169	181	194	194	194	194	194	223	286	329	377	404	404	377	352	286	233
117	90.5	97.0	111	128	137	147	169	181	194	208	208	208	208	208	239	307	352	404	433	433	404	377	307	249
118	97.0	104	119	137	147	158	181	194	208	223	223	223	223	223	256	329	377	433	464	464	433	404	329	267
119	104	111	128	147	158	169	194	208	223	239	239	239	239	239	274	352	404	464	497	497	464	433	352	286
120	111	119	137	158	169	181	208	223	239	256	256	256	256	256	294	377	433	497	533	533	497	464	377	307
121	119	128	147	169	181	194	223	239	256	274	274	274	274	274	315	404	464	533	571	571	533	497	404	329
122	128	137	158	181	194	208	239	256	274	294	294	294	294	294	338	433	497	571	611	611	571	533	433	352
123	137	147	169	194	208	223	256	274	294	315	315	315	315	315	362	464	533	611	655	655	611	571	464	377
124	147	158	181	208	223	239	274	294	315	338	338	338	338	338	388	497	571	655	702	702	655	611	497	404



Section B36.6 *Correction for spectral irregularities.* Noise having pronounced irregularities in the spectrum (for example, discrete frequency components or tones), must be adjusted by the correction factor C(k) calculated as follows:

(a) *Step 1.* Starting with the corrected sound pressure level in the 80 Hz one-third octave band (band number 3), calculate the changes in sound pressure level (or "slopes") in the remainder of the one-third octave bands as follows:

$$s(3,k) = \text{no value}$$
$$s(4,k) = SPL(4,k) - SPL(3,k)$$
$$\vdots$$
$$s(i,k) = SPL(i,k) - SPL((i-1),k)$$
$$\vdots$$
$$s(24,k) = SPL(24,k) - SPL(23,k)$$

(b) *Step 2.* Encircle the value of the slope, s(i,k), where the absolute value of the change in slope is greater than 5; that is, where

$$\| \Delta s(i,k) \| = \| s(i,k) - s((i-1),k) \| > 5$$

(c) *Step 3.* (1) If the encircled value of the slope s(i,k) is positive and algebraically greater than the slope s((i−1),k), encircle SPL(i,k).

(2) If the encircled value of the slope s(i,k) is zero or negative and the slope s((i−1),k) is positive, encircle (SPL((i−1),k)).

(3) For all other cases, no sound pressure level value is to be encircled.

(d) *Step 4.* Omit all SPL(i,k) encircled in Step 3 and compute new sound pressure levels SPL'(i,k) as follows:

(1) For nonencircled sound pressure levels, let the new sound pressure levels equal the original sound pressure levels,

$$SPL'(i,k) = SPL(i,k)$$

(2) For encircled sound pressure levels in bands 1-23, let the new sound pressure level equal the arithmetic average of the preceding and following sound pressure levels,

$$SPL'(i,k) = (\tfrac{1}{2})(SPL((i-1),k) + SPL((i+1),k))$$

(3) If the sound pressure level in the highest frequency band (i=24) is encircled, let the new sound pressure level in that band equal

$$SPL'(24,k) = SPL(23,k) + s(23,k).$$

(e) *Step 5.* Recompute new slopes s' (i,k), including one for an imaginary 25-th band, as follows:

$$s'(3,k) = s'(4,k)$$
$$s'(4,k) = SPL'(4,k) - SPL'(3,k)$$
$$\vdots$$
$$s'(i,k) = SPL'(i,k) - SPL'((i-1),k)$$
$$s'(24,k) = SPL'(24,k) - SPL'(23,k)$$
$$s'(25,k) = s'(24,k)$$

(f) *Step 6.* For i from 3 to 23, compute the arithmetic average of the three adjacent slopes as follows:

$$s(i,k) = (\tfrac{1}{3})[s'(i,k) + s'((i+1),k) + s'((i+2),k)]$$

(g) *Step 7.* Compute final adjusted one-third octave-band sound pressure levels, SPL" (i,k), by beginning with band number 3 and proceeding to band number 24 as follows:

$$SPL''(3,k) = SPL(3,k)$$
$$SPL''(4,k) = SPL''(3,k) + s(3,k)$$
$$\vdots$$
$$SPL''(i,k) = SPL''((i-1),k) + s((i-1),k)$$
$$\vdots$$
$$SPL''(24,k) = SPL''(23,k) + s(23,k)$$

(h) *Step 8.* Calculate the differences, F(i,k), between the original and the adjusted sound pressure levels as follows:

$$F(i,k) = SPL(i,k) - SPL''(i,k)$$

and note only value greater than zero.

(i) *Step 9.* For each of the 24 one-third octave bands, determine tone correction factors from the sound pressure level differences F(i,k) and Table B2.

(j) *Step 10.* Designate the largest of the tone correction factors, determined in Step 9, as C(k). An example of the tone correction procedure is given in Table B3.

(k) Tone corrected perceived noise levels PNLT(k) are determined by adding the C(k) values to corresponding PNL(k) values, that is,

$$PNLT(k) = PNL(k) + C(k)$$

(l) For any i-th one-third octave band, at any k-th increment of time, for which the tone correction factor is suspected to result from something other than (or in addition to) an actual tone (or any special irregularity other than aircraft noise), an additional analysis may be made using a filter with a bandwidth narrower than one-third of an octave. If the narrow band analysis corroborates that suspicion, then a revised value for the background sound pressure level, SPL"(i,k) may be determined from the analysis and used to compute a revised tone correction factor, F(i,k), for that particular one-third octave band.

(m) Tones resulting from ground-plane reflections in the 800 Hz and lower one-third octave bands may be excluded from the calculation of corrections for spectral irregularities. To qualify for this exclusion, the pseudotones must be clearly identified as

not being related to the engine noise. This identification may be made either by comparing measured data with data from a flush mounted microphone, or by observing the Doppler shift characteristics of the tone during the flyover-noise/time history. Since pseudotones are related to ground reflections, a microphone mounted flush to the ground will yield a spectral shape which can be distinguished from that produced by the 4-foot high microphone at those frequencies which can be related to ground reflection's geometrical relationships. Identification through Doppler shifting (the symmetric variation of frequency with time) can be made because the Doppler frequency variation yields a frequency increase for an approaching signal and a frequency decrease for a receding signal. Pseudotones at frequencies above 800 Hz generally should not yield significant tone corrections. However, for consistency, each tone correction value must be included in the computation for spectral irregularities. While the tone corrections below 800 Hz may be ignored for the spectral irregularity correction, the SPL values must be included in the noy calculation prescribed in section B36.13 of this appendix.

(n) After the value of PNLTM for each flyover-noise/time history, is identified, the frequency for the largest tone correction factor (C(k)) must be identified for the two preceding and the two succeeding, 500-millisecond time intervals, to identify possible tone suppression at PNLTM as a result of band sharing of the tone. If the value of C(k) for PNLTM is less than the average value of C(k) for those five consecutive time intervals, that average value of C(k) must be used to compute a new value for PNLTM.

Section B36.7 Maximum tone corrected perceived noise level. (a) The maximum tone corrected perceived noise level, PNLTM, *is the maximum calculated value* of the tone corrected perceived noise level, PNLT(k), calculated in accordance with the procedure of section B36.5 of this appendix. Figure B2 is an example of a flyover noise time history where the maximum value is clearly indicated. Half-second time intervals, Δt, are small enough to obtain a satisfactory noise time history.

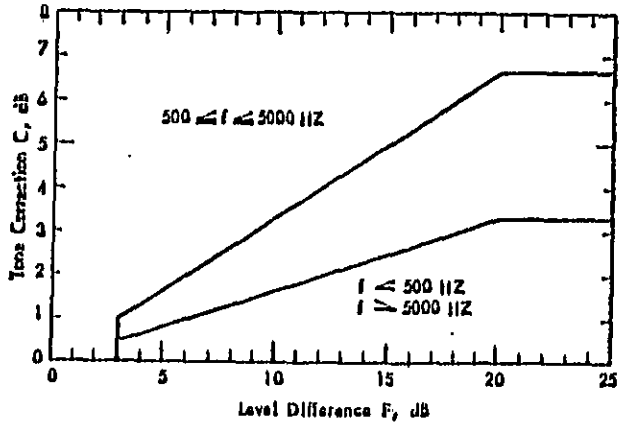


TABLE B2—TONE CORRECTION FACTORS

Frequency f, Hz	Level difference F, dB	Tone correction C, dB
50 ≤ f < 500	F < 3 3 ≤ F < 20 20 ≤ F	0 F/6 3 1/3
500 ≤ f ≤ 5000	F < 3 3 ≤ F < 20 20 ≤ F	0 F/3 6 2/3
5000 < f ≤ 10000	F < 3 3 ≤ F < 20 20 ≤ F	0 F/6 3 1/3

① Band (i)	② f HZ	③ SPL dB	④ S dB Step 1	⑤ ΔS1 dB Step 2	⑥ SPL' dB Step 4	⑦ S' dB Step 5	⑧ S̄ dB Step 6	⑨ SPL" dB Step 7	⑩ F dB Step 8	⑪ C. dB Step 9
1	50	-	-	-	-	-	-	-	-	-
2	63	-	-	-	-	-	-	-	-	-
3	80	70	-	-	70	-8	-2 1/3	70	-	
4	100	62	- 8	-	62	-8	+3 1/3	67 2/3	-	
5	125	(70)	+(8)	16	71	+9	+6 2/3	71	-	
6	160	80	+10	2	80	+9	+2 2/3	77 2/3	2 1/3	
7	200	82	+(2)	0	82	+2	-1 1/3	80 1/3	1 2/3	
8	250	(83)	+ 1	1	79	-3	-1 1/3	79	4	2/3
9	315	76	-(7)	8	76	-3	+ 1/3	77 2/3	-	
10	400	(80)	+(4)	11	78	+2	+1	78	2	
11	500	80	0	4	80	+2	0	79	1	
12	630	79	- 1	1	79	-1	0	79	-	
13	800	78	- 1	0	78	-1	- 1/3	79	-	
14	1000	80	+ 2	3	80	+2	- 2/3	78 2/3	1 1/3	
15	1250	78	- 2	4	78	-2	- 1/3	78	-	
16	1600	76	- 2	0	76	-2	+ 1/3	77 2/3	-	
17	2000	79	+ 3	5	79	+3	+1	78	1	
18	2500	(85)	+ 6	3	79	0	- 1/3	79	6	[2]
19	3150	79	-(6)	12	79	0	-2 2/3	78 2/3	1/3	
20	4000	78	-	5	78	-1	-6 1/3	76	2	
21	5000	71	-(7)	6	71	-7	-8	69 2/3	1 1/3	
22	6300	60	-11	4	60	-11	-8 2/3	61 2/3	-	
23	8000	54	- 6	5	54	-6	-8	53	1	0
24	10000	45	- 9	3	45	-9	-	45	-	
						-9				

Step 1	③(i) - ③(i-1)
Step 2	|④(i) - ④(i-1)|
Step 3	see instructions
Step 4	see instructions
Step 5	⑥(i) - ⑥(i-1)

Step 6	[⑦(i) + ②(i+1) + ⑦(i+2)] ÷ 3
Step 7	⑨(i-1) + ⑧(i-1)
Step 8	③(i) - ⑨(i)
Step 9	see Table B2

Table B1. Example of Tone Correction Calculation for a Turbofan Engine

(b) If there are no pronounced irregularities in the spectrum, then the procedure of § B36.6 of this Appendix would be redundant since PNLTM(k) would be identically equal to PNL(k). For this case, PNLTM would be the maximum value of PNL(k) and would equal PNLM.

Section B36.9 *Duration correction.* The duration correction factor D is determined by the integration technique defined by the expression:

$$D = 10 \log \left[(1/T) \int_{t(1)}^{t(2)} \text{ant}\,[PNLT/10]\, dt \right] - PNLTM$$

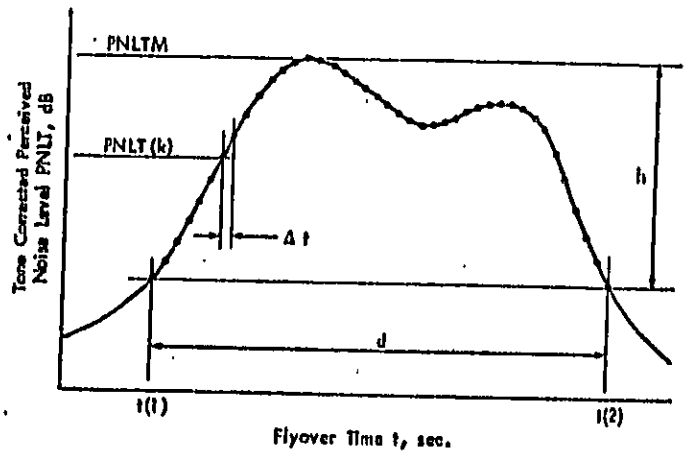


Figure B2. Example of Perceived Noise Level Corrected for Tones as a Function of Aircraft Flyover Time

where T is a normalizing time constant, PNLTM is the maximum value of PNLT, and t(1) and t(2) are the limits of the significant noise time history.

(a) Since PNLT is calculated from measured values of SPL, there will, in general, be no obvious equation for PNLT as a function of time. Consequently, the equation can be rewritten with a summation sign instead of an integral sign as follows:

$$D = 10 \log \left[(1/T) \sum_{k=0}^{d} \Delta t \text{ ant } (PNLT(k)/10) \right] - PNLTM$$

where Δt is the length of the equal increments of time for which PNLT(k) is calculated and d is the time interval to the nearest 1.0 second during which PNLT(k) is within a specified value, h, of PNLTM.

(b) Half-second time intervals for Δt are small enough to obtain a satisfactory history of the perceived noise level. A shorter time interval may be selected by the applicant provided approved limits and constants are used.

(c) The following values for T, Δt, and h, must be used in calculating D:

$$T = 10 \text{ sec},$$

$$\Delta t = 0.5 \text{ sec}, \text{ and}$$

$$h = 10 \text{ dB}.$$

Using the above values, the equation for D becomes

$$D = 10 \log \left[\sum_{k=0}^{N} \text{ant } (PNLT(k)/10) \right] - PNLTM - 13$$

where the integer d is the duration time defined by the points that are 10 dB less than PNLTM.

(d) If the 10 dB-down points fall between calculated PNLT(k) values (the usual case), the applicable limits for the duration time must be chosen from the PNLT(k) values closest to PNLTM − 10. For those cases with more than one peak value of PNLT(k), the applicable limits must be chosen to yield the largest possible value for the duration time.

(e) If the value of PNLT(k) at the 10 dB-down points is 90 PNdB or less, the value of d may be taken as the time interval between the initial and the final times for which PNLT(k) equals 90 PNdB.

(f) If the value of PNLT(k) at the 10 dB-down points is 90 PNdB or less, the value of d may be taken as the time interval between the initial and the final times for which PNLT(k) equals 90 PNdB, except that, for applications made after September 17, 1971, the aircraft testing procedures must include the 10 dB-down points in the flyover noise/time record.

Section B36.11 *Effective perceived noise level.* (a) The total subjective effect of an aircraft flyover is designated "effective perceived noise level," EPNL, and is equal to the algebraic sum of the maximum value of the tone corrected perceived noise level, PNLTM, and the duration correction, D. That is,

$$EPNL = PNLTM + D$$

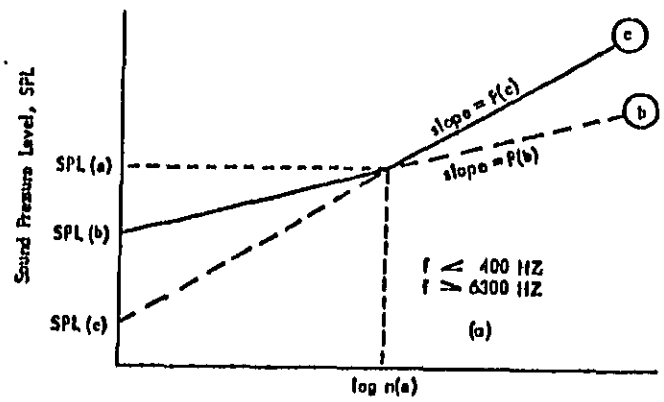
where PNLTM and D are calculated under sections B36.7 and B36.9 of this appendix.

(b) The above equation can be rewritten by substituting the equation for D from § B36.9 of this appendix, that is,

$$EPNL = 10 \log \left[\sum_{k=0}^{N} \text{ant } (PNLT(k)/10) \right] - 13$$

Section B36.13 *Mathematical formulation of noy tables.* (a) The relationship between sound pressure level and perceived noisiness given in Table B1 is illustrated in Figure B3. The variation of SPL with log n for a given one-third octave band can be expressed by either one or two straight lines depending upon the frequency range. Figure B3(a) illustrates the double line case for frequencies below 400 Hz, and above 6,300 Hz and Figure B3(b) illustrates the single line case for all other frequencies.

(b) The important aspects of the mathematical formulation are:



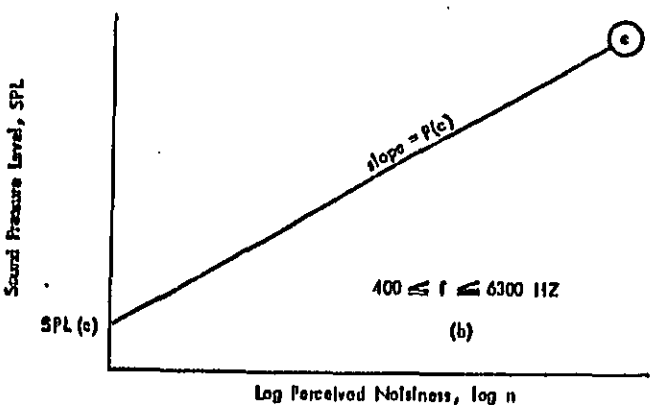


Figure B3. Sound Pressure Level as a Function of Noyt.

), the slopes of the straight lines, p(b) and
e),
2, the intercepts of the lines on the SPL-
is, SPL(b), and SPL(c), and
1, the coordinates of the discontinuity,
L(a), and log n(a).
The equations are as follows:

ase 1, Figure B3(a). f<400 Hz.
f>6300 Hz.

$$SPL(a) = \frac{p(c)SPL(b) - p(b)SPL(c)}{p(c) - p(b)}$$

$$\log n(a) = \frac{SPL(c) - SPL(b)}{p(b) - p(c)}$$

(a) SPL(b)≤SPL≤SPL(a).

$$n = \text{ant} \frac{SPL - SPL(b)}{p(b)}$$

(b) SPL>SPL(a).

$$n = \text{ant} \frac{SPL - SPL(c)}{p(c)}$$

(c) 0≤log n≤log n(a).

SPL=p(b) log n + SPL(b)

(d) log n≥log n(a).

SPL=p(c) log n + SPL(c).

Case 2, Figure B3(b), 400≤f≤6300 Hz.

(a) SPL≥SPL(a).

$$n = \text{ant} \frac{SPL - SPL(c)}{p(c)}$$

(b) log n≥0.

SPL=p(c) log n + SPL(c)

4 the reciprocals of the slopes be defined
as.

M(b)=1/p(b)
M(c)=1/p(c)

hen the equations can be written,

ase 1, Figure B3(a). f<400 Hz.
f>6300 Hz.

$$SPL(a) = \frac{M(b)SPL(b) - M(c)SPL(c)}{M(b) - M(c)}$$

$$\log n(a) = \frac{M(b)M(c)(SPL(c) - SPL(b))}{M(c) - M(b)}$$

(a) SPL(b)≤SPL≤SPL(a).

n=ant M(b)(SPL−SPL(b))

(b) SPL≤SPL(a).

n=ant M(c)(SPL−SPL(c))

(c) 0≤log n≤log n(a).

$$SPL = \frac{\log n}{M(b)} + SPL(b)$$

(d) log n≥log n(a).

$$SPL = \frac{\log n}{M(c)} + SPL(c)$$

Case 2. Figure B3(b), 400≤f≤6300 Hz.

(a) SPL≥SPL(a).

n=ant M(c)(SPL−SPL(c))

(b) log n≥0.

$$SPL = \frac{\log n}{M(c)} + SPL(c)$$

(c) Table B4 lists the values of the important constants necessary to calculate sound pressure level as a function of perceived noisiness.

[Doc. No. 9337, 34 FR 18304, Nov. 18, 1969, as amended by Amdt. 36-5, 41 FR 30080, Aug. 19, 1976; Amdt. 36-9, 43 FR 8746, Mar. 2, 1978]

Appendix C—Noise Levels for Transport Category and Turbojet Powered Airplanes Under § 36.201

Sec.
C36.1 *Noise measurement and evaluation.*
C36.3 *Noise measuring points.*
C36.5 *Noise levels.*
C36.7 *Takeoff test conditions.*
C36.9 *Approach test conditions.*

Section C36.1 *Noise measurement and evaluation.* Compliance with this appendix must be shown with noise levels measured and evaluated as prescribed, respectively, by

Appendix A and Appendix B of this part, or under approved equivalent procedures.

Section C36.3 *Noise measuring points.* Compliance with the noise level standards of section C36.5 must be shown—

(a) For takeoff, at a point 21, 325 feet (6,500 meters) from the start of the takeoff roll on the extended centerline of the runway;

(b) For approach, at a point 6,562 feet (2,000 meters) from the threshold on the extended centerline of the runway; and

(c) For the sideline, at the point, on a line parallel to and 1,476 feet (450 meters) from the extended centerline of the runway, where the noise level after liftoff is greatest, except that, for an airplane powered by more than three turbojet engines, this distance must be 0.35 nautical miles for the purpose of showing compliance with Stage 1 or Stage 2 noise limits (as applicable).

Sec. C36.5 *Noise levels.*

(a) *Limits.* Except as provided in paragraphs (b) and (c) of this section, it must be shown by flight test that the noise levels of the airplane, at the measuring points described in section C36.3, do not exceed the following (with appropriate interpolation between weights):

(1) Stage 1 noise limits for acoustical changes for airplanes regardless of the number of engines are those noise levels prescribed under § 36.7(c) of this part.

(2) Stage 2 noise limits for airplanes regardless of the number of engines are as follows:

(i) *For takeoff.* 108 EPNdB for maximum weights of 600,000 pounds or more, reduced by 5 EPNdB per halving of the 600,000 pounds maximum weight down to 93 EPNdB for maximum weights of 75,000 pounds and less.

(ii) *For sideline and approach.*—108 EPNdB for maximum weights of 600,000 pounds or more, reduced by 3 EPNdB per halving of the 600,000 pounds maximum weight down to 102 EPNdB for maximum weights of 75,000 pounds and less.

(3) Stage 3 noise limits are as follows:

(i) *For takeoff.*

(A) *For airplanes with more than 3 engines.* 106 EPNdB for maximum weights of 850,000 pounds or more, reduced by 4 EPNdB per halving of the 850,000 pounds maximum weight down to 89 EPNdB for maximum weights of 44,673 pounds or less;

(B) *For airplanes with 3 engines.*—104 EPNdB for maximum weights of 850,000 pounds or more, reduced by 4 EPNdB per halving of the 850,000 pounds maximum weight down to 89 EPNdB for maximum weights of 63,177 pounds and less; and

(C) *For airplanes with fewer than 3 engines.*—101 EPNdB for maximum weights of 850,000 pounds or more, reduced by 4 EPNdB per halving of the 850,000 pounds maximum weight down to 89 EPNdB for maximum weights of 100,250 pounds and less.

(ii) *For sideline,* regardless of the number of engines, 103 EPNdB for maximum weights of 882,000 pounds or more, reduced by 2.56 EPNdB per halving of the 882,000 pounds maximum weight down to 94 EPNdB for maximum weights of 77,200 pounds or less.

(iii) *For approach,* regardless of the number of engines.—106 EPNdB for maximum weights of 617,300 pounds or more, reduced by 2.33 EPNdB per halving of the 617,300 pounds weight down to 98 EPNdB for maximum weights of 77,200 pounds or less.

(b) *Tradeoffs.* Except to the extent limited under §§ 36.7(c)(1) and 36.7(d)(3)(i)(B) of this part, the noise level limits prescribed in paragraph (a) of this section may be exceeded at one or two of the measuring points specified in section C36.3 of this appendix, if—

(1) The sum of the exceedances is not greater than 3 EPNdB;

(2) No exceedance is greater than 2 EPNdB; and

(3) The exceedances are completely offset by reductions at other required measuring points.

Band (i)	f (Hz)	M(b)	SPL (b) dB	SPL (c) dB	M(c)	SPL (c) dB
1	50	0.043478	64	81.0	0.030103	57
2	63	0.040570	60	85.8	0.030103	51
3	80	0.036031	56	87.3	0.030103	49
4	100	0.038631	53	79.8	0.030103	47
5	125	0.035336	51	79.6	0.030103	46
6	160	0.033333	48	78.0	0.030103	45
7	200	0.033333	46	74.0	0.030103	43
8	250	0.032051	44	74.8	0.030103	42
9	315	0.030675	42	84.6	0.030103	41
10	400				0.030103	40
11	500				0.030103	40
12	630				0.030103	40
13	800				0.030103	40
14	1000				0.030103	40
15	1250				0.030103	38

Point (i)		M(d)	SPL (h) dB	SPL (g) dB	M(c)	SPL (c) dB
16	1500				0.030103	34
17	2000				0.029960	32
18	2500				0.029960	30
19	3150				0.029960	29
20	4000				0.029960	28
21	5000				0.029960	30
22	6300				0.029960	31
23	8000	0.042285	37	44.3	0.029960	34
24	10000	0.042285	41	50.7	0.029960	37

(c) *Prior applications.* For applications for type certificates made prior to December 1, 1969, and for applications for approval of changes in type design involving acoustical changes to airplanes covered by those certificates that are made before October 20, 1975, and approved before August 1, 1981, for airplanes powered by more than three turbojet engines with bypass ratios of two or more, the value prescribed in paragraph (b)(1) of this section may not exceed 8 EPNdB and the value prescribed in paragraph (b)(2) of this section may not exceed 3 EPNdB.

Sec. C36.7 *Takeoff test conditions.*

(a) This section applies to all takeoff noise tests conducted under this appendix in showing compliance with this part.

(b) Takeoff power or thrust must be used from the start of takeoff roll to at least the following altitude above the runway:

(1) *For Stage 1 airplanes and for Stage 2 airplanes that do not have turbojet engines with a bypass ratio of 2 or more,* the following apply:

(i) For airplanes with more than three turbojet engines—700 feet (214 meters).

(ii) For all other airplanes—1,000 feet (305 meters).

(2) *For Stage 2 airplanes that have turbojet engines with a bypass ratio of 2 or more and for Stage 3 airplane,* the following apply:

(i) For airplanes with more than three turbojet engines—689 feet (210 meters).

(ii) For airplanes with three turbojet engines—853 feet (260 meters).

(iii) For airplanes with fewer than three turbojet engines -984 feet (300 meters).

(iv) For airplanes not powered by turbojet engines -1,000 feet (305 meters).

(c) Upon reaching the altitude specified in paragraph (b) of this section, the power or thrust may not be reduced below that needed to maintain level flight with one engine inoperative, or to maintain a four percent climb gradient, whichever power or thrust is greater.

(d) Except as provided in paragraph (f) of this section, a speed of at least V_2 + 10 knots must be attained as soon as practicable after liftoff, and must be maintained throughout the takeoff noise test.

(e) A constant takeoff configuration, selected by the applicant, must be maintained throughout the takeoff noise test, except that the landing gear may be retracted.

(f) For applications made for subsonic airplanes after September 17, 1971, and for Concorde airplanes, the following apply:

(1) For subsonic airplanes the test day speeds and the acoustic day reference speed must be the minimum approved value of V_2 + 10 knots, or the all-engines-operating speed at 35 feet (for turbine engine powered airplanes) or 50 feet (for reciprocating engine powered airplanes), whichever speed is greater as determined under the regulations constituting the type certification basis of the airplane. These tests must be conducted at the test day speeds±3 knots. Noise values measured at the test day speeds must be corrected to the acoustic day reference speed.

(2) For Concorde airplanes, the test day speeds and the acoustic day reference speed must be the minimum approved value of V_2 + 30 knots, or the all-engines-operating speed at 35 feet, whichever speed is greater as determined under the regulations constituting the type certification basis of the airplane, except that the reference speed may not exceed 250 knot. These tests must be conducted at the test day speeds ±3 knots. Noise values measured at the test day speeds must be corrected to the acoustic day reference speed.

(3) If a negative runway gradient exists in the direction of takeoff, performance and acoustic data must be corrected to the zero slope condition.

Sec. C36.9 *Approach test conditions.*

(a) This section applies to all approaches conducted in showing compliance with this part.

(b) The airplane's configuration must be that used in showing compliance with the landing requirements in the airworthiness regulations constituting the type certification basis of the airplane. If more than one configuration is used in showing compliance with the landing requirements in the airworthiness regulations constituting the type certification basis of the airplane, the configuration that is most critical from a noise standpoint must be used.

(c) The approaches must be conducted with a steady glide angle of 3°±0.5° and must be continued to a normal touchdown with no airframe configuration change.

(d) Except as provided in paragraph (f) of this section, a steady approach speed of not less than 1.30 V_2 +10 knots must be established and maintained over the approach measuring point.

(e) All engines must be operating at approximately the same power or thrust.

(f) For applications made for subsonic airplanes after September 17, 1971, and for Concorde airplanes, the following apply:

(1) For subsonic airplanes a steady approach speed, that is either 1.30 V_2 +10 knots or the speed used in establishing the approved landing distance under the airworthiness regulations constituting the type certification basis of the airplane, whichever speed is greatest, must be established and maintained over the approach measuring point.

(2) For Concorde airplanes a steady approach speed, that is either the landing reference speed + 10 knots or the speed used in establishing the approved landing distance under the airworthiness regulations constituting the type certification basis of the airplane, whichever speed is greater, must be established and maintained over the approach measuring point.

(3) A tolerance of ±3 knots may be used throughout the approach noise testing.

(Secs. 307, 313(a), 601, 603, and 611, 49 U.S.C. 1348, 1354(a), 1421, 1423, and 1431; sec. 6(c), 49 U.S.C. 1655(c); Title I of the National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.); and EO 11514, Mar. 5, 1970)

[Doc. No. 9237, 34 FR 18384, Nov. 18, 1969, as amended by Amdt. 36-1, 34 FR 18810, Nov. 26, 1969; 34 FR 19020, Nov. 29, 1969; Amdt. 36-5, 41 FR 35056, Aug. 19, 1976, Amdt. 36-7, 42 FR 12373, Mar. 3, 1977; Amdt. 36-8, 43 FR 8730, Mar. 2, 1978; Amdt. 36-10, 43 FR 38420, June 29, 1978; 43 FR 44476, Sept. 28, 1978; 43 FR 47468, Oct. 16, 1978; Amdt. 36-12, 46 FR 33465, June 29, 1981]

Appendices D-E—[Reserved]

Appendix F—Noise Requirements for Propeller-Driven Small Airplanes

PART A—GENERAL

Sec.
F36.1 *Scope.*

PART B—NOISE MEASUREMENT

F36.101 *General test conditions.*

Sec.
F36.103 *Acoustical measurement system.*
F36.105 *Sensing, recording, and reproducing equipment.*
F36.107 *Noise measurement procedures.*
F36.109 *Data recording, reporting, and approval.*
F36.111 *Flight procedures.*

PART C—DATA CORRECTION

F36.201 *Correction of data.*
F36.203 *Validity of results.*

PART D—NOISE LIMITS

F36.301 *Aircraft noise limits.*

PART A—GENERAL

Section F36.1 *Scope.* This appendix prescribes limiting noise levels, and procedures for measuring noise and correcting noise data, for the propeller driven small airplanes specified in § 36.1.

PART B—NOISE MEASUREMENT

Sec. F36.101 *General test conditions.*

(a) The test area must be relatively flat terrain having no excessive sound absorption 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 degrees from this axis.

(b) The tests must be carried out under the following 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 degrees F. or below 41 degrees 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 wind velocities of more than 4 knots are reported, the flight direction must be aligned to within ±15 degrees of wind direction and flights with tail wind and head wind must be made in equal numbers. 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 alter 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.

(f) Sound pressure level data for noise valuation purposes must be obtained with coustical equipment that complies with ection F36.103 of this appendix.

ec. F36.103 *Acoustical measurement system.* The acoustical measurement system must consist of approved equipment equivalent to the following:

(a) A microphone system with frequency esponse compatible with measurement and nalysis system accuracy as prescribed in ection F36.105 of this appendix.

(b) Tripods or similar microphone mountngs that minimize interference with the ound being measured.

(c) Recording and reproducing equipment haracteristics, frequency response, and dyamic range compatible with the response nd accuracy requirements of section 36.103 of this appendix.

(d) Acoustic calibrators using sine wave or roadband noise of known sound pressure evel. If broadband noise is used, the signal ust be described in terms of its average nd maximum root-mean-square (rms) value r nonoverload signal level.

ec. F36.105 *Sensing, recording, and reproducing equipment.*

(a) The noise produced by the airplane ust be recorded. A magnetic tape recorder s acceptable.

(b) The characteristics of the system must omply with the recommendations in Internaional Electrotechnical Commission (IEC) ublication No. 179, entitled "Precision ound Level Meters" as incorporated by reference in Part 36 under § 36.6 of this part.

(c) The response of the complete system o a sensibly plane progressive sinusoidal ave of constant amplitude must lie within he tolerance limits specified in IEC Publiation No. 179, dated 1973, over the frequen-y range 45 to 11,200 Hz.

(d) If limitations of the dynamic range of he equipment make it necessary, high freuency pre-emphasis must be added to the ecording channel with the converse de-emhasis on playback. The pre-emphasis must e applied such that the instantaneous reorded sound pressure level of the noise ignal between 800 and 11,200 Hz does not ary more than 20 dB between the maxium and minimum one-third octave bands.

(e) If requested by the Administrator, the ecorded noise signal must be read through n "A" filter with dynamic characteristics esignated "slow," as defined in IEC Publiation No. 179, dated 1973. The output ignal from the filter must be fed to a rectifying circuit with square law rectification, ntegrated with time constants for charge nd discharge of about 1 second or 800 milliseconds.

(f) The equipment must be acoustically alibrated using facilities for acoustic free-field calibration and if analysis of the tape recording is requested by the Administrator, the analysis equipment shall be electronically calibrated by a method approved by the FAA.

(g) A windscreen must be employed with microphone during all measurements of aircraft noise when the wind speed is in excess of 6 knots.

Sec. F36.107 *Noise measurement procedures.*

(a) The microphones must be oriented in a known direction so that the maximum sound received arrives as nearly as possible in the direction for which the microphones are calibrated. The microphone sensing elements must be approximately 4' 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) The ambient noise, including both acoustical background and electrical noise of the measurement systems, must be recorded and determined in the test area with the system gain set at levels that will be used for aircraft noise measurements. If aircraft sound pressure levels do not exceed the background sound pressure levels by at least 10 dB(A), approved corrections for the contribution of background sound pressure level to the observed sound pressure level must be applied.

Sec. 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 operations employed in obtaining the final data.

(b) Measured and corrected sound pressure levels obtained with equipment conforming to the specifications described in section F36.105 of this appendix must be reported.

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

(d) The following atmospheric data, measured immediately before, after, or during each test at the observation points prescribed in section F36.101 of this appendix must be reported:

(1) Air temperature and relative humidity.

(2) Maximum, minimum, and average wind velocities.

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

(f) The following airplane information must be reported:

(1) Type, model and serial numbers (if any) of airplanes, engines, and propellers.

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

(3) Maximum certificated takeoff weights.

(4) Airspeed in knots for each overflight of the measuring point.

(5) Engine performance in terms of revolutions per minute 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.

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

Sec. 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) Each test over flight must be conducted:

(1) At not less than the highest power in the normal operating range provided in an Airplane Flight Manual, or in any combination of approved manual material, approved placard, or approved instrument markings; and

(2) At stabilized speed with propellers synchronized and with the airplane in cruise configuration, except that if the speed at the power setting prescribed in this paragraph would exceed the maximum speed authorized in level flight, accelerated flight is acceptable.

PART C—DATA CORRECTION

Sec. F36.201 *Correction of data.*

(a) Noise data obtained when the temperature is outside the range of 68 degrees F. ±9 degrees F., or the relative humidity is below 40 percent, must be corrected to 77 degrees F. and 70 percent relative humidity by a method approved by the FAA.

(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 algebraically to the measured value. It is limited to 5dB(A).

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

$$\Delta dB = 60 - 20 \log_{10} \left\{ (11{,}430 - D_{50}) \frac{R/C}{V_y} + 80 \right\}$$

Where:

D_{50} = Takeoff distance to 50 feet at maximum certificated takeoff weight.

R/C = Certificated best rate of climb (fpm).

V_y = Speed for best rate of climb in the same units as rate of climb.

(d) When takeoff distance to 50' is not listed as approved performance information, the figures of 2000 for single-engine airplanes and 1600' for multi-engine airplanes must be used.

Sec. F36.203 *Validity of results.*

(a) The test results must produce an average dB(A) 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 to exceed ±1.5 dB(A). No test result may be omitted from the averaging process, unless omission is approved by the FAA.

PART D—NOISE LIMITS

Sec. 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.

(b) For airplanes for which application for a type certificate is made on or after October 10, 1973, the noise level must not exceed 68 dB(A) up to and including aircraft weights of 1,320 pounds (600 kg.). For weights greater than 1,320 pounds up to and including 3,030 pounds (1,050 kg.) the limit increases at the rate of 1 dB/100 pounds (1 dB/75 kg.) to 82 dB(A) at 3,030 pounds, after which it is constant at 82 dB(A) up to and including 12,500 pounds. However, airplanes produced under type certificates covered by this paragraph must also meet paragraph (d) of this section for the original in-

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suance of standard airworthiness certificates or restricted category airworthiness certificates if those airplanes have not had flight time before the date specified in that paragraph.

(c) For airplanes for which application for a type certificate is made on or after January 1, 1975, the noise levels may not exceed the noise limit curve prescribed in paragraph (b) of this section, except that 80 dB(A) may not be exceeded at weights from and including 3,300 pounds to and including 12,500 pounds.

(d) For airplanes for which application is made for a standard airworthiness certificate or for a restricted category airworthiness certificate, and that have not had any flight time before January 1, 1980, the requirements of paragraph (c) of this section apply, regardless of date of application, to the original issuance of the certificate for that airplane.

(Title I of the National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.); and E.O 11514, Mar. 5, 1970)

[Doc. No. 13243, 40 FR 1036, Jan. 6, 1975; 40 FR 6347, Feb. 11, 1975, as amended by Amdt. 36-6, 41 FR 56004, Dec. 23, 1976; Amdt. 36-8, 42 FR 4113, Jan. 24, 1977; Amdt. 36-9, 43 FR 6754, Mar. 2, 1978]

SECTION 3B

PART 150

Part 150—Airport Noise Compatibility Planning

Subpart A—General Provisions

§ 150.1 Scope and purpose.

This Part prescribes the procedures, standards, and methodology governing the development, submission, and review of airport noise exposure maps and airport noise compatibility programs, including the process for evaluating and approving or disapproving those programs. It prescribes single systems for—(a) measuring noise at airports and surrounding areas that generally provides a highly reliable relationship between projected noise exposure and surveyed reaction of people to noise; and (b) determining exposure of individuals to noise that results from the operations of an airport. This Part also identifies those land uses which are normally compatible with various levels of exposure to noise by individuals. It provides technical assistance to airport operators, in conjunction with other local, State, and Federal authorities, to prepare and execute appropriate noise compatibility planning and implementation programs.

§ 150.3 Applicability.

This Part applies to the airport noise compatibility planning activities of the operators of "public use airports," not used exclusively by helicopters, as that term is used in Section 101(1) of the ASNA Act as amended (49 U.S.C. 2101) and as defined in § 503(17) of the Airport and Airway Improvement Act of 1982 (49 U.S.C. 2202).

§ 150.5 Limitations of this Part.

(a) Pursuant to the ASNA Act (49 U.S.C. § 2101 et seq.), this Part provides for airport noise compatibility planning and land use programs necessary to the purposes of those provisions. No submittal of a map, or approval or disapproval, in whole or part, of any map or program submitted under this Part is a determination concerning the acceptability or unacceptability of that land use under Federal, State, or local law.

(b) Approval of a noise compatibility program under this Part is neither a commitment by the FAA to financially assist in the implementation of the program, nor a determination that all measures covered by the program are eligible for grant-in-aid funding from the FAA.

(c) Approval of a noise compatibility program under this Part does not by itself constitute an FAA implementing action. A request for Federal action or approval to implement specific noise compatibility measures may be required, and an FAA decision on the request may require an environmental assessment of the proposed action, pursuant to the National Environmental Policy Act (42 U.S.C. § 432 *et seq.*) and applicable regulations, directives, and guidelines.

(d) Acceptance of a noise exposure map does not constitute an FAA determination that any specific parcel of land lies within a particular noise contour. Responsibility for interpretation of the effects of noise contours upon subjacent land uses, including the relationship between noise contours and specific properties, rests with the sponsor or with other state or local government.

§ 150.7 Definitions.

As used in this Part, unless the context requires otherwise, the following terms have the following meanings:

"Airport" means any public use airport, not exclusively used by helicopters, as defined by the ASNA Act, including: (a) Any airport which is used or to be used for public purposes, under the control of a public agency, the landing area of which is publicly owned; (b) any privately owned reliever airport; and (c) any privately owned airport which is determined by the Secretary to enplane annually 2,500 or more passengers and

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receive scheduled passenger service of aircraft, which is used or to be used for public purposes.

"Airport noise compatibility program" and "program" mean that program, and all revisions thereto, reflected in documents (and revised documents) developed in accordance with Appendix B of this Part, including the measures proposed or taken by the airport operator to reduce existing noncompatible land uses and to prevent the introduction of additional noncompatible land uses within the area.

"Airport Operator" means, the operator of an airport as defined in the ASNA Act.

"ASNA Act" means the Aviation Safety and Noise Abatement Act of 1979, as amended (49 U.S.C. § 2101 et seq.).

"Average sound level" means the level, in decibels, of the mean-square, A-weighted sound pressure during a specified period, with reference to the square of the standard reference sound pressure of 20 micropascals.

"Compatible land use" means the use of land that is identified under this Part as normally compatible with the outdoor noise environment (or an adequately attenuated noise level reduction for any indoor activities involved) at the location because the yearly day-night average sound level is at or below that identified for that or similar use under Appendix A (Table 1) of this Part.

"Day-night average sound level" (DNL) means the 24-hour average sound level, in decibels, for the period from midnight to midnight, obtained after the addition of ten decibels to sound levels for the periods between midnight and 7 A.M., and between 10 P.M., and midnight, local time." The symbol for DNL is L_{dn}.

"Noise exposure map" means a scaled, geographic depiction of an airport, its noise contours, and surrounding area developed in accordance with Section A150.101 of Appendix A of this Part, including the accompanying documentation setting forth the required descriptions of forecast aircraft operations at the airport during the fifth calendar year beginning after submission of the map, together with the ways, if any, those operations will affect the map (including noise contours and the forecast land uses).

"Noise level reduction" (NLR) means the amount of noise level reduction in decibels achieved through incorporation of noise attenuation (between outdoor and indoor levels) in the design and construction of a structure.

"Noncompatible land use" means the use of land that is identified under this Part as normally compatible with the outdoor noise environment (or an adequately attenuated noise reduction level for the indoor activities involved at the location) because the yearly day-night average sound level is above that identified for that or similar use under Appendix A (Table 1) of this Part.

"Regional Director" means the Director of the FAA Region having responsibility for the geographic area in which the airport in question is located.

"Restriction affecting flight procedures" means any requirement, limitation, or other action affecting the operation of aircraft, in the air or on the ground.

"Sound exposure level" means the level, in decibels, of the time integral of squared A-weighted sound pressure during a specified period or event, with reference to the square of the standard reference sound pressure of 20 micropascals and a duration of one second.

"Yearly day-night average sound level" (YDNL) means the 365-day average, in decibels, day-night average sound level. The symbol for YDNL is also L_{dn}.

§ 150.3 Designation of noise systems.

For purposes of this Part, the following designations apply:

(a) The noise at an airport and surrounding areas covered by a noise exposure map must be measured in A-weighted sound pressure level (L_A) in units of decibels (dBA) in accordance with the specifications and methods prescribed under Appendix A of this Part.

(b) The exposure of individuals to noise resulting from the operation of an airport must be established in terms of yearly day-night average sound level (YDNL) calculated in accordance with the specifications and methods prescribed under Appendix A of this Part.

(c) Uses of computer models to create noise contours must be in accordance with the criteria prescribed under Appendix A of this Part.

§ 150.11 Identification of land uses.

For the purposes of this Part, uses of land which are normally compatible or noncompatible with various noise exposure levels to individuals around airports must be identified in accordance with the criteria prescribed under Appendix A of this Part. Determination of land use must be based on professional planning criteria and procedures utilizing comprehensive, or master, land use planning, zoning, and building and site designing, as appropriate. If more than one current or future land use is permissible, determination of compatibility must be based on that most adversely affected by noise.

§ 150.13 Incorporations by reference.

(a) *General.* This Part prescribes certain standards and procedures which are not set forth in full text in the rule. Those standards and procedures are hereby incorporated by reference and were approved for incorporation by reference by the Director of the Federal Register under 5 U.S.C. § 552(a) and 1 CFR Part 51.

(b) *Changes to incorporated matter.* Incorporated matter which is subject to subsequent change is incorporated by reference according to the specific reference and to the identification statement. Adoption of any subsequent change in incorporated matter that affects compliance with standards and procedures of this Part will be made under 14 CFR Part 11 and 1 CFR Part 51.

(c) *Identification statement.* The complete title or description which identifies each published matter incorporated by reference in this Part is as follows:

International Electrotechnical Commission (IEC) Publication No. 179, entitled "Precision Sound Level Meters," dated 1973.

(d) *Availability for purchase.* Published material incorporated by reference in this Part may be purchased at the price established by the publisher or distributor at the following mailing addresses:

IEC publications:

(1) The Bureau Central de la Commission Electrotechnique, Internationale, 1, rue de Varembe, Geneva, Switzerland.

(2) American National Standards Institute, 1430 Broadway, New York, NY 10018.

(e) *Availability for inspection.* A copy of each publication incorporated by reference in this Part is available for public inspection at the following locations:

(1) FAA Office of the Chief Counsel, Rules Docket, Room 916, Federal Aviation Administration Headquarters Building, 800 Independence Avenue, SW., Washington, D.C. 20591.

(2) Department of Transportation, Branch Library, Room 930, Federal Aviation Administration Headquarters Building, 800 Independence Avenue, SW., Washington, DC. 20591.

(3) The respective Regional Offices of the Federal Aviation Administration as follows:

(i) New England Regional Office, 12 New England Executive Park, Burlington, Massachusetts 01803.

(ii) Eastern Regional Office, Federal Building, John F. Kennedy (JFK) International Airport, Jamaica, New York 11430.

(iii) Southern Regional Office, 3400 Norman Berry Street, East Point, Georgia (P.O. Box 20636, Atlanta, Georgia) 30320.

(iv) Great Lakes Regional Office, 2300 East Devon, Des Plaines, Illinois 60018.

(v) Central Regional Office, 601 East 12th Street, Kansas City, Missouri 64106.

(vi) Southwest Regional Office, 4400 Blue Mound Road, (P.O. Box 1689), Fort Worth, Texas 76101.

(vii) Northwest Mountain Regional Office, 17900 Pacific Highway, South, C-68966, Seattle, Washington 98168.

(viii) Western Pacific Regional Office, 15000 Aviation Boulevard, Hawthorne, California (P.O. Box 92007, Worldway Postal Center, Los Angeles) 90009.

(ix) Alaskan Regional Office, 701 "C" Street, Box 14, Anchorage, Alaska 99513.

(xi) European Office, 15, Rue de la Loi (3rd Floor) B1040 Brussels, Belgium.

(4) The Office of the Federal Register, Room 8401, 1100 "L" Street, NW, Washington, D.C.

Subpart B—Development of Noise Exposure Maps and Noise Compatibility Programs

§ 150.21 Noise exposure maps and related descriptions.

(a) Each airport operator may after completion of the consultations and public procedure specified under paragraph (b) of this section, submit to the Regional Director five copies of the noise exposure map (or revised map) which identifies each noncompatible land use in each area depicted on the map, as of the date of submission, and five copies of a map each with accompanying documentation setting forth—

(1) The noise exposure based on forecast aircraft operations at the airport for the fifth calendar year beginning after the date of submission (based on reasonable assumptions concerning future type and frequency of aircraft operations, number of nighttime operations, flight patterns, airport layout including any planned airport development, planned land use changes, and demographic changes in the surrounding areas); and

(2) The nature and extent, if any, to which those forecast operations will affect the compatibility of land uses depicted on the map.

(b) Each map, and related documentation submitted under this section must be developed and prepared in accordance with Appendix A of this Part, or an FAA approved equivalent, and in consultation with states, and public agencies and planning agencies whose area, or any portion of whose area, of jurisdiction is within the L_{dn} 65 dB contour depicted on the map, FAA regional officials, and other Federal officials having local responsibility for the area depicted on the map. This consultation must include regular aeronautical users of the airport. The airport operator shall certify that it has afforded interested persons adequate opportunity to submit their views, data, and comments concerning the correctness and adequacy of the draft noise exposure map and descriptions of forecast aircraft operations. Each map and revised map must be accompanied by documentation describing the consultation accomplished under this paragraph and the opportunities afforded the public to review and comment during the development of the map. One copy of all written comments received during consultation shall also be filed with the Regional Director.

(c) The Regional Director acknowledges receipt of noise exposure maps and descriptions and indicates whether they are in compliance with the applicable requirements. The Regional Director publishes in the FEDERAL REGISTER a notice of compliance for each such noise exposure map and description, identifying the airport involved. Such notice includes information as to when and where the map and related documentation are available for public inspection.

(d) If, after submission of a noise exposure map under paragraph (a) of this section, any change in the operation of the airport would create any "substantial, new noncompatible use" in any area depicted on the map beyond that which is forecast for the fifth calendar year after the date of submission, airport operator shall, in accordance with this section, promptly prepare and submit a revised noise exposure map. A change in the operation of an airport creates a substantial new noncompatible use if that change results in an increase in the yearly day-night average sound level of 1.5 dB or greater in either a land area which was formerly compatible but is thereby made noncompatible under Appendix A (Table 1), or in a land area which was previously determined to be noncompatible under that Table and whose noncompatibility is now significantly increased. Such updating of the map shall include a reassessment of those areas excluded under Sec. A150.101(e) (5) of Appendix A because of high ambient noise levels. If the five-year forecast map is based on assumptions involving recommendations in a noise compatibility program which are subsequently disapproved by the FAA, a revised map must be submitted if revised assumptions would create a substantial, new noncompatible use not indicated on the initial five-year map. Revised noise exposure maps are subject to the same requirements and procedures as initial submissions of noise exposure maps under this Part.

(e) Each map, or revised map, and description of consultation and opportunity for public comment, submitted to the FAA, must be certified as true and complete under penalty of 18 U.S.C. § 1001.

(f) (1) The ASNA Act provides, in Section 107(a) (49 U.S.C. 2107(a)), that no person who acquires property or an interest therein after the date of enactment of the Act in an area sur-

rounding an airport with respect to which a noise exposure map has been submitted under Section 103 of the Act shall be entitled to recover damages with respect to the noise attributable to such airport if such person had actual or constructive knowledge of the existence of such noise exposure map unless, in addition to any other elements for recovery of damages, such person can show that—

(i) A significant change in the type or frequency of aircraft operations at the airport; or

(ii) A significant change in the airport layout; or

(iii) A significant change in the flight patterns; or

(iv) A significant increase in nighttime operations; occurred after the date of the acquisition of such property or interest therein and that the damages for which recovery is sought have resulted from any change or increase.

(2) The Act further provides in Section 107(b), (49 U.S.C. 2107(b)): That for this purpose, "constructive knowledge" shall be imputed, at a minimum, to any person who acquires property or an interest therein in an area surrounding an airport after the date of enactment of this Act if—

(i) Prior to the date of such acquisition, notice of the existence of a noise exposure map for such area was published at least three times in a newspaper of general circulation in the country in which such property is located; or

(ii) A copy of such noise exposure map is furnished to such person at the time of such acquisition.

(g) For this purpose, the term "significant" in paragraph (f) of this section means that change or increase is one or more of the four factors which results in a "substantial new noncompatible use" as defined in § 150.21(d), affecting the property in issue. Responsibility for applying or interpreting this provision with respect to specific properties rests with local government.

§ 150.23 Noise compatibility programs.

(a) Any airport operator who has submitted an acceptable noise exposure map under § 150.21 may, after FAA notice of acceptability and other consultation and public procedure specified under paragraphs (b) and (c) of this section, as applicable, submit to the Regional Director five copies of a noise compatibility program.

(b) An airport operator may submit the noise compatibility program at the same time as the noise exposure map. In this case, the Regional Director will not begin the statutory 180-day review period (for the program) until after FAA reviews the noise exposure map and finds that it and its supporting documentation are in compliance with the applicable requirements.

(c) Each noise compatibility program must be developed and prepared in accordance with Appendix B of this Part, or an FAA approved equivalent, and in consultation with FAA regional officials, the officials of the state and of any public agencies and planning agencies whose area, or any portion of whose area, of jurisdiction within the L_{dn} 65 dB noise contours is depicted on the noise exposure map, and other Federal officials having local responsibility for land uses depicted on the map. Consultation with FAA regional officials shall include, to the extent practicable, informal agreement from FAA on proposed new or modified flight procedures. For air carrier airports, consultation must include any air carriers and, to the extent practicable, other aircraft operators using the airport. For other airports, consultation must include, to the extent practicable, aircraft operators using the airport.

(d) Prior to and during the development of a program, and prior to submission of the resulting draft program to the FAA, the airport operator shall afford adequate opportunity for the active and direct participation of the states, and public agencies and planning agencies in the areas surrounding the airport, aeronautical users of the airport, and the general public to submit their views, data, and comments on the formulation and adequacy of that program.

(e) Each noise compatibility program submitted to the FAA must consist of at least the following:

(1) A copy of the noise exposure map and its supporting documentation as found in compliance with the applicable requirements by the FAA, per § 150.21(c).

(2) A description and analysis of the alternative measures considered by the airport operator in developing the program, together

with a discussion of why each rejected measure was not included in the program.

(3) Program measures proposed to reduce or eliminate present and future noncompatible land uses and a description of the relative contribution of each of the proposed measures to the overall effectiveness of the program.

(4) A description of public participation and the consultation with officials of public agencies and planning agencies in areas surrounding the airport, FAA regional officials and other Federal officials having local responsibility for land uses depicted on the map, any air carriers and other users of the airport.

(5) The actual or anticipated effect of the program on reducing noise exposure to individuals and noncompatible land uses and preventing the introduction of additional noncompatible uses within the area covered by the noise exposure map. The effects must be based on expressed assumptions concerning the type and frequency of aircraft operations, number of nighttime operations, flight patterns, airport layout including planned airport development, planned land use changes, and demographic changes within the L_{dn} 65 dB noise contours.

(6) A description of how the proposed future actions may change any noise control or compatibility plans or actions previously adopted by the airport proprietor.

(7) A summary of the comments at any public hearing on the program and a copy of all written material submitted to the operator under paragraphs (c) and (d) of this section, together with the operator's response and disposition of those comments and materials to demonstrate the program is feasible and reasonably consistent with obtaining the objectives of airport noise compatibility planning under this Part.

(8) The period covered by the program, the schedule for implementation of the program, the persons responsible for implementation of each measure in the program, and, for each measure, documentation supporting the feasibility of implementation, including any essential governmental actions, costs, and anticipated sources of funding that will demonstrate that the program is reasonably consistent with achieving the goals of airport noise compatibility planning under this Part.

(9) Provision for revising the program if made necessary by revision of the noise exposure map.

Subpart C—Evaluations and Determinations of Effects of Noise Compatibility Programs

PART A—GENERAL

§ 150.31 Preliminary review; acknowledgments.

(a) Upon receipt of a noise compatibility program submitted under § 150.23, the Regional Director acknowledges to the airport operator receipt of the program and conducts a preliminary review of the submission.

(b) If, based on the preliminary review, the Regional Director finds that the submission does not conform to the requirements of this Part, he disapproves and returns the unacceptable program to the airport operator for reconsideration and development of a program in accordance with this Part.

(c) If, based on the preliminary review, the Regional Director finds that the program conforms to the requirements of this Part, the Regional Director publishes in the FEDERAL REGISTER a notice of receipt of the program for comment which indicates the following:

(1) The airport covered by the program, and the date of receipt.

(2) The availability of the program for examination in the offices of the Regional Director and the airport operator.

(3) That comments on the program are invited and, will be considered by the FAA.

(d) The date of signature of the published notice of receipt starts the 180-day approval period for the program.

§ 150.33 Evaluation of programs.

(a) The FAA conducts an evaluation of each noise compatibility program and, based on that evaluation, either approves or disapproves the program. The evaluation includes consideration of proposed measures to determine whether they—

(1) May create an undue burden on interstate or foreign commerce (including unjust discrimination);

(2) Are reasonably consistent with obtaining the goal of reducing existing noncompatible land uses and preventing the introduction of additional noncompatible land uses; and

(3) Include the use of new or modified flight procedures to control the operation of aircraft for purposes of noise control, or affect flight procedures in any way.

(b) The evaluation may also include an evaluation of those proposed measures to determine whether they may adversely affect the exercise of the authority and responsibilities of the Administrator under the Federal Aviation Act of 1958, as amended.

(c) To the extent considered necessary, the FAA may—

(1) Confer with the airport operator and other persons known to have information and views material to the evaluation;

(2) Explore the objectives of the program and the measures, and any alternative measures, for achieving the objectives.

(3) Examine the program for developing a range of alternatives that would eliminate the reasons, if any, for disapproving the program.

(4) Convene an informal meeting with the airport operator and other persons involved in developing or implementing the program for the purposes of gathering all facts relevant to the determination of approval or disapproval of the program and of discussing any needs to accommodate or modify the program as submitted.

(d) If requested by the FAA, the airport operator shall furnish all information needed to complete FAA's review under (c).

(e) An airport operator may, at any time before approval or disapproval of a program, withdraw or revise the program. If the airport operator withdraws or revises the program or indicates to the Regional Director, in writing, the intention to revise the program, the Regional Director terminates the evaluation and notifies the airport operator of that action. That termination cancels the 180-day review period. The FAA does not evaluate a second program for any airport until any previously submitted program has been withdrawn or a determination on it is issued. A new evaluation is commenced upon receipt of a revised program, and a new 180-day approval period is begun, unless the Regional Director finds that the modification made, in light of the overall revised program, can be integrated into the unmodified portions of the revised program without exceeding the original 180-day approval period or causing undue expense to the government.

§ 150.35 Determinations; publication; effectivity.

(a) The FAA issues a determination approving or disapproving each airport noise compatibility program (and revised program). Portions of a program may be individually approved or disapproved. No conditional approvals will be issued. A determination on a program acceptable under this Part is issued within 180 days after the program is received under § 150.23 of this Part or it may be considered approved, except that this time period may be exceeded for any portion of a program relating to the use of flight procedures for noise control purposes. A determination on portions of a program covered by the exceptions to the 180-day review period for approval will be issued within a reasonable time after receipt of the program. Determinations relating to the use of any flight procedure for noise control purposes may be issued either in connection with the determination on other portions of the program or separately. Except as provided by this paragraph, no approval of any noise compatibility program, or any portion of a program, may be implied in the absence of the FAA's express approval.

(b) The Administrator approves programs under this Part, if—

(1) It is found that the program measures to be implemented would not create an undue burden on interstate or foreign commerce (including any unjust discrimination) and are reasonably consistent with achieving the goals of reducing existing noncompatible land uses around the airport and of preventing the introduction of additional noncompatible land uses;

(2) The program provides for revision if made necessary by the revision of the noise map; and

(3) Those aspects of programs relating to the use of flight procedures for noise control can be implemented within the period covered by the program and without—

(i) Reducing the level of aviation safety provided;

(ii) Derogating the requisite level of protection for aircraft, their occupants and persons and property on the ground;

(iii) Adversely affecting the efficient use and management of the Navigable Airspace and Air Traffic Control Systems; or

(iv) Adversely affecting any other powers and responsibilities of the Administrator prescribed by law or any other program, standard, or requirement established in accordance with law.

(c) When a determination is issued, the Regional Director notifies the airport operator and publishes a notice of approval or disapproval in the FEDERAL REGISTER identifying the nature and extent of the determination.

(d) Approvals issued under this Part for a program or portion thereof become effective as specified therein and may be withdrawn when one of the following occurs:

(1) The program or portion thereof is required to be revised under this Part or under its own terms, and is not so revised;

(2) If a revision has been submitted for approval, a determination is issued on the revised program or portion thereof, that is inconsistent with the prior approval.

(3) A term or condition of the program, or portion thereof, or its approval is violated by the responsible government body.

(4) A flight procedure or other FAA action upon which the approved program or portion thereof is dependent is subsequently disapproved, significantly altered, or rescinded by the FAA.

(5) The airport operator requests rescission of the approval.

(6) Impacts on flight procedures, air traffic management, or air commerce occur which could not be foreseen at the time of approval.

A determination may be sooner rescinded or modified for cause with at least 30 days written notice to the airport operator of the FAA's intention to rescind or modify the determination for the reasons stated in the notice. The airport operator may, during the 30-day period, submit to the Regional Director for consideration any reasons and circumstances why the determination should not be rescinded or modified on the basis stated in the notice of intent. Thereafter, the FAA either rescinds or modifies the determination consistent with the notice or withdraws the notice of intent and terminates the action.

(e) Determinations may contain conditions which must be satisfied prior to implementation of any portion of the program relating to flight procedures affecting airport or aircraft operations.

(f) Noise exposure maps for current and five year forecast conditions that are submitted and approved with noise compatibility programs are considered to be the new FAA accepted noise exposure maps for purposes of Part 150.

Appendix A

Noise Exposure Maps

PART A—GENERAL

§ A150.1 Purpose.

(a) This Appendix establishes a uniform methodology for the development and preparation of airport noise exposure maps. That methodology includes a single system of measuring noise at airports for which there is a highly reliable relationship between projected noise exposure and surveyed reactions of people to noise along with a separate single system for determining the exposure of individuals to noise. It also identifies land uses which, for the purpose of this Part are considered to be compatible with various exposures of individuals to noise around airports.

(b) This Appendix provides for the use of the the FAA's Integrated Noise Model (INM) or an FAA approved equivalent, for developing standardized noise exposure maps and predicting noise impacts. Noise monitoring may be utilized by airport operators for data acquisition and data refinement, but is not required by this Part for the development of noise exposure maps or airport noise compatibility programs. Whenever noise monitoring is used, under this Part, it should be accomplished in accordance with Sec. A150.5 of this Appendix.

§ A150.3 Noise descriptors.

(a) *Airport Noise Measurement.* The A-Weighted Sound Level, measured, filtered and recorded in accordance with Sec. A150.5 of this Appendix, must be employed as the unit for the measurement of single event noise at airports and in the areas surrounding the airports.

(b) *Airport Noise Exposure.* The yearly day-night average sound level (YDNL) must be employed for the analysis and characterization of multiple aircraft noise events and for determining the cumulative exposure of individuals to noise around airports.

§ A150.5 Noise measurement procedures and equipment.

(a) Sound levels must be measured or analyzed with equipment having the "A" frequency weighting, filter characteristics, and the "slow response" characteristics as defined in International Electrotechnical Commission (IEC) Publication No. 179, entitled "Precision Sound Level Meters" as incorporated by reference in Part 150 under § 150.11. For purposes of this Part, the tolerances allowed for general purpose, type 2 sound level meters in IEC 179, are acceptable.

(b) Noise measurements and documentation must be in accordance with accepted acoustical measurement methodology, such as those described in American National Standards Institute publication ANSI 51.13, dated 1971 as revised 1979, entitled "ANS—Methods for the Measurement of Sound Pressure Levels"; ARP No. 796, dated 1969, entitled "Measurement of Aircraft Exterior Noise in the Field"; "Handbook of Noise Measurement," Ninth Ed. 1980, by Arnold P. G. Peterson; or "Acoustic Noise Measurement," dated Jan., 1979, by J. R. Hassell and K. Zaveri. For purposes of this Part, measurements intended for comparison to a State or local standard or with another transportation noise source (including other aircraft) must be reported in maximum A-weighted sound levels (L_{AM}); for computation or validation of the yearly day-night average level (L_{dn}), measurements must be reported in sound exposure level (L_{AE}), as defined in Sec. A150.205 of this Appendix.

PART B—NOISE EXPOSURE MAP DEVELOPMENT

§ A150.101 Noise contours and land uses.

(a) To determine the extent of the noise impact around an airport, airport proprietors developing noise exposure maps in accordance with this Part must develop L_{dn} contours. Continuous contours must be developed for YDNL levels of 65, 70, and 75 (additional contours may be developed and depicted when appropriate). In those areas where YDNL values are 65 YDNL or greater, the airport operator shall identify land uses and determine land use compatibility in accordance with the standards and procedures of this Appendix.

(b) Table 1 of this Appendix describes compatible land use information for several land uses as a function of YDNL values. The ranges of YDNL values in Table 1 reflect the statistical variability for the responses of large groups of people to noise. Any particular level might not, therefore, accurately assess an individual's perception of an actual noise environment. Compatible or noncompatible land use is determined by comparing the predicted or measured YDNL values at a site with the values given. Adjustments or modifications of the descriptions of the land-use categories may be desirable after consideration of specific local conditions.

(c) Compatibility designations in Table 1 generally refer to the major use of the site. If other uses with greater sensitivity to noise are permitted by local government at a site, a determination of compatibility must be based on that use which is most adversely affected by noise. When appropriate, noise level reduction through incorporation of sound attenuation into the design and construction of a structure may be necessary to achieve compatibility.

(d) For the purpose of compliance with this Part, all land uses are considered to be compatible with noise levels less than L_{dn} 65 dB. Local needs or values may dictate further delineation based on local requirements or determinations.

(e) Except as provided in (f) below, the noise exposure maps must also contain and identify:

(1) Runway locations.

(2) Flight tracks.

(3) Noise contours of L_{dn} 65, 70, and 75 dB resulting from aircraft operations.

(4) Outline of the airport boundaries.

(5) Noncompatible land uses within the noise contours, including those within the L_{dn} 65 dB contours. (No land use has to be identified as noncompatible if the self-generated noise from that use and/or the ambient noise from other nonaircraft and nonairport uses is equal to or greater than the noise from aircraft and airport sources.)

(6) Location of noise sensitive public buildings (such as schools, hospitals, and health care facilities), and properties on or eligible for inclusion in the National Register of Historic Places.

(7) Locations of any aircraft noise monitoring sites utilized for data acquisition and refinement procedures.

(8) Estimates of the number of people residing within the L_{dn} 65, 70, and 75 dB contours.

(9) Depiction of the required noise contours over a land use map of a sufficient scale and quality to discern streets and other identifiable geographic features.

(f) Notwithstanding any other provision of this Part, noise exposure maps prepared in connection with studies which were either Federally funded or Federally approved and which commenced before October 1, 1981, are not required to be modified to contain the following items:

(1) Flight tracks depicted on the map.

(2) Use of ambient noise to determine land use compatibility.

(3) The L_{dn} 70 dB noise contour and data related to the L_{dn} 70 dB contour. When determinations on land use compatibility using Table 1 differ between L_{dn} 65–70 dB and the L_{dn} 70–75 dB, determinations should either use the more conservative L_{dn} 70–75 dB column or reflect determinations based on local needs and values.

(4) Estimates of the number of people residing within the L_{dn} 65, 70, and 75 dB contours.

TABLE 1

LAND USE COMPATIBILITY* WITH YEARLY DAY-NIGHT AVERAGE SOUND LEVELS

Land Use	*Yearly Day-Night Average Sound Level (L_{dn}) in Decibels*					
	Below 65	*65-70*	*70-75*	*75-80*	*80-85*	*Over 85*
Residential						
Residential, other than mobile homes and transient lodgings	Y	N(1)	N(1)	N	N	N
Mobile home parks	Y	N	N	N	N	N
Transient lodgings	Y	N(1)	N(1)	N(1)	N	N
Public Use						
Schools	Y	N1)1	N(1)	N	N	N
Hospitals and nursing homes	Y	25	30	N	N	N
Churches, auditoriums, and concert halls	Y	25	30	N	N	N
Governmental services	Y	Y	25	30	N	N
Transportation	Y	Y	Y(2)	Y(3)	Y(4)	Y(4)
Parking	Y	Y	Y(2)	Y(3)	Y(4)	N
Commercial Use						
Offices, business and professional	Y	Y	25	30	N	N
Wholesale and retail—building materials, hardware and farm equipment	Y	Y	Y(2)	Y(3)	Y(4)	N
Retail trade—general	Y	Y	25	30	N	N
Utilities	Y	Y	Y(2)	Y(3)	Y(4)	N
Communication	Y	Y	25	30	N	N
Manufacturing And Production						
Manufacturing, general	Y	Y	Y(2)	Y(3)	Y(4)	N
Photographic and optical	Y	Y	25	30	N	N
Agriculture (except livestock) and forestry	Y	Y(6)	Y(7)	Y(8)	Y(8)	Y(8)
Livestock farming and breeding	Y	Y(6)	Y(7)	N	N	N
Mining and fishing, resource production and extraction	Y	Y	Y	Y	Y	Y
Recreational						
Outdoor sports arenas and spectator sports	Y	Y(5)	Y(5)	N	N	N
Outdoor music shells, amphitheaters	Y	N	N	N	N	N
Nature exhibits and zoos	Y	Y	N	N	N	N
Amusements, parks, resorts and camps	Y	Y	Y	N	N	N
Golf courses, riding stables and water recreation	Y	Y	25	30	N	N

Numbers in parentheses refer to notes.

* The designations contained in this table do not constitute a Federal determination that any use of land covered by the program is acceptable or unacceptable under Federal, State, or local law. The responsibility for determining the acceptable and permissible land uses and the relationship between specific properties and specific noise contours rests with the local authorities. FAA determinations under Part 150 are not intended to substitute federally determined land uses for those determined to be appropriate by local authorities in response to locally determined needs and values in achieving noise compatible land uses.

KEY TO TABLE 1

SLUCM	Standard Land Use Coding Manual.
Y (Yes)	Land Use and related structures compatible without restrictions.
N (No)	Land Use and related structures are not compatible and should be prohibited.
NLR	Noise Level Reduction (outdoor to indoor) to be achieved through incorporation of noise attenuation into the design and construction of the structure.
25, 30, or 35	Land used and related structures generally compatible; measures to achieve NLR of 25, 30, or 35 dB must be incorporated into design and construction of structure.

NOTES FOR TABLE 1

(1) Where the community determines that residential or school uses must be allowed, measures to achieve outdoor to indoor Noise Level Reduction (NLR) of at least 25 dB and 30 dB should be incorporated into building codes and be considered in individual approvals. Normal residential construction can be expected to provide a NLR of 20 dB, thus, the reduction requirements are often stated as 5, 10 or 15 dB over standard construction and normally assume mechanical ventilation and closed windows year round. However, the use of NLR criteria will not eliminate outdoor noise problems.

(2) Measures to achieve NLR of 25 dB must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas or where the normal noise level is low.

(3) Measures to achieve NLR of 30 dB must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas or where the normal noise level is low.

(4) Measures to achieve NLR of 35 dB must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas or where the normal noise level is low.

(5) Land use compatible provided special sound reinforcement systems are installed.

(6) Residential buildings require an NLR of 25.

(7) Residential buildings require an NLR of 30.

(8) Residential buildings not permitted.

§ A150.103 Use of computer prediction model.

(a) The airport operator shall acquire the aviation operations data necessary to develop noise exposure contours using an FAA approved methodology or computer program, such as the Integrated Noise Model (INM). In considering approval of a methodology or computer program, key factors include the demonstrated capability to produce the required output and the public availability of the program or methodology to provide interested parties the opportunity to substantiate the results.

(b) The following information must be obtained for input to the calculation of noise exposure contours:

(1) A map of the airport and its environs at an adequately detailed scale (not less than 1 inch to 8,000 feet) indicating runway length, alignments, landing thresholds, takeoff start-of-roll points, airport boundary, and flight tracks out to at least 30,000 feet from the end of each runway.

(2) Airport activity levels and operational data which will indicate, on an annual average-daily-basis, the number of aircraft, by type of aircraft, which utilize each flight track, in both the standard daytime (0700– 2200 hours local) and nighttime (2200–0700 hours local) periods for both landings and takeoffs.

(3) For landings—glide slopes, glide slope intercept altitudes, and other pertinent information needed to establish approach profiles along with the engine power levels needed to fly that approach profile.

(4) For takeoffs—the flight profile which is the relationship of altitude to distance from start-of-roll along with the engine power levels needed to fly that takeoff profile; these data must reflect the use of noise abatement departure procedures and, if applicable, the takeoff weight of the aircraft or some proxy for weight such as stage length.

(5) Existing topographical or airspace restrictions which preclude the utilization of alternative flight tracks.

(6) The government furnished data depicting aircraft noise characteristics (if not already a part of the computer program's stored data bank).

(7) Airport elevation and average temperature.

§ A150.105 Identification of public agencies and planning agencies.

(a) The airport proprietor shall identify each public agency and planning agency whose jurisdiction or responsibility is either wholly or partially contained within the L_{dn} 65 dB boundary.

(b) For those agencies identified in (a) that have land use planning and control authority, the supporting documentation shall identify their geographic area of jurisdiction.

PART C—MATHEMATICAL DESCRIPTIONS

§ A150.201 General.

The following mathematical descriptions provide the most precise definition of the yearly day-night average sound level (L_{dn}), the data necessary for its calculation, and the methods for computing it.

§ A150.203 Symbols.

The following symbols are used in the computation of L_{dn}:

Measure (in dB)	*Symbol*
Average Sound Level, During Time T	L_T
Day-Night Average Sound Level (individual day)	L_{dni}
Yearly Day-Night Average Sound Level	L_{dn}
Sound Exposure Level	L_{AE}

§ A150.205 Mathematical computations.

(a) Average sound level must be computed in accordance with the following formula:

$$L_T = 10 \log_{10}\left[\frac{1}{T}\int_0^T 10^{L_A(t)/10}\,dt\right] \quad (1)$$

where T is the length of the time period, in seconds, during which the average is taken; $L_A(t)$ is the instantaneous time varying A-weighted sound level during the time period T.

(1) Note: When a noise environment is caused by a number of identifiable noise events, such as aircraft flyovers, average sound level may be conveniently calculated from the sound exposure levels of the individual events occurring within a time period T:

$$L_T = 10 \log_{10}\left[\frac{1}{T}\sum_{i=1}^{n} 10^{L_{AEi}/10}\right] \quad (2)$$

where L_{AEi} is the sound exposure level of the i-th event, in a series of n events in time period T, in seconds.

(2) Note: When T is one hour, L_T is referred to as a one-hour average sound level.

(b) Day-night average sound level (individual day) must be computed in accordance with the following formula:

$$L_{dn} = 10 \log_{10}\left[\frac{1}{86400}\left(\int_{0000}^{0700} 10^{[L_A(t)+10]/10}\,dt + \int_{0700}^{2200} 10^{L_A(t)/10}\,dt + \int_{2200}^{2400} 10^{[L_A(t)+10]/10}\,dt\right)\right] \quad (3)$$

Time is in seconds, so the limits shown in hours and minutes are actually interpreted in seconds. It is often convenient to compute day-night average sound level from the one-hour average sound levels obtained during successive hours.

(c) Yearly day-night average sound level must be computed in accordance with the following formula:

$$L_{dn} = 10 \log_{10}\left[\frac{1}{365}\sum_{i=1}^{365} 10^{L_{dni}/10}\right] \quad (4)$$

where L_{dni} is the day-night average sound level for the i-th day out of one year.

(d) Sound exposure level must be computed in accordance with the following formula:

$$L_{AE} = 10 \log_{10}\left(\frac{1}{t_0}\int_{t_1}^{t_2} 10^{L_A(t)/10}\,dt\right) \quad (5)$$

where t_0 is one second and $L_A(t)$ is the time-varying A-weighted sound level in the time interval t_1 to t_2.

The time interval should be sufficiently large that it encompasses all the significant sound of a designated event.

The requisite integral may be approximated with sufficient accuracy by integrating $L_A(t)$ over the time interval during which $L_A(t)$ lies within 10 decibels of its maximum value, before and after the maximum occurs.

Appendix B

Noise Compatibility Programs

§ B150.1 Scope and purpose.

(a) This Appendix prescribes the content and the methods for developing noise compatibility programs authorized under this Part. Each program must set forth the measures which the airport operator (or other person or agency responsible) has taken, or proposes to take, for the reduction of existing noncompatible land uses and the prevention of the introduction of additional noncompatible land uses within the area covered by the noise exposure map submitted by the operator.

(b) The purpose of a noise compatibility program is:

(1) To promote a planning process through which the airport operator can examine and analyze the noise impact created by the operation of an airport, as well as the costs and benefits associated with various alternative noise reduction techniques, and the responsible impacted land use control jurisdictions can examine existing and forecast areas of noncompatibility and consider actions to reduce noncompatible uses.

(2) To bring together through public participation, agency coordination, and overall cooperation, all interested parties with their respective authorities and obligations, thereby facilitating the creation of an agreed upon noise abatement plan especially suited to the individual airport location while at the same time not unduly affecting the national air transportation system.

(3) To develop comprehensive and implementable noise reduction techniques and land use controls which, to the maximum extent feasible, will confine severe aircraft YDNL values of L_{dn} 75 dB or greater to areas included within the airport boundary and will establish and maintain compatible land uses in the areas affected by noise between the L_{dn} 65 and 75 dB contours.

§ B150.3 Requirement for noise map.

(a) It is required that a current and complete noise exposure map and its supporting documentation as found in compliance with the applicable requirements by the FAA, per § 150.21(c) be included in each noise compatibility program:

(1) To identify existing and future noncompatible land uses, based on airport operation and off-airport land uses, which have generated the need to develop a program.

(2) To identify changes in noncompatible uses to be derived from proposed program measures.

(b) If the proposed noise compatibility program would yield maps differing from those previously submitted to FAA, the program shall be accompanied by appropriately revised maps. Such revisions must be prepared in accordance with the requirements of Sec. A150.101(e) of Appendix A and will be accepted by FAA in accordance with § 150.35(f).

§ B150.5 Program standards.

Based upon the airport noise exposure and noncompatible land uses identified in the map, the airport operator shall evaluate the several alternative noise control actions and develop a noise compatibility program which—

(a) Reduces existing noncompatible uses and prevents or reduces the probability of the establishment of additional noncompatible uses;

(b) Does not impose undue burden on interstate and foreign commerce;

(c) Provides for revision in accordance with § 150.23 of this Part.

(d) Is not unjustly discriminatory.

(e) Does not derogate safety or adversely affect the safe and efficient use of airspace.

(f) To the extent practicable, meets both local needs and needs of the national air transportation system, considering tradeoffs between economic benefits derived from the airport and the noise impact.

(g) Can be implemented in a manner consistent with all of the powers and duties of the Administrator of FAA.

§ 150.7 Analysis of program alternatives.

(a) Noise control alternatives must be considered and presented according to the following categories:

(1) Noise abatement alternatives for which the airport operator has adequate implementation authority.

(2) Noise abatement alternatives for which the requisite implementation authority is vested in a local agency or political subdivision governing body, or a state agency or political subdivision governing body.

(3) Noise abatement options for which requisite authority is vested in the FAA or other Federal agency.

(b) At a minimum, the operator shall analyze and report on the following alternatives, subject to the constraints that the strategies are appropriate to the specific airport (for example, an evaluation of night curfews is not appropriate if there are no night flights and none are forecast):

(1) Acquisition of land and interests therein, including, but not limited to air rights, easements, and development rights, to ensure the use of property for purposes which are compatible with airport operations.

(2) The construction of barriers and acoustical shielding, including the soundproofing of public buildings.

(3) The implementation of a preferential runway system.

(4) The use of flight procedures (including the modifications of flight tracks) to control the operation of aircraft to reduce exposure of individuals (or specific noise sensitive areas) to noise in the area around the airport.

(5) The implementation of any restriction on the use of airport by any type or class of aircraft based on the noise characteristics of those aircraft. Such restrictions may include, but are not limited to—

(i) Denial of use of the airport to aircraft types or classes which do not meet Federal noise standards;

(ii) Capacity limitations based on the relative noisiness of different types of aircraft;

(iii) Requirement that aircraft using the airport must use noise abatement takeoff or approach procedures previously approved as safe by the FAA;

(iv) Landing fees based on FAA certificated or estimated noise emission levels or on time of arrival; and

(v) Partial or complete curfews.

(6) Other actions or combinations of actions which would have a beneficial noise control or abatement impact on the public.

(7) Other actions recommended for analysis by the FAA for the specific airport.

(c) For those alternatives selected for implementation, the program must identify the agency or agencies responsible for such implementation, whether those agencies have agreed to the implementation, and the approximate schedule agreed upon.

§ 150.9 Equivalent Programs.

(a) Notwithstanding any other provision of this Part, noise compatibility programs prepared in connection with studies which were either Federally funded or Federally approved and commenced before October 1, 1981, are not required to be modified to contain the following items:

(1) Flight tracks.

(2) A noise contour of L_{dn} 70 dB resulting from aircraft operations and data related to the L_{dn} 70 dB contour. When determinations on land use compatibility using Table 1 of Appendix A differ between L_{dn} 65–70 dB and L_{dn} 70–75 dB, the determinations should either use the more conservative L_{dn} 70–75 dB column or reflect determinations based on local needs and values.

(3) The categorization of alternatives pursuant to Sec. B150.7(a), although the persons responsible for implementation of each measure in the program must still be identified in accordance with § 150.23(a) (8).

(4) Use of ambient noise to determine land use compatibility.

(b) Previously prepared noise compatibility program documentation may be supplemented to include these and other program requirements which have not been excepted.

SECTION 3C

LEGAL BACKGROUND

LEGAL ASPECTS OF NOISE ABATEMENT

My purpose today is not to make you "environmental lawyers" by giving you a detailed course in aviation noise law. Time precludes this and moreover, if I were to make you "noise lawyers" you wouldn't need me.

The Aircraft Noise Problem, in its purest sense is a technological one which should be solved by engineers, not by lawyers. Although technological advances have reduced noise at the source (stage III aircraft), the noisiest problem facing pilots and operators are the political ramifications of aircraft noise. This has provided the impetus for the noise lawsuits, which is where the lawyers get involved.

I intend to give you a brief review of the development of "aircraft noise" law which is being used by citizens as a tactic to force curfews of airports, to reduce capacity and to require the use of preferential runways and the flying of noise abatement procedures.

In doing this I intend to cover three main areas which are (1) Landowner rights; (2) the airport proprietor's liability and authority to restrict operations, and (3) the role of the FAA/Federal Government.

Our law has generally jealously guarded the rights of property owners and has followed the old maxim, a man's home is his castle. When one bought a parcel of land, he owned not only the surface but the air above and the ground below. Our interest today centers on the air rights above the property rather than the mineral rights below. In the early days when airplanes were novel, people were delighted when one flew over their property just so they could see it.

The noise problem from the legal standpoint had its starting place, like aviation, in North Carolina. In 1946, a chicken farmer who was in the flight path of the Greenville, NC airport filed suit against the U.S. Government whose military planes were flying over his land both day and night. He sought money damages because they were unable to sleep, were nervous, and were frightened because of the overflights and unable to raise chickens as they flew into the walls and killed themselves when planes passed low overhead. The Supreme Court held that the overlfights were taking (inverse condemnation of an easement) and the U.S. may pay the landowner for the diminution of the value of the property. In this case the Government who leased the Airport and owned and operated the aircraft was held liable. There was no other significant noise litigation until 1962 when the Supreme Court was faced with the question of who should pay for the "noise taking" of one's property -- the airport owner, the Federal Government, or the airlines who operated the aircraft which generated the noise? In this case, which involved the greater Pittsburgh Airport, the county owned and operated the airport. However, the United States had shared in the cost of building the airport (50-75%) and had laid out the airport and runways in accordance with the standards established by the CAA administrator. The airlines had a lease arrangement with the airport allowing them to land and takeoff aircraft.

In this case the lower courts determined that there was a noise taking of the property and the question presented to the Supreme Court was who should pay for the taking. Should it be the Government who prescribed how the approaches should be laid out? Or was it the airlines that were the real culprits since it was their airplanes that made the noise or was it the county who determined the site of the airport. The court was faced with deciding which one of those three entities would be liable. Parenthetically, a nameless predecessor of Dick Deeds by some 20 years was immortalized by the Supreme Court's opinion when they specifically recognized ALPA. They said "moreover their house was so close to the runways or path of glide that as the spokesman for the members of the Air Line Pilots Associaiton admitted, 'If we had engine failure we would have no course but to plow into your house.'"

The court answered the liability question by saying the county was liable because it was the county who determined where the airport should be built and who designed it for public use in conformity with the rules and regulations of the CAA. The court likened the county airport to a bridge. When the county decides it is necessary to build a bridge for public use they must acquire the necessary land by purchase. Therefore in the case of the airport the cost of any taking of land near the airport must be borne by the airport owner, which in this case was the county.

Airport owners were not overjoyed at being left with sole responsibility for aircraft noise and they attempted to spread the wealth by seeking equitable or contractual contributions for the air carriers, the airframe manufacturers and engine manufacturers. It's only fair they should share the costs as they are the ones who actually make the noise. The first attempt to share the liability was made by the city of Los Angeles who sought equitable or contractual indemnification from air carriers, airframe and engine manufacturers for a judgement that had been obtained for inverse condemnation. The court rejected the city's argument that operators and manufacturers should share the costs of aircraft noise on the basis that only the city could acquire by condemnation an easement over the land and surrounding the airport. Furthermore, there was no indication in the lease that the parties intended the airlines to indemnify the city for using flight paths in the manner contemplated by and provided for in the lease. In Milwaukee, property owners attempted to hold both the county and airlines liable for noise nuisance. The Court determined that the county was not responsible and not the airlines since it created and operated the airport. Several other cases involving Minneapolis, Chicago, New York, and again Los Angeles uniformly followed the Griggs Supreme Court reasoning and held the airport proprietor solely liable for aircraft noise damages.

Since it is settled that the airport owner has liability, the next question to arise was the authority of airports or owners to restrict airport usage. In 1972 California was beginning to become very agressive in the environmental area and the city of Burbank exercised its police power as a municipality and imposed a night time curfew on a privately owned airport within its jurisdiction. The airport owner sued the city to invalidate the ordinance on the gounds that the federal government by virtue of the Federal Aviation Act and the Noise Control Act has preempted state and local control over airport noise. The Supreme Court agreed holding that the noise control act of 1972

preempted the city's exercise of police. power. That seemed to establish Federal preemption in the aircraft Noise area, except in that a footnote the Court was careful to point out that the opinion did not determine what limits, if any, would apply to an airport proprietor. Indeed, the court suggested that owners could deny use of their airports so long as the exclusion was not discriminatory. Thereafter, again in California, the authority of a city, who was the proprietor of an airport, to restrict airport usage was put to a judicial test. The city of Hayward, who was the proprietor of the airport enacted an ordinance that prohibited all aircraft from operating between the hours of 11 p.m. and 7 a.m. if they exceeded 75 DBA. The city of Santa Monica imposed a total restriction on Jet aircraft and imposed a total curfew between 11 p.m. and 7 a.m. These ordinances differed in that one was based on noise levels and one was a total ban.

The courts have upheld both of these ordinances. As a result of these and subsequent cases, the test for validity of airport restrictions imposed by proprietors is that they must be (1) reasonable, (2) nondiscriminatory and (3) not regulate the aircraft while in flight which is the sole responsibility of the FAA. Subsequent court decisions in other jurisdictions have followed the theory that the airport owner can control airport access and set noise limits so long as they are reasonable and even-handedly applied. The courts have held that this authority is necessary since the airport operator is liable. If the airport proprietor is to be held responsible for noise damage, he must have the authority to control it.

The authority of an airport proprietor to restrict operations was summed up by the court that directed the city of New York Port Authority to permit the Concorde to land at JFK.

> "The proper domain of the operator is the issuance of regulations or the establishment of requirements as to the permissible level of noise which can be created by aircraft using the airport. . . It is clear to us that the Port authority is vested only with the power to promulgate reasonable, nonarbitrary and nondiscriminatory regulations that establish acceptable noise levels for the airport and its immediate environs. Any other conduct by an airport proprietor would frustrate the statutory scheme and unconstitutionally burden the commerce Congress sought to foster.
>
> While the airport owner/operator has the control of noise on the ground, the FAA continues to have the authority to prescribe flight rules and control noise at the source.

Given this state of the law, the landowners near airports who want to reduce the noise level have concentrated on two courses of action (1) pressure on the local government and (2) lawsuits designed to force the airport owners to curtail operations. They are suing the airport for (1) a taking, (2) trespassing and (3) nuisance. Under the taking theory you could only recover your damages one time. Since the standard measure of damages for a "taking" is the difference between the value of the property before the airport began operations and the value after, often there is no damages: because of the airport's proximity, the value of the property often increases. This makes the

nuisance theory more attractive. The latter cause of action, nuisance, has become the most popular because it is a continuing damage time, that is, if it is not abated, you can get damages periodically. In California for instance, every 100 days you have a new cause of action. This varies from state to state. Needless to say, such suits can become very expensive from the damages aspect, the public relations aspect and the litigation costs, so naturally the airport operator is forced to reduce the noise by seeking new flight procedures from FAA, reducing operations, using only certain runways and imposing curfews. Therefore, by using this litigation tactic, the homeowners achieve their goal of curtailing operations at a given airport. Additionally, we find landing fees and other user charges being increased to cover the increased legal expenses, damage awards and to purchase property or insulate homes near the airport. The problem is that the permissable level of noise before it becomes a nuisance varies from place to place. There are no standard legal definitions as to what level of noise is permissable. If we do not adopt some national standards soon, interstate commerce could be adversely impacted.

I would like to move now to more fully consider the role of the FAA. The FAA is, of course, responsible for all flight procedures and noise source control from aircraft engines, and this exclusive authority to regulate stems from the Federal Aviation Act of 1958. This is now a settled law. The FAA's role in aviation noise was recognized by Congress as early as 1968 when they enacted the Control and Abatement of Aircraft noise and Sonic Boom Act. Congress later enacted the Noise Control Act of 1972 to involve the EPA in the federal control of aircraft noise. Most recently they enacted the Aviation Safety and Noise Abatement Act of 1979 which was amended in 1982. This provides that if airport operators engage in airport noise planning and submit a noise exposure map to the FAA they will be eligible to receive limited federal funds from the Airport Improvement Program to purchase property and insulate homes.

While this legislation is a step in the right direction, it stops short of providing mandatory uniform national minimum noise standards and makes participation in "noise planning" voluntary. Congress elected not to preempt the local government's authority to control ground aircraft noise. There are reasons for this. The Federal Government does not want to preempt control of aircraft upon the ground primarily because of the liability involved. It could prove very expensive. Moreover, the Federal Government would like to avoid becoming involved in the local political thicket of noise control. The FAA has implemented this statute in Part 150 of the FAR's. However, Part 150, like the statute, is voluntary and may be best described as advisory.

Another statute which is not directly related to noise but which the FAA has made effective use of in opposing efforts to impose curfews and other restrictions upon airport operators is the Airport Improvement Program Act. In giving airports grants for improvement, the FAA has imposed conditions that among other things require the airport to keep the airport open to "all types, kinds and classes of aeronautical uses on fair and reasonable terms and to operate the airport lights each night." Based upon these convenants, the FAA has successfully resisted restrictions on type of aircraft using an airport (Orange County) and enjoining the imposition of a curfew at Republic Airport in Farmingdale, NY. So the FAA has reacted in a few situations to counter the

restrictions at airports resulting from noise. However, as Dick Deeds has pointed out, it is difficult for the FAA to tell an airport they cannot impose restrictions on aircraft operations which amount to curfews when they have done so themselves at National airport. This brings us to the airport operator who is holding the bag in regard to aircraft operations noise. Most, if not all, of the air carrier airports are operated by local political bodies which by their nature are extremely sensitive to voter pressuers. Even though many of the most vocal homeowners may have bought their house with full knowledge of the nearby airport and its operations, they nevertheless want the noise curtailed, especially at night. To achieve a reduction in operations, they have organized and been very effective in using their political muscle. This has resulted in the studies, community roundtables, and such, which seek ways to reduce noise and have been required to monitor noise levels and impose restrictions to reduce noise levels. These restrictive actions are also brought about by the nuisance lawsuits and the need of the airport to abate the nuisance to avoid large damage awards. The airport operator is caught between competing interests of those who want increased capacity and those who want peace and quiet. Of course, as pilots, you want to be "good neighbors" but our interest and indeed, responsibility is to insure that any noise abatement procedures which may be imposed are safe and if possible standardized.

The best solution to this problem in my view is a national aircraft noise policy that would preempt the diverse standards we now have. Short of this solution, one of the ways to obtain this goal is for pilots to be active in the formulation of the airport's noise abatement policies. This can be done by participating in the community noise meetings and explaining as pilots you want to be a good neighbor, but there are limitations from a safety standpoint that affects them both as passengers and possible victims on the ground. I know Dick Deeds has had some success in this area. Sometimes an explanation by a pilot of why certain actions that may reduce noise are unacceptable from the safety standpoint is enough to cause the citizens involved to seek reasonalbe alternatives.

The ultimate solution to the noise problem is to set a national standard and reduce the noise at the source to that level. However, until that is achieved and the airlines can afford to purchase this new equipment, we must find means to permit the continued use of existing equipment to ensure interstate commerce is not impeded and flight safety is not impaired. That is the challenge facing the aviation community and hopefully we can work together to further our common interest which is unfettered access to airports utilizing safe and standardized procedures that generate the least amount of noise.

FEDERAL STATUTORY BACKGROUND OF AIRCRAFT NOISE

The aircraft noise problem has not been left to the sole purview of the Courts. Congress has attempted to address this difficult problem through legislation. However, because of the intense pressures from the environmental groups and the economic considerations involved, the resulting legislation has not been really effective for anyone, as it lacks the necessary mandatory requirements.

As we discussed earlier, Congress is fully aware of the liability involved in aircraft noise and so far has been unwilling to pass any really effective legislation for fear of assuming that liability.

However, it is useful to know what legislation has been enacted as it explains the reason for the FAA's actions, or at least part of them, in the area of noise abatement.

As most of you know, the act that created the FAA and empowered it to license pilots, certificate aircraft, establish flight rules and procedures, is the Federal Aviation Act of 1958. At the time the FAA was created aircraft noise was not a major problem and this legislation did not address noise. As time progressed and noise became a problem, Congress in 1968 enacted and amended the Aviation Act to add Section 611 which was entitled "Control and Abatement of Aircraft Noise and Sonic Boom."

This statute directed the FAA, after consultation with the Secretary of Transportation and EPA to prescribe and amend standards for the measurement of aircraft noise and sonic boom and to prescribe such regulations as may be necessary to provide for the control and abatement of aircraft noise and sonic boom. The statute also directed the FAA not to issue an original type certificate unless the aircraft meets the FAA standards which are designed to protect the public from aircraft noise. This statute was slightly amended in subsequent years.

The FAA's response or implementation of this law was the promulgation of Part 36 in 1969 which was designed to control aircraft noise at its source by prescribing noise standards that had to be met by all newly certified aircraft. Of course as we know, Part 36 was amended to require all aircraft to meet Part 36 standards by January 1, 1985. There was a small community exemption from this standard which was later imposed by Congress although neither Congress nor the FAA defined small community.

Of course Congress has now agreed to exempt two airports, Miami and Bangor from Part 36 requirements, providing the operators involved have made good faith efforts to install hush kits when they become available.

Congress took no major legislative role in aircraft noise abatement until 1972 when the Noise Control Act of 1972 was passed.

This act amended Section 611 to the extent that it prohibited the FAA from issuing an original type certificate to any aircraft that failed to meet Part 36 standards. It also sought to impose noise standards for all products

distributed in interstate commerce. This included aircraft, motor carriers, railroads engines, etc. The law required the EPA to publish noise standards for all products which could be identified identified as major sources of noise and required manufacturers to warrant that their affected products met the standards in the EPA regulations. With regard to aircraft noise the Act required both the FAA and EPA to consider the effect of aircraft noise on the public health and welfare. The FAA retained its authority over aircraft noise but was required to hold public hearings on EPA proposed aircraft noise regulations. However, the law really had no teeth with respect to the FAA as they were not mandated to implement any of the EPA proposed regulations. As a result, although EPA has proposed several regulations regarding aircraft noise virtually all have been rejected. While the FAA paid little heed to the EPA, it was busy preparing its response to the Noise Control Act. This response is embodied in the Aviation Noise Abatement Policy published in November 18, 1976 by the Department of Transportation.

The FAA's interpretation of the law was that the airport proprietor has single liability for any noise damages but that responsibility for aircraft noise abatement was jointly shared by federal, state and local governments, the air carriers, airport proprietors and citizens.

The FAA's view of the law was stated as follows:

1. The federal government has preempted the areas of airspace use and management, air traffic control, safety and the regulation of aircraft noise at its source. The federal government also has substantial power to influence airport development through its administration of the Airport and

Airway Development Program now the Airport Improvement Program.

2. Other powers and authorities to control noise rest with the airport proprietor - including the power to select an airport site, acquire land, assure compatible land use, and control airport design, scheduling and operations - subject only to Constitutional prohibitions against creation of an undue burden on interstate and foreign commerce, unjust discrimination, and interference with exclusive federal regulatory responsibilities over safety and airspace management.

3. State and local governments may protect their citizens through land use controls and other police power measures not affecting aircraft operations. In addition, to the extent they are airport proprietors, they have powers described in paragraph 2.

The FAA went on in its policy to define the actions an airport could implement without any consultation or approval from the FAA and those actions that required the FAA or someone else's cooperation or action.

For review purposes these are:

a. Actions that the airport proprietor can implement directly:

(1) location of engine run-up areas;

(2) time when engine run-up for maintenance can be done;

(3) establishment of landing fees based on aircraft noise emission characteristics or time of day.

b. Actions that the airport proprietor can implement directly if he has authority, or propose to other appropriate local authorities:

(1) plan and control of land use adjacent to the airport by zoning or other appropriate land use controls, such as utility expenditures and the issuance of building permits;

(2) enact building codes which require housing and public buildings in the vicinity of airports to be appropriately insulated; and

(3) require appropriate notice of airport noise to the purchasers of real estate and prospective residents in areas near airports.

c. Actions that the airport proprietor can implement directly in conjunction with other appropriate local authorities and with financial assistance from the FAA, where appropriate:

(1) acquire land to insure its use for purposes compatible with airport operations;

(2) acquire interests in land, such as easements or air rights, to insure its use for purposes compatible with airport operations;

(3) acquire noise suppressing equipment, construction of physical barriers, and landscape for the purpose of reducing the impact of aircraft noise; and

(4) undertake airport development, such as new runways or extended runways, that would shift noise away from populated areas or reduce the noise impact over presently impacted areas.

d. Actions that the airport proprietor can propose to FAA for implementation at a specific airport as operational noise control procedures:

(1) a preferential runway use system;

(2) preferential approach and departure flight tracks;

(3) a priority runway use system;

(4) a rotational runway use system;

(5) flight operational procedures such as thrust reduction or maximum climb on takeoff;

(6) higher glide slope angles and glide slope intercept altitudes on approach; and

(7) displaced runway threshold.

e. Actions an airport proprietor can establish, after providing an opportunity to airport users, the general public and to FAA to review and advise:

(1) restrictions on the use of or operations at the airport in a particular time period or by aircraft type, such as:

(a) limiting the number of operations per day or year;

(b) prohibiting operations at certain hours - curfews;

(c) prohibiting operation by a particular type or class of aircraft; and

(2) any combination of the above.

f. Actions an airport proprietor can propose to an airline:

(1) shifting operations to neighboring airports;

(2) rescheduling of operations by aircraft type or time of day.

Congress, unhappy with FAA's slow response to EPA proposals to abate aircraft noise, when it enacted the "Quiet Communities Act of 1976" it amended

Section 611 of the Federal Aviation Act to require the FAA to respond to EPA proposals in ninety days.

Finally, in 1979 Congress again addressed aircraft noise and enacted the Aviation Safety and Noise Abatement Act of 1979.

Congress defined aircraft noise as a major problem facing this country and observed:

> Over $200 million has been expended by airport proprietors to acquire noise-impacted land around airports and the Nation's major airports have suits currently pending for hundreds of millions of dollars and potential liabilities that can be measured in the billions of dollars.
>
> Citizen opposition to aircraft noise has delayed, and in some cases prevented, airport development and expansion and the installation of facilities to improve safety and airport capacity.
>
> Airport operators, in the face of prolonged Federal inaction, are imposing unilaterally, and at an accelerated rate, curfews and other restrictions on airport use for noise relief purposes.
>
> Aircraft noise is a major problem affecting the present viability and future growth of this Nation's air transportation system. The problem of aircraft noise is not a localized problem restricted to a few critical airports - it is a national problem.
>
> Over 6 million people and 900,000 acres of land are impacted by aircraft noise levels deemed normally unacceptable for new residential construction loan guarantees by the Departent of Housing and Urban development (HUD).
>
> The President's Council on Wage and Price Stability has estimated that aircraft noise costs taxpayers around airports some $3.25 billion annually in decreased property values.

To respond to this problem, Congress directed the Secretary of Transportation to promulgate a regulation to:

1. establish a single system of measuring noise for which there is a highly reliable relationship between projected noise exposure and surveyed reactions of people to noise, to be uniformly applied in measuring thse noise at airports and the areas surrounding such airports;

2. establish a single system for determining the exposure of individuals to noise which results from the operations of an airport and which includes, but is not limited to, noise intensity, duration, frequency, and time of occurrence; and

3. identify land uses which are normally compatible with various exposures of individuals to noise.

The act provided for airport plans submitted pursuant to the regulation to be approved by the FAA and further provided that airport development funds would be provided to implement noise abatement actions in the approved plan.

Additionally the act precluded property owners who acquired property in the vicinity of an airport after the act and with knowledge of a noise exposure map which had been submitted to recover any damages for noise.

There were exceptions to this provision and they provided for damage suits even if a noise exposure map had been submitted if any of the following occurred:

1. a significant change in type or frequency of aircraft operations at the airport;

2. a significant change in airport layout;

3. a significant change in flight patterns

4. a significant increase in nighttime operations.

While this act was a step in the right direction, it stopped short of making the program mandatory. Whether airports wanted to participate was a voluntary choice on their part. Congress was unwilling to preempt state and local authority because of the large liability for noise damage which they estimated could range to 3-1/4 billion dollars per year.

The passage of the Noise Abatement Act was the impetus that caused the FAA to publish Part 150 which has been thoroughly discussed.

The statutes which I have discussed are the legislative background, from a federal standpoint of aircraft noise abatement and explain some of the reasons for the FAA regulations in this area.

I have not discussed, and will not in this forum the plethora of state laws on this subject. To those of you who will become embroiled in state laws because of your participation in an individual study, I offer my services on an "as needed" basis to provide that information.

THE AVIATION NOISE ABATEMENT CONTROVERSY: MAGNIFICENT LAWS, NOISY MACHINES, AND THE LEGAL LIABILITY SHUFFLE†

by
*John M. Wertich**
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I. INTRODUCTION

Citizens of this nation, especially those residing near airports,[1] have endeavored for two decades to stem the burgeoning tide of airport noise, which may cause significant physical or psychological injury[2] or may be simply annoying.[3] Since the commercialization of jet aircraft, federal, state and local governments have enacted a plethora of laws

† The opinions expressed herein are those of the authors and are not necessarily endorsed by the Department of Airports, City of Los Angeles or the Federal Aviation Administration.

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1. "Approximately six million U.S. citizens currently reside on 900,000 acres of land exposed to levels of aircraft noise that create a significant annoyance for most residents." U.S. DEP'T OF TRANSP. FEDERAL AVIATION ADMIN., AVIATION NOISE ABATEMENT POLICY 17 (1976) [hereinafter cited as NOISE ABATEMENT POLICY]. For a discussion of the methodology of measuring noise, *see infra* notes 20 & 90.

2. *See, e.g., Birth Defects Linked to Airport Noise*, MED. WORLD NEWS, Apr. 3, 1970, at 84 (increased incidence of birth defects linked to aircraft noise); Herridge & Chir, *Aircraft Noise and Mental Hospital Admission*, 6 SOUND 32 (1972) (nervous breakdowns found more prevalent around Heathrow Airport than in quieter areas); Meecham & Smith, *Effects of Jet Aircraft Noise on Mental Hospital Admission*, 11 BRIT. J. AUDIOLOGY 81 (1977) (higher proportion of mental hospital admissions found near Los Angeles International Airport than in less noisy areas).

3. "Although there may be indirect and subtle social and psychological harms, aircraft noise is predominantly an annoyance problem. It does not present any direct physical health danger to the vast majority of people exposed." NOISE ABATEMENT POLICY, *supra* note 1, at 17; *see also* Glorig, *Non-Auditory Effects of Noise Exposure*, SOUND & VIBRATION May 1971, at 28 (to date, studies of the effects of noise exposure have failed to reveal any harmful health effects).

designed to attain relief from noise. Meaningful relief, however, has not been achieved.

Through legislation, Congress has attempted to create a uniform national noise abatement plan directed and monitored by one entity: the Federal Aviation Administration (FAA).[4] Unfortunately, this goal has not been realized. Apparently in an effort to limit federal government liability, the FAA has failed to assume the responsibility envisioned in the federal legislation. In addition, the recent trend of decisions by courts that have held airport proprietors liable for the personal injury and property damages caused by aircraft noise,[5] and Congress' retreat from its previous policy favoring financial aid to noise impacted airports, have also undermined the movement for a uniform national aviation noise abatement plan.

The FAA's abdication of leadership, adverse court decisions, and the reduction in federal financial aid have left airport proprietors to fend for themselves. Spurred on by a rash of noise lawsuits,[6] local airport proprietors, in a legitimate effort to minimize their liability exposure, have adopted noise abatement regulations based on parochial, rather than national, interests.[7] These local regulations, in turn, have caused further divisions in the effort to create a national aircraft noise abatement plan.

The unfortunate consequence is that the *liability* for aviation noise has been partially disconnected from the *responsibility* for aviation noise abatement. This is a result of decisions in which various courts have held that the *liability* for aviation noise damages rests solely on the hundreds of individual airport proprietors, while *responsibility* for aviation noise abatement resides collectively among federal, state and local governments, air carriers, and airport proprietors. This "single liability/shared responsibility" situation promotes, rather than discour-

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4. *See infra* text accompanying notes 8-57.

5. *See infra* text accompanying notes 64-74, 109-27.

6. *See* Burke, *Legal Roar Over Jet Noise*, The Nat'l L.J., Dec. 1, 1980, at 1, col. 2. "In the last four years, at least 16 other cities [other than Los Angeles] have been faced with airport noise claims in excess of $260 million." *Id.* at 10, col. 1.

7. *See* H.R. Rep. No. 594, 94th Cong., 2d Sess. 14, *reprinted in* 1976 U.S. Code Cong. & Ad. News 1600, 1603.

> In addition, aircraft noise has resulted in curfews and other operational constraints which have restricted the use of existing facilities, and have caused problems relating to the safety of the system. Because of noise emanating from the operations at airports, full utilization and expansion of airports to accommodate current and future traffic have been hampered.

Id.

ages, confusion. The result is unwarranted agony for all the parties—particularly citizens living near airports.

This article will (1) review national aviation noise legislation and its implementation by the FAA, (2) analyze the judicial decisions that discuss the imposition of liability for aircraft noise, and (3) offer two alternative approaches that would more equitably apportion liability.

II. Federal Laws and FAA Implementation

A. Regulatory Provisions

1. Federal Aviation Act of 1958—the beginning

Federal regulation of airspace and air commerce is authorized under the Federal Aviation Act of 1958 (1958 Act)[8] which entrusted certain powers to the FAA and to the Civil Aeronautics Board (CAB).[9] The FAA's responsibility under the 1958 Act, to be carried out primarily through the promulgation of Federal Aviation Regulations (FARs), was to promote air safety, regulate the use of the navigable airspace, establish air navigation facilities, operate a national system of air traffic control,[10] and certify airmen, airplanes and certain airports for commercial use.[11] This exclusive federal control was based on Congress' recognition that the public has a basic right to air transit.[12] Moreover, the power to ensure such travel was declared to be a right of national sovereignty.[13]

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8. 49 U.S.C. §§ 1301-1552 (1976 & Supp. III 1979). The 1958 Act, as amended, is the basis of federal aviation regulations. This article is not intended to review all of its provisions.

9. The authority of the CAB is concerned primarily with the economic aspects of the aviation industry. For the CAB's area of responsibility, see 49 U.S.C. §§ 1302, 1321-1389 (1976 & Supp. III 1979). Theoretically, the CAB could regulate aircraft noise by refusing to certify new routes or by suspending or changing existing ones. However, Congress, in § 401(e)(4) of the 1958 Act, placed limits on the CAB's power to do this. Moreover, the CAB has never exercised this power, and, in light of the recent enactment of the Airline Deregulation Act of 1978, Pub. L. No. 95-504, 92 Stat. 1703 (codified in scattered sections of 18, 49 U.S.C. (Supp. III 1979)), it is unlikely to do so in the future. The Airline Deregulation Act will gradually eliminate the CAB's control over routes and fares. The Airline Deregulation Act also provides for the phased elimination and transfer of the CAB's remaining functions to other governmental agencies: the Department of Transportation, the Postal Service, and the Department of Justice. By January 1, 1985, the CAB's functions will terminate.

10. 49 U.S.C. § 1348 (1976).

11. *Id.* at §§ 1421-1432.

12. *Id.* at § 1304.

13. *Id.* at § 1508(a). "The United States of America is declared to possess and exercise complete and exclusive national sovereignty in the airspace of the United States. . . ." *Id.*

2. Federal Aviation Act Amendments of 1968—aircraft noise problem recognized

While the 1958 Act seemingly granted the FAA responsibility for all aspects of aviation, it did not specifically authorize the FAA to establish limits on aircraft noise emissions or otherwise to regulate for noise abatement purposes.[14] In 1968, however, Congress added section 611 to the 1958 Act.[15] This section recognized that there was a noise problem and authorized the FAA to prescribe standards for the measurement of aircraft noise and to establish regulations to control and abate such noise. This grant of authority was limited, however. The standards and regulations had to be "consistent with the highest degree of safety" and be "economically reasonable, technologically practicable, and appropriate for the particular type of *aircraft*."[16] Thus, the resulting regulations were directed at the source of noise—the aircraft itself—rather than at airport proprietors.

3. Part 36—FAA attempts to control noise at its source

In response to section 611, the FAA promulgated FAR Part 36[17] (Part 36) in 1969. Part 36 was the embodiment of the FAA's attempt to control aircraft noise at its source. It provided a mechanism by which aircraft noise could be uniformly measured. It also established maximum allowable noise levels (depending on weight and number of engines) that aircraft of *new* design could not exceed in order to obtain type certification.[18] It did not address possible changes in flight procedures to reduce noise, nor did it apply to then currently operating aircraft.[19] The noise levels were expressed as an Effective Perceived Noise Level (EPNdB) and permitted heavier aircraft to make more noise.[20] The adoption of Part 36 encouraged new airplane types to be markedly

14. For example, although the FAA, in accordance with 49 U.S.C. § 1423(c) (1976), could certify aircraft as "airworthy," the certification had to be based on safety considerations, not noise.

15. Federal Aviation Act Amendments of 1968, Pub. L. No. 90-411, § 611, 82 Stat. 395 (current version at 49 U.S.C. § 1431 (1976 & Supp. III 1979)).

16. 49 U.S.C. § 1431(d)(3)-(4) (1976) (emphasis added).

17. 34 Fed. Reg. 18,364 (1969) (current version at 14 C.F.R. § 36 (1981)).

18. Before an aircraft may fly, it must first be type certificated. The FAA Administrator is vested with the power to issue type certificates for aircraft. 49 U.S.C. § 1423 (1976). Type certificates concern the basic design of an aircraft. Once a general design is type certificated, all other aircraft built according to that design are entitled to type certificates. *See* Morton v. Dow, 525 F.2d 1302 (10th Cir. 1975).

19. 34 Fed. Reg. 18,364 (1969).

20. For example, depending upon the type of engine, the standard for most B-747-100 aircraft is approximately 108 EPNdB, the maximum noise output allowable. U.S. DEP'T OF

quieter than the generation of turbojets developed in the late 1950s and early 1960s.

Since 1969, Part 36 has been amended several times to expand its coverage from newly designed domestic subsonic jet aircraft to *all* jet powered and propeller driven aircraft. For example, by extending the standards to newly manufactured domestic subsonic aircraft of *older* design,[21] the 1973 amendment significantly increased the number of aircraft subject to Part 36. In a 1976 amendment, the FAA tackled the most controversial aspect of controlling aircraft noise at its source by requiring *currently* operating domestic subsonic aircraft with maximum gross weights over 75,000 pounds to meet Part 36 standards.[22] This was accomplished by establishing a phased compliance program for all operating aircraft.[23] Whether by retrofitting or otherwise, all operating aircraft were required to comply with Part 36 standards on or before January 1, 1985. However, effective February 1, 1981, the compliance dates were extended for some types of aircraft to January 1, 1988,[24] and

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TRANSP. FEDERAL AVIATION ADMIN., ADVISORY CIRCULAR NO. 36-1B, CERTIFICATED AIRPLANE NOISE LEVELS (1977); NOISE ABATEMENT POLICY, *supra* note 1, at 36.

Because people's reactions to noise differ widely, it is difficult to establish a simple mathematical formula that accurately represents human reaction to noise annoyance. For example, the noise emanating from a waterfall may produce more sound energy than the screech of chalk across a blackboard. To many, however, the latter is much more annoying. Even the experts are not in agreement on the relative merits of expressing noise impact in terms of dB, dBA, dBD, PnL, EPNL, EPNdB, SEL, SENEL, CNR, NEF, CNEL, ASDS, LdN or Leq. For the purposes of type certification, see *supra* note 18, the FAA utilizes units of EPNdB (a unit of perceived noise that attempts to take into account the actual sound energy received by a listener, the ear's response to that sound energy, the added annoyance of any pure tones or "screeches," and its duration). NOISE ABATEMENT POLICY, *supra* note 1, at 12-14. On the other hand, the FAA has recently designated decibels (dBA) and the yearly day-night average sound level (LdN) as the standards for determining the level of airport noise exposure. 47 Fed. Reg. 8,338, 8,339 (1981) (to be codified in 14 C.F.R. § 150). For further information, see Callahan, *Noise and its Measurement*, MINNESOTA CITIES, Feb. 1980, at 26; Aleksich, Jr., *Aircraft Noise Law: A Technical Perspective*, 35 A.B.A.J. 740 (1969).

21. 38 Fed. Reg. 29,569 (1973).

22. It was controversial primarily because of the potential economic impact on the airline industry of being required to retrofit (acoustically modify by applying sound absorbent material), reengine or replace noncomplying aircraft. 41 Fed. Reg. 56,049 (1976). For example, in 1976, the FAA estimated that modification of all affected aircraft would cost close to one billion dollars. *Id.* at 56,052.

23. This was effectuated by adding a new Subpart E to 14 C.F.R. § 91. 41 Fed. Reg. 56,046, 56,055-56 (1976) (current version at 14 C.F.R. §§ 91.301-.311 (1981). The FAA adopted the phased compliance program because, as of the effective date of the amendment, only 500 of the United States fleet of 2,100 large jet aircraft complied with Part 36. 41 Fed. Reg. 56,046 (1976).

24. These include certain two-engine or three-engine aircraft under FAA approved replacement plans and certain two-engine aircraft under the small communities exemption provisions. 45 Fed. Reg. 79,302, 79,313 (1980). Interestingly, neither Congress, which man-

Part 36 was made applicable to foreign as well as domestic aircraft.[25] The last amendment was in direct response to a congressional mandate.[26]

4. Noise Control Act of 1972—EPA climbs aboard

In 1972, Congress, apparently dissatisfied with the progress of the FAA,[27] passed the Noise Control Act of 1972.[28] Among other things, the Act amended section 611. In essence, it prohibited the FAA from issuing an original type certificate to any aircraft that failed to meet Part 36 noise standards.[29] The Act also recognized a role for local governments, but added the Environmental Protection Agency (EPA) to the regulatory process and required both the FAA and EPA to consider the effect of aircraft noise on the public health and welfare. While the FAA maintained regulatory authority over aircraft noise, it was mandated to hold public hearings on EPA proposed aircraft noise regulations. The FAA, however, was not required to adopt the regulations. As a result, the EPA has had meager influence on the regulatory process—nearly all EPA proposals have been rejected,[30] sometimes after

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dated this exemption, nor the FAA defined what constitutes "small community service." One might have thought that the rationale was to encourage air carriers to provide service to small communities and thus permit noisier aircraft to service those communities. In practice, however, the exemption applies to particular aircraft whether they fly to a community with a population of 5,000 or 5,000,000.

25. In its Aviation Noise Abatement Policy, the FAA stated that it would unilaterally impose its own aircraft noise standards on foreign air carriers unless the International Civil Aviation Organization (ICAO) established a noise abatement schedule substantially similar to Part 36. NOISE ABATEMENT POLICY, *supra* note 1, at 42. The ICAO is responsible for setting international noise standards. This was not done to the FAA's satisfaction, so the FAA considered itself mandated by the Aviation Safety and Noise Abatement Act of 1979, Pub. L. No. 96-193, 94 Stat. 50 (1980) (codified in scattered sections of 49 U.S.C.A. (West Supp. 1981)), to apply Part 36 standards to foreign air carriers. 45 Fed. Reg. 79,302, 79,305-310 (1980).

26. 45 Fed. Reg. 79,302, 79,305-06 (1980).

27. During the first four years after the addition of § 611 to the 1958 Act, the FAA had promulgated only one noise regulation, Part 36. This regulation applied only to new designs for domestic aircraft and left both operating aircraft and foreign aircraft unregulated.

28. 42 U.S.C. §§ 4901-4918 (1976), 49 U.S.C. § 1431 (1976). Actually, the Act addressed much more than aircraft noise. Among other things, it mandated the EPA to set noise standards for all products in interstate and foreign commerce.

29. 49 U.S.C. § 1431(6)(2) (1976). In other words, Congress wanted the FAA to apply Part 36 standards to all newly produced aircraft even though aircraft of that type were already in operation, as opposed to those merely on the drawing boards. Aircraft that do not comply with Part 36 standards as originally promulgated in 1969 include: all B-707s and DC-8s; depending on engine type, most B-737s, DC-9s, and BAC 1-11s; some B-727s; and a few B-747s. All DC-10 and L-1011 aircraft comply. NOISE ABATEMENT POLICY, *supra* note 1, at 36.

30. To date, the EPA has proposed 11 regulations; only one has been adopted in full.

long delays.

5. FAA's Noise Abatement Policy of 1976—a self-serving document

It is one thing for Congress to enact legislation and proffer its intent through committee reports. It is quite another for the federal bureaucracy to interpret the meaning of the legislation and promulgate regulations. In 1976, the FAA issued its interpretation of congressional intent in the area of aviation noise abatement when it published its Aviation Noise Abatement Policy. In the FAA's view, *single liability* for noise damages resides in the airport proprietor, but *shared* responsibility for aviation noise abatement resides jointly among federal, state and local governments, air carriers, airport proprietors, and citizens.[31] Taking into account the entire breadth of legislative history concerning aviation noise law, the FAA postulated a "legal framework" that is best stated in its own words:

> 1. The federal government has preempted the areas of airspace use and management, air traffic control, safety and the regulation of aircraft noise at its source. The federal government also has substantial power to influence airport development through its administration of the Airport and Airway Development Program.
>
> 2. Other powers and authorities to control airport noise rest with the airport proprietor—including the power to select an airport site, acquire land, assure compatible land use, and control airport design, scheduling and operations—subject only to Constitutional prohibitions against creation of an undue burden on interstate and foreign commerce, unjust discrimination, and interference with exclusive federal regulatory responsibilities over safety and airspace management.
>
> 3. State and local governments may protect their citi-

Statement of Walter C. Collins, Noise Abatement Officer at Los Angeles International Airport (June 23, 1981). For example, on August 29, 1975, the EPA proposed two amendments to the Federal Aviation Regulations which would have required pilots of all civil turbojet-powered aircraft to utilize a two-segment approach to a landing runway. Generally, a two-segment approach procedure requires the pilot to fly an initial steep glide path segment (six degrees) and to intercept the conventional glide path (three degrees) at 700 feet above the elevation of the airport. This procedure was to be used under certain circumstances during clear weather and upon approach to a runway that had an FAA approved two-segment Instrument Landing System (ILS) approach procedure. Both proposals were rejected for safety reasons. 41 Fed. Reg. 52,388 (1976).

31. NOISE ABATEMENT POLICY, *supra* note 1, at 5-6, 29-34.

> zens through land use controls and other police power measures not affecting aircraft operations. In addition, to the extent they are airport proprietors, they have the powers described in paragraph 2.[32]

To alleviate the burden of these proprietary powers, the FAA declared that it would support local airport proprietors' actions to abate noise; however, it reserved the right to block the implementation of such actions under either the supremacy or the commerce clause of the Constitution.[33] The FAA was, and still is, asserting that the extensive federal role envisioned by congressional legislation should be fragmented and accomplished piecemeal by local airport proprietors but, importantly, with no federal liability.[34] Thus, exclusive airport proprietor liability exists in the midst of pervasive federal control of aircraft flight operations.

6. Quiet Communities Act of 1978 and the Aviation Safety and Noise Abatement Act of 1979

Partially to speed up FAA response to EPA proposals, Congress further amended section 611 in the Quiet Communities Act of 1978.[35] It specified a ninety-day time limit for FAA response to EPA suggested regulations for noise abatement. It further required the FAA to provide the public with a detailed analysis and response to the EPA proposals.

In 1979, Congress continued its march toward pervasive controls and enacted the Aviation Safety and Noise Abatement Act of 1979 (ASNA).[36] ASNA required the Secretary of Transportation to estab-

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32. *Id.* at 34.

33. *See id.* at 58, in which the FAA discusses its review procedure of airport proprietor use restrictions. *See also* U.S. CONST., art. I, § 8.

34. It is possible that the FAA is reevaluating this position. In a speech given on February 18, 1982, FAA Administrator J. Lynn Helms hinted at this reevaluation when discussing proposed legislation involving FAA review of local noise regulations:

> The FAA, under the bill being drafted, would consider those national consequences and determine if the benefits to the national users from keeping the airport open for that hour were greater than the costs to the local residents. If so, that hour will be preserved. The FAA would propose to accept the economic consequences of such a judgment. That is, the FAA would become liable for the incremental difference between a reasonable local viewpoint and a truly national perspective.

Address of J. Lynn Helms, 16th Annual Southern Methodist University Air Law Symposium (Feb. 18, 1982).

35. Quiet Communities Act of 1978 § 3, 49 U.S.C. § 1431(c)(1) (Supp. III 1979). Note that it took the FAA fifteen months to reject the EPA suggested two-segment approach procedure. *See supra* note 30.

36. Pub. L. No. 96-193, 94 Stat. 50 (1980) (codified in scattered sections of 49 U.S.C.A. (West Supp. 1981)).

lish federal standards for measuring and assessing noise as it impacts residents near airports.[37] Additionally, airport proprietors were made eligible under the Airport and Airways Development Act of 1970 to obtain federal funds to assist them in airport noise compatibility planning.[38]

Interestingly, according to ASNA, airport proprietors may, but are not required to, submit "noise exposure maps" and "noise compatibility programs" to the Secretary.[39] The map, if submitted, must set forth the incompatible land uses existing near the airport as well as the projected effects of airport operations in 1985.[40] The program should list the measures taken or to be taken to reduce any incompatible noise. However, after the first map is submitted, the proprietor must report any changes that create a "substantial new noncompatible use in any area surrounding [the] airport."[41] Importantly, if the Secretary approves a noise program and allocates funds, the United States Government is not "liable for damages resulting from aviation noise by reason of any action taken by the Secretary or the Administrator of the Federal Aviation Administration under this section."[42]

Again, the negative aspect of liability is apparent. Although Congress excluded federal liability for noise damages related to the approval of a noise compatibility plan around a federally supported airport, it failed to address the thorny question of what liability, if any, an airport proprietor should have for noise damage resulting from the proprietor's management of its airport. This statutory program could represent the ultimate "Catch-22" for the airport proprietors who seem to be in dire need of assistance to protect their dual-faceted interest of economic survival and airport noise abatement.[43]

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37. 49 U.S.C.A. § 2102 (West Supp. 1981). EPNdB was the standard used by the FAA to *measure* aircraft noise. Congress wanted the FAA to establish a standard for *assessing* the impact of the noise on the community. *See supra* note 20.

38. 49 U.S.C.A. § 2104(c)(1) (West Supp. 1981).

39. *See id.* at §§ 2103(1), 2104(a).

40. 49 U.S.C.A. § 2103(1) (West Supp. 1981). The regulation promulgated to implement ASNA, 14 C.F.R. § 15, defines incompatible uses in general to include mobile homes, churches, schools, concert halls, residential properties, and libraries. 46 Fed. Reg. 8,316 (1981).

41. 49 U.S.C.A. § 2103(2) (West Supp. 1981).

42. *Id.* at § 2104(d).

43. *See* Burke, *Legal Roar Over Jet Noise*, Nat'l L.J., Dec. 1, 1980, at 1, col. 1.

> "It's kind of a Catch-22 situation," said Maureen R. George, chairwoman of the National Institution of Municipal Law Officers' airport litigation committee.
>
> "The courts are saying that cities have no authority to control noise," she said. "But on the other hand [some courts] are finding that cities are liable for the damages coming from that noise."

Id. at 10, col. 3-4 (brackets in original).

B. Federal Funding of Airport Development

For over thirty-five years Congress has experimented with different methods of aiding the aviation industry.[44] In 1970, finding the airport and airway system inadequate to meet the requirements of the then projected growth in aviation, Congress enacted the Airport and Airway Development Act of 1970 (AADA)[45] as the vehicle for expanding and improving the system. Congress included in the AADA a provision establishing a ten-year program (1970 through 1980) for increased federal matching grants to airport proprietors for eligible "airport development" projects.[46] Eligible projects included construction, equipment purchases, and land and easement acquisitions related to improving the safety of airports.[47] Significantly, eligible projects *did not* include noise abatement projects.

The FAA, under the direction of the Secretary of Transportation, was charged with administering this program. Hundreds of millions of dollars per year were spent on airport development. An Airport and Airway Trust Fund was established in the United States Treasury, with revenues derived from various taxes on airport activities, to meet the obligations incurred under the AADA.[48] At least one-third of the amount authorized was to be distributed at the discretion of the Secretary of Transportation. In 1973, Congress amended the AADA to increase federal financial assistance to airports and to prohibit the levy of a "head" tax on aviation passengers by state or local governments;[49] the latter could have been used by airport proprietors to supplement their revenues.

In 1976, Congress recognized that aircraft noise was becoming a

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44. *See, e.g.*, Federal Airport Act, Pub. L. No. 79-377, 60 Stat. 170 (1946) (repealed 1970).

45. Pub. L. No. 91-258, 84 Stat. 219 (1970) (codified in scattered sections of 16, 42, 49 U.S.C.).

46. *Id.* at §§ 2, 14 (current versions at 49 U.S.C. §§ 1701, 1714 (1976)).

47. *Id.* at § 11(2) (current version at 49 U.S.C. § 1711(3) (1976)).

48. Airport and Airway Revenue Act of 1970, Pub. L. No. 91-258, 84 Stat. 236 (codified in scattered sections of 26, 49 U.S.C.). The Trust Fund was established by § 208 of the Act. The users of aviation pay for the program. Trust Fund revenues are received from, among other sources, an 8% tax on airline tickets. 26 U.S.C. § 4261(a) (1976). However, pursuant to § 208, as amended, 49 U.S.C.A. § 1742 (West 1976 and Supp. 1981), after September 30, 1980 the revenues received from these taxes no longer go into the Trust Fund but remain in the general fund of the United States Treasury.

49. Airport Development Acceleration Act of 1973, § 7(a), 49 U.S.C. § 1513 (1976). The purpose of the federal head tax was to ensure both that passengers and air carriers would be taxed at a uniform rate and that the flow of interstate commerce and the development of air transportation would not be inhibited by local head taxes. *See* S. REP. No. 12, 93d Cong., 1st Sess. 4, *reprinted in* 1973 U.S. CODE CONG. & AD. NEWS 1434, 1435.

major problem.[50] It amended the definition of "airport development" contained in the AADA to include "any acquisition of land or of any interest therein necessary to ensure that such land is used only for purposes which are compatible with the noise levels of the operation of a public airport."[51] Thus, airport proprietors were *eligible* to receive funds for such projects as the construction of physical barriers, landscaping to diminish noise, and the purchase of land for noise attenuation purposes.[52] In addition, the 1976 amendment increased the federal government's matching share of airport development projects for large airports from 50% to 75%.[53]

In 1978, Congress authorized the FAA to grant airport proprietors funds for the development of noise abatement *plans* around airports.[54] In 1980, funding for noise compatibility purposes was expanded. The FAA received authority to award grants not only for the development of airport noise compatibility planning studies, but also to make limited amounts available for those projects approved by the FAA as contained in an approved noise compatibility program.[55] Eligible projects included the construction of barriers and acoustical shielding, soundproofing of buildings, and the acquisition of land and air easements for noise compatibility purposes.[56] This funding created the potential for a greatly expanded program to reduce the amount of noise inflicted on residents surrounding airports. The program, however, was never fully developed, primarily because funding for such projects was discontinued when, on September 30, 1980, the ten-year funding program contained in the AADA expired in accordance with its own terms.[57]

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50. [A]ircraft noise has resulted in curfews and other operational constraints which have restricted the use of existing facilities, and have caused problems relating to the safety of the system. Because of noise emanating from the operations at airports, full utilization and expansion of airports to accommodate current and future traffic have been hampered.

H.R. REP. No. 594, 94th Cong., 2d Sess. 13, *reprinted in* 1976 U.S. CODE CONG. & AD. NEWS 1600, 1603.

51. Airport and Airway Development Act Amendments of 1976, § 3(a)(1), 49 U.S.C. § 1711(2)(C) (1976).

52. H.R. REP. No. 594, 94th Cong., 2d Sess. 19, *reprinted in* 1976 U.S. CODE CONG. & AD. NEWS 1600, 1613.

53. Airport and Airway Development Act Amendments of 1976, § 9(a), 49 U.S.C. § 1717(a) (1976).

54. Quiet Communities Act of 1978, § 2, 42 U.S.C. § 4913 (Supp. III 1979).

55. Aviation Safety and Noise Abatement Act of 1979, § 104(c), 49 U.S.C.A. § 2104(c) (West Supp. 1981).

56. *Id.* at § 2104(a)(3), (5).

57. *See* Feazel, *Airport Aid Delay Until 1981 Expected*, AVIATION WEEK & SPACE TECH., Oct. 13, 1980, at 36. Because of Congress' failure thus far to reinstitute the funding provisions of the AADA, two of the largest United States Airport Associations recently told

The legislative history described above clearly illustrates the congressionally created atmosphere of pervasive federal involvement in the area of aviation noise abatement. Although the federal government has not totally preempted local proprietors from exercising certain responsibilities, the FAA's role has certainly been predominant. However, despite its predominance, the FAA has consistently refused to accept primary responsibility for noise abatement or any liability for aircraft noise damages. This refusal has led to extensive litigation over the powers, rights, and obligations of local airport proprietors. Because legislative intent in this area is not perfectly clear, and because the FAA's actions have been below apparent congressional authorization, the courts have played a major role in attempting to resolve these issues. In that light, this article will leave the partly cloudy world of legislators and regulators to go to the partly sunny world of adjudicators.

III. Judicial Decisions

A. *Introduction—Room for the Litigious Litigant*

Citizens, individually or as a group, may sue an airport proprietor to recover damages for injuries to property or person resulting from aircraft noise; they may also seek injunctive relief.[58] Moreover, air carriers and aviation associations can sue airport proprietors for injunctive relief to modify or eliminate airport proprietor or local government imposed airport use restrictions (e.g., curfews) designed to reduce aircraft noise.[59] Conversely, an airport proprietor can sue an airline or aviation

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Congress that a program allowing members to withdraw voluntarily from participation in the airport development program and impose their own head taxes "must be included in any final legislative package." 260 Aviation Daily 165 (1982).

58. For a discussion of "inverse condemnation" and "taking" actions, see Griggs v. Allegheny County, 369 U.S. 84 (1962); United States v. Causby, 328 U.S. 256 (1946); Luedtke v. County of Milwaukee, 371 F. Supp. 1040 (E.D. Wis. 1974), *aff'd in part, vacated and remanded in part*, 521 F.2d 387 (7th Cir. 1975); Greater Westchester Homeowners Ass'n v. City of Los Angeles, 26 Cal. 3d 86, 603 P.2d 1329, 160 Cal. Rptr. 733 (1979), *cert. denied*, 449 U.S. 820 (1980); Aaron v. City of Los Angeles, 40 Cal. App. 3d 471, 115 Cal. Rptr. 162 (1974), *cert. denied*, 419 U.S. 1122 (1975); Adams v. County of Dade, 355 So. 2d 794 (Dist. Ct. of App.), *cert. denied*, 344 So. 2d 323 (Fla. 1976); Thornburg v. Port of Portland, 233 Or. 178, 376 P.2d 100 (1962).

For cases discussing airport proprietors' potential liability for tortious management, see Luedtke v. County of Milwaukee, 371 F. Supp. 1040 (E.D. Wis. 1974), *aff'd in part, vacated and remanded in part*, 521 F.2d 387 (7th Cir. 1975); Greater Westchester Homeowners Ass'n v. City of Los Angeles, 26 Cal. 3d 86, 603 P.2d 1329, 160 Cal. Rptr. 733 (1979), *cert. denied*, 449 U.S. 820 (1980); San Diego Unified Port Dist. v. Superior Ct., 67 Cal. App. 3d 361, 136 Cal. Rptr. 557, *cert. denied*, 434 U.S. 859 (1977).

59. *See, e.g.*, City of Burbank v. Lockheed Air Terminal, 411 U.S. 624 (1973) (curfew);

aircraft noise cases which constitute the foundation upon which the lower courts have determined that the airport proprietor is liable for certain consequences of aircraft noise. These cases are *United States v. Causby*,[64] *Griggs v. Allegheny County*,[65] and *City of Burbank v. Lockheed Air Terminal, Inc.*[66] Interestingly, all three majority opinions were written by Mr. Justice Douglas.

In *Causby*, decided in 1946, military aircraft had repeatedly passed over a chicken farmer's land at an altitude of eighty-three feet. The noise from these aircraft was sufficient to destroy the residential and commercial value of the farmer's land. The Supreme Court agreed with the landowner's contention that his property had been taken by the federal government (the airport proprietor) without compensation in violation of the fifth amendment:[67]

> The airspace, apart from the immediate reaches above the land, is part of the public domain. We need not determine at this time what those precise limits are. Flights over private land are . . . a taking, [if] they are so low and so frequent as to be a direct and immediate interference with the enjoyment and use of the land.[68]

Causby was not the last word on the parameters of federal liability for aircraft noise;[69] *Griggs v. Allegheny County*[70] extended the general

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64. 328 U.S. 256 (1946).
65. 369 U.S. 84 (1962).
66. 411 U.S. 624 (1973).
67. *See* U.S. CONST. amend. V, which provides in part: "[N]or shall private property be taken for public use, without just compensation."
68. 328 U.S. 256, 266 (1946).
69. Lower federal courts have applied *Causby* narrowly. In Batten v. United States, 306 F.2d 580 (10th Cir. 1962), *cert. denied*, 371 U.S. 955 (1963), which also involved military aircraft, property owners were denied the right to recover damages as a result of noise and vibrations caused by aircraft that did not invade the plaintiff's airspace or render the property uninhabitable. Thus, when the federal government is the airport proprietor, recovery is permitted for a "taking" only when an aircraft physically invades the property's airspace.

State courts, however, in interpreting the just compensation clauses contained in their state constitutions, have allowed recovery for less than physical invasion of airspace. *See, e.g.*, Aaron v. City of Los Angeles, 40 Cal. App. 3d 471, 115 Cal. Rptr. 162 (1974), *cert. denied*, 419 U.S. 1122 (1975). The *Aaron* court was of the view that physical invasion was not necessary because aircraft noise is capable of accurate measurement. The court concluded that in California there is a taking if there is a

> *measurable reduction* in market value resulting from the operation of the airport in such manner that the noise from aircraft using the airport causes a substantial interference with the use and enjoyment of the [adjacent] property, and the interference is sufficiently direct and sufficiently peculiar that the [property] owner, if uncompensated, would pay more than his proper share to the public undertaking.

Id. at 484, 115 Cal. Rptr. at 176 (emphasis added).
70. 369 U.S. 84 (1962).

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Id. at 484, 115 Cal. Rptr. at 176 (emphasis added).

70. 369 U.S. 84 (1962).

concept enunciated in *Causby* to local airport proprietors via the fourteenth amendment. In *Griggs*, the defendant, Allegheny County, operated the Greater Pittsburgh Airport. The aircraft utilizing the airport flew so low and near Mr. Griggs' residential property that his family was forced to move. The Court reasoned that the airport proprietor was responsible for acquiring sufficient land adjacent to the airport to reduce the impact of aviation noise and, if it failed to perform that function, it was liable for the resulting aircraft noise damage to Mr. Griggs' property because a "constitutional taking" had occurred.[71] Justice Douglas set the tone for airport operator liability by stating that "[r]espondent in designing . . . [the airport] had to acquire some private property. Our conclusion is that by constitutional standards it did not acquire enough."[72] The airport proprietors, rather than the FAA or the airlines operating out of the commercial airport, were held liable for any noise damage.

In a strong dissent, Justice Black, joined by Justice Frankfurter, urged that because "Congress has over the years adopted a comprehensive plan for national and international air commerce, regulating in minute detail virtually every aspect of air transit,"[73] it would be unfair to saddle localities such as Allegheny County with a heavy financial burden or to throw a "monkey wrench into Congress' finely tuned national transit mechanism."[74] Thus, even early on, serious dissension existed within the Supreme Court as to whether local proprietor liability was the equitable solution to the aircraft noise problem.

Griggs seems to have a narrow holding that is often soft-pedaled or ignored: the airport proprietor had the original opportunity to purchase enough land possibly to prevent the noise damage and, because it did not, it was liable. The Court's rationale does not indicate what the result would have been had some damage still resulted from federally approved flights even though the airport proprietor had done all that reasonably could have been done to prevent noise damage. Under what fact pattern would the Court have absolved the proprietor yet held the federal government liable?

C. Municipalities Are Preempted from Imposing Airport Use Restrictions—Or Are They?

Eleven years after *Griggs*, the Supreme Court decided *City of Bur-*

71. *Id.* at 89-90.
72. *Id.* at 90.
73. *Id.* at 91 (Black, J., dissenting).
74. *Id.* at 94.

bank v. Lockheed Air Terminal, Inc.[73] In 1970, the City of Burbank, through exercise of its police powers, enacted an ordinance establishing an 11:00 p.m. to 7:00 a.m. curfew on jet aircraft operations at the then privately owned Hollywood-Burbank Airport. The airport operator sued for an injunction against the enforcement of the Burbank ordinance. After reviewing the provisions of the Federal Aviation Act of 1958, the Noise Control Act of 1972, and the regulations enacted pursuant to them, the Supreme Court held the ordinance to be an impermissible intrusion into a federally preempted area.[76] Justice Douglas, again writing for the Court, stated that the Noise Control Act of 1972 "reaffirms and reinforces the conclusion that the FAA, now in conjunction with the EPA, has full control over aircraft noise, *pre-empting state and local control*."[77] Justice Douglas continued by observing that while the "[c]ontrol of noise is of course deep-seated in the police powers of the States. . . . [t]he pervasive control vested in EPA and in FAA under the 1972 Act seems to us to leave no room for local curfews *or other local controls*."[78]

The *Burbank* Court did not set forth "the ultimate remedy . . . for aircraft noise which plagues many communities and *tens of thousands of people*."[79] However, it hinted that the remedy might be found in the procedures adopted in accordance with the Noise Control Act of 1972 and in the procedures involved in the implementation of various rules and regulations relating to the control of aircraft noise. The Court noted that the Administrator of the FAA had already imposed regulations relating to takeoff and landing procedures, runway preferences, and noise standards which aircraft must meet as a condition to type certification.[80] Moreover, "[a]ny regulations adopted by the Administrator to control noise pollution must be consistent with the 'highest degree of safety.'"[81] The interdependence of these factors, the Court concluded, "requires a uniform and exclusive system of federal regulation if the congressional objectives underlying the Federal Aviation Act are to be fulfilled."[82] Thus, the rationale for the *Burbank* decision is that the delicate balance between aircraft safety and efficiency man-

75. 411 U.S. 624 (1973).
76. *Id.* at 638.
77. *Id.* at 633 (emphasis added).
78. *Id.* at 638 (emphasis added).
79. *Id.* (emphasis added).
80. *Id.*
81. *Id.* at 639 (quoting 49 U.S.C. § 1431(d)(3)).
82. 411 U.S. at 638. Justice Douglas wrote that a municipality cannot control the hours of operation of an airport through its police powers, i.e., impose a curfew. *Id.*

dated by the Federal Aviation Act requires a uniform and exclusive system of federal regulation.

Burbank seemed to offer a simple point of law: the federal government's control over aviation noise abatement is pervasive and preemptive. It would have remained a simple case had the Court used only thirteen footnotes. Justice Douglas' footnote 14,[83] however, hinted that an airport proprietor might have power to regulate the use of its airport that a nonproprietor municipality did not have. The issue was not resolved because it was not before the Court.[84] Footnote 14, though politely hidden, turned out to be a dormant volcano waiting to erupt.

D. The "Proprietor Exception" to Preemption—Airport Proprietors Have Limited Power

Notwithstanding the lack of specific Supreme Court recognition, there has been legislative, executive, and judicial reliance on what has become known as the "proprietor exception" to *Burbank*'s preemption decision.[85] Such reliance has created a legal anomaly.[86] Because federal preemption was the basis for striking down the curfew in *Burbank*, one could hardly believe that Congress would accept an airport proprietor's tinkering with the national transportation system, but not accept

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83. Footnote 14 provides:

> The letter from the Secretary of Transportation also expressed the view that "the proposed legislation will not affect the rights of a State or local public agency, *as the proprietor of an airport*, from issuing regulations or establishing requirements as to the permissible level of noise which can be created by aircraft using the airport. Airport owners *acting as proprietors* can presently deny the use of their airports to aircraft on the basis of noise considerations so long as such exclusion is nondiscriminatory." This portion as well was quoted with approval in the Senate Report.
>
> Appellants and the Solicitor General submit that this indicates that a municipality with jurisdiction over an airport has the power to impose a curfew on the airport, notwithstanding federal responsibility in the area. But, we are concerned here not with an ordinance imposed by the City of Burbank as "proprietor" of the airport, but with the exercise of police power. While the Hollywood-Burbank Airport may be the only major airport which is privately owned, many airports are owned by one municipality yet physically located in another. For example, the principal airport serving Cincinnati is located in Kentucky. Thus, authority that a municipality may have as a landlord is not necessarily congruent with its police power. We do not consider here what limits, if any, apply to a municipality as a proprietor.

Id. at 635 n.14 (emphasis in original).

84. *Id.*

85. *See generally* Santa Monica Airport Ass'n v. City of Santa Monica, 481 F. Supp. 927, 932 (C.D. Cal. 1979), *aff'd*, 659 F.2d 100 (9th Cir. 1981); Brief of the United States of America, *Amicus Curiae*, Santa Monica Airport Ass'n v. City of Santa Monica, *id.*; Brief of the United States of America, *Amicus Curiae*, San Diego Unified Port Dist. v. Gianturco, 457 F. Supp. 283 (S.D. Cal. 1978), *aff'd*, 651 F.2d 1306 (9th Cir. 1981).

86. Air Transp. Ass'n v. Croul, 389 F. Supp. 58 (N.D. Cal. 1975).

a sovereign state or political subdivision's intrusion. Furthermore, the Supreme Court, to validate such an interpretation, would have had to conclude that the ill-effects of a curfew imposed by a proprietor/municipality are acceptable, while the ill-effects of a curfew imposed by a nonproprietor/municipality are not.[87] Unfortunately, though the Supreme Court clearly decided the specific preemption issue in *Burbank*, it left somewhat of a "sticky wicket" in its wake, particularly the controversy regarding proprietor/municipality powers.

An objective view of *Burbank* suggests that the Supreme Court knew exactly what it was doing: placing limits on local interference with federal management of the airspace—be the interferer a proprietor or nonproprietor. The Supreme Court accepts cases because of their national import. It may be beyond credibility that the Supreme Court granted certiorari in *Burbank* to reach a decision that would apply solely to Hollywood-Burbank Airport, the only privately owned major airport in the United States. Consequently, footnote 14 might well be the latest in a long list of convenient "red herrings."[88]

The *Causby*, *Griggs*, and *Burbank* decisions have established a classic confrontation, and their progeny reflect the resulting confusion. While *Griggs* represents proprietor liability in the midst of a sea of federal regulatory actions, *Burbank* represents federal preemption in the midst of a sea of locally imposed airport use restrictions. Can the two principles coexist?

An early test came in *Air Transport Association v. Crotti*,[89] where the Air Transport Association sought a determination of whether air-

87. In discussing the effects of a curfew along with the FAA's position, the Supreme Court pointed out that according to the testimony at trial, the increased congestion and inefficiency brought on by *Burbank*-type curfews would aggravate the noise problem. *See* 411 U.S. at 627-28.

88. This view was supported by the EPA in a 1975 study:

> However, the Supreme Court does not note probable jurisdiction and affirm a case such as *Burbank* unless a substantial Federal question is presented. If after noting probable jurisdiction, the Court finds that the appellant [sic] constitute a class of one or two and that no broad question is therefore presented, the case will be dismissed. When the Court affirms with a precedent setting opinion it "must" have believed that state and local government *owned* airports could be included within the preemption rationale . . . . Nothing in the opinion explicitly suggests the foregoing except that, with an exception or two, all air carrier airports are owned by states or political subdivisions thereof. If all such airports can be curfewed by their owners as owners, the *Burbank* opinion means very little.

Brief for Plaintiff/Appellant and Plaintiffs-Intervenors/Appellants, Santa Monica Airport Ass'n v. City of Santa Monica, 659 F.2d 100 (9th Cir. 1981) (quoting Environmental Protection Agency, Aircraft/Airport Noise Report—Legal and Institutional Analysis of Aircraft and Airport Noise Apportionment of Authority Between Federal, State and Local Government, at 2-46 (July 27, 1973)).

89. 389 F. Supp. 58 (N.D. Cal. 1975).

lines were subject to California's aircraft noise standards.[90] In answer, a three-judge district court opined that because *Griggs* established that airport proprietors are responsible for damage to private property as a result of aircraft using their facilities, the proprietors have a concomitant right to control the use of their airports.[91] In addition, the court used footnote 14 to support its decision that such airport proprietor action is an exception to the preemption rule of *Burbank*.[92] Thus, the *Griggs*-supported rationale enabled the court to sustain a public airport's right to select the type of air service it desires.[93] The court held that California's use of Community Noise Equivalent Levels (CNELs) as a standard for measuring aircraft noise was not per se invalid as an

90. In 1969, the California Legislature enacted legislation directing the State Department of Aeronautics (now the Department of Transportation) to adopt noise standards for airports operating under a state permit. CAL. PUB. UTIL. CODE §§ 21669-21669.4 (West Supp. 1981). Pursuant to this statutory authorization, the Department subsequently adopted "noise standards." 21 CAL. ADMIN. CODE §§ 5000-5080.5 (1979).

These standards seek to achieve a gradual reduction in the amount of noise generated by aircraft takeoffs and landings at California airports. They establish what is known as a Community Noise Equivalent Level (CNEL). CNEL provides a method for computing on a 24-hour basis an average noise exposure level. A cumulative analysis (e.g., nighttime operations are penalized ten times) takes into account the total noise generated by aircraft "events" over a given period of time. In graduated steps, no airport is to have a "noise impact boundary" containing an "incompatible land use" in excess of 65dB on the CNEL scale by 1985.

The CNEL standards require an *airport operator* to operate its airport so as not to exceed the applicable CNEL noise level. 21 CAL. ADMIN. CODE § 5062 (1979). An operator unable to comply with the noise standards may apply to the Department for a variance. 21 CAL. ADMIN. CODE § 5075 (1979). As a practical matter, the noise standards are so stringent that all of the major airports in California—including those at Los Angeles, San Francisco, San Jose, Burbank, San Diego, and Ontario, as well as John Wayne Airport in Orange County—must apply on an annual basis for a variance as a matter of routine. Feit, *Experts Expect Noise To Worsen As More Jets Use Ontario Airport*, The Sun (Ontario, Cal.), June 3, 1981 at B7, col. 2.

91. *See* 389 F. Supp. at 63-64.

92. *Id.* at 63. The court stated:

> We believe that the Airlines' total reliance on *Burbank* is misplaced. The factual picture supporting *Burbank* is of narrow focus, a single police power ordinance of a municipality—not an airport proprietor—intending to abate aircraft noise by *forbidding* aircraft flight at certain night hours. The holding in *Burbank* is limited to that proscription as constituting an unlawful exercise of police power in a field pre-empted by the federal government, and we take as gospel the words in footnote 14 in *Burbank*: "[A]uthority that a municipality may have as a landlord is not necessarily congruent with its police power. *We do not consider here what limits, if any, apply to a municipality as a proprietor.*"

Id. (emphasis in original).

93. *Id.* at 63-64. Perhaps *Griggs* is not the final verdict for California's CNEL methodology. In San Diego Unified Port Dist. v. Gianturco, 457 F. Supp. 283 (S.D. Cal. 1978), *aff'd*, 651 F.2d 1306 (9th Cir. 1981), a district court found that California's attempt to condition the granting of a variance from its CNEL requirement for the operation of the San Diego airport was a nonproprietary regulation prohibited by *Burbank*. *See infra* note 132.

invasion of a federally preempted area.[94] However, the same court also cited *Burbank* to strike down California's Single Event Noise Exposure Levels (SENELs) because the use of this standard was an attempt to regulate "noise levels occurring when an aircraft is in direct flight [which is an unlawful intrusion] into the exclusive federal domain of control over aircraft flights and operations."[95]

If liability follows responsibility, the *Crotti* decision suggests two propositions: first, airport proprietors are liable for damage that they can control (noise from an aircraft while on the ground at the airport and possibly noise that could be excluded by preventing or limiting air service); and, second, the federal government preempts airport proprietor liability for noise damage that the proprietor cannot control (aircraft in flight). However, *Crotti* did not go the "extra mile" because it said nothing about federal liability for noise damages caused by aircraft while under FAA control in the air.[96]

The culprit is *Burbank*; it left some "daylight" for proprietor-initiated restrictions on airport use that were ultimately supported in principle by the FAA in its 1976 Noise Policy and in other pronouncements.[97] Courts could then use congressional vagueness, executive interpretations, and judicial dicta to support an exception to the *Burbank* preemption rule. But that is not always such an easy task, and one court's difficulty was aptly expressed by Judge Peckham in *National Aviation v. City of Hayward*:[98]

> Thus, this court finds itself caught on the horns of a particularly sharp dilemma: If on one hand, we follow the dicta

94. 389 F. Supp. at 64-65. The court left for another day the decision of whether the CNEL provisions were invalid as actually applied. *Id.* at 65.

95. *Id.* at 65.

96. Although the *Crotti* court viewed CNEL as a legitimate manner of measuring and regulating noise near airports, in a recent speech FAA Administrator J. Lynn Helms reached a contrary conclusion. According to Mr. Helms, the FAA is drafting legislation to require FAA approval of local restrictions on airport noise. Specifically addressing California's use of this CNEL concept, Mr. Helms commented that "unrealistic California noise standards will either shut down significant segments of the air transportation industry or create compromises on safety." Helms continued, "Clearly, the California noise laws are putting such pressures on the airport operators that the operators are seeking solutions which make trade-offs between noise and safety." Finally, the FAA Administrator considered that such measures "could cripple our air transportation system and stifle this nation's continued economic development." *See States Airport Noise Rules Called Too Strict*, Los Angeles Times, Feb. 19, 1982 at 20, col. 4. Query: Would a requirement of prior approval by the FAA of all local aircraft noise regulations represent the final link in the chain leading to absolute preemption, thus insulating airport proprietors from nuisance liability?

97. *See* NOISE ABATEMENT POLICY, *supra* note 1, at 34.

98. 418 F. Supp. 417 (N.D. Cal. 1976).

> in footnote 14 of the *Burbank* opinion, which is intended to comport with the court's holding in *Griggs*, we will severely undercut the rationale of *Burbank*'s finding of preemption. If on the other hand, we disregard the proprietor exception as dicta in order to fully effectuate the *Burbank* rationale, we impose upon airport proprietors the responsibility under *Griggs* for obtaining the requisite noise easements, yet deny them the authority to control the level of noise produced at their airports.[99]

Hayward involved an action brought by four airplane operators at the Hayward Municipal Airport, a noncommercial airport, to declare unconstitutional an ordinance enacted in the City's capacity as airport proprietor. The ordinance prohibited aircraft exceeding certain noise levels from taking off between 11 p.m. and 7 a.m. In harmonizing *Burbank* and *Crotti*, the court held that preemption did not forbid the enforcement of the Hayward ordinance. In the court's view, Congress intended only to preclude a municipal authority that was not an airport proprietor from enacting police power regulations regarding airport noise. It did not intend to preclude an airport *proprietor* from taking steps to exclude aircraft on the basis of noise considerations.[100]

The court also found that there was insufficient evidence to conclude that the Hayward ordinance did more than "incidentally" burden interstate commerce. Moreover, the court viewed, as mere speculation, the possibility that other airport proprietors might adopt similar ordinances, which together would create an impermissible burden.[101]

Hayward did not resolve the liability/responsibility dilemma because Judge Peckham seemed to be searching for total preemption, which, of course, he did not find. The decision, however, implies that Congress and the FAA could take charge and preempt most local noise abatement efforts while simultaneously curtailing expensive litigation.[102] Also, the FAA could more clearly establish the acceptable limits of locally imposed use restrictions. However, because neither the

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99. *Id.* at 424.

100. *Id.* at 424-25.

101. *Id.* at 423.

102. Judge Peckham was not the only judge to suggest the potential for federal preemption. Justice Rehnquist did the same in his dissent in *Burbank*:

> Clearly Congress could pre-empt the field to local regulation if it chose, and very likely the authority conferred on the Administrator of FAA by 49 U.S.C. § 1431 is sufficient to authorize him to promulgate regulations effectively pre-empting local action. But neither Congress nor the Administrator has chosen to go that route.

411 U.S. at 643 (Rehnquist, J., dissenting).

Crotti nor the *Hayward* court found sufficient evidence of preemption, it was left for another day and another court to determine Congress' intent in this area.

Such a day came when the Second Circuit Court of Appeals addressed the Concorde landing rights issue in *British Airways Board v. Port Authority (Concorde I)*[103] and *British Airways Board v. Port Authority (Concorde II)*.[104] In these cases, the Port Authority of New York tried to ban the operation of the Concorde at John F. Kennedy Airport after the United States Secretary of Transportation had ordered a sixteen-month operational test to consider the feasibility and desirability of supersonic transport service to selected American airports. In two separate opinions, the court acknowledged that both airport proprietors and the FAA have a stake in airport noise abatement but that there were significant limitations to proprietary actions as well as to the degree of federal preemption.[105] Accordingly, the court recognized and accepted an implied sharing of responsibility. It noted that "Congress repeatedly has declined to alter this cooperative scheme. . . . [T]he legislative history clearly states that the statute [the Federal Aviation Act] was merely intended to strengthen the FAA's regulatory role within the area already totally preempted—control of flights through navigable airspace."[106] While recognizing that the FAA had broad executive powers, the court in *Concorde I* observed that "the Supreme Court [in *Burbank*] has refrained from holding that Congress has occupied the field of noise regulation to the exclusion of airport proprietors."[107] Thus, airport proprietors can impose use restrictions. However, according to the court, an airport proprietor is subject to two important constitutional restrictions: first, proprietor-imposed noise regulations must not create an undue burden on interstate or foreign commerce; second, such restrictions may not unjustly discriminate between different categories of airport users.[108]

While it is easy to speak of congressional intent and two-tiered responsibility, it is much more difficult to discuss two-tiered liability. In fact, after all its in-depth reading of federal statutory schemes, the Second Circuit did not even hint that the federal government could or should be liable for any noise damages it might have caused. If there is

103. 558 F.2d 75 (2d Cir. 1977).
104. 564 F.2d 1002 (2d Cir. 1977).
105. 558 F.2d at 83; 564 F.2d at 1010-11.
106. 558 F.2d at 83-84 (footnote omitted).
107. *Id.* at 84.
108. *Id.*

no federal liability, can pervasive federal presence shield the airport proprietor from liability for noise damage?

E. Airport Proprietor Personal Injury Liability—A Split Decision

That question can be addressed by examining *San Diego Unified Port District v. Superior Court*,[109] in which the court denied an attempt by a group of noise-distressed residents to recover nuisance damages from an airport proprietor because the federal government controlled the flight of the airplanes. In *San Diego*, the plaintiff homeowners sued under nuisance and negligence theories, claiming that the airport proprietor had failed to enact adequate regulations, such as a curfew, for the control of noise. The court used federal preemption to shield the airport proprietor from liability.[110] It reasoned that because a *non*airport proprietor could not impose a curfew, neither could an airport proprietor. In the court's view, the impact of the curfew remained the same—congestion and interference with flight schedules.[111] The Port District, according to the court, did not have the authority to impose a curfew and thus could not be liable for failing to do what it was not authorized to do.[112] No mention was made, however, of federal liability. Interestingly, the court indicated that the supremacy clause, the basis for preemption, would not shield the proprietor from liability for tortious mismanagement of those noise abatement aspects under its control.[113] Although this court did shield the proprietor from one aspect of liability, the principle of shared responsibility was basically reinforced.

It is an understatement that airport proprietors would rather not have the distinction of being the sole entity liable for aircraft noise. However, to date, but for a few exceptions,[114] that distinction has been

109. 67 Cal. App. 3d 361, 136 Cal. Rptr. 557, *cert. denied*, 434 U.S. 859 (1977).

110. *Id.* at 376, 136 Cal. Rptr. at 566.

111. *Id.* at 368, 136 Cal. Rptr. at 561. The court of appeal, in referring to the proprietor exemption theory, doubted that the United States Supreme Court intended that municipalities could do as proprietors what they were forbidden to do under the cloak of the police power.

112. *Id.* at 376, 136 Cal. Rptr. at 566.

113. *Id.* at 377, 136 Cal. Rptr. at 567.

114. *See* Luedtke v. County of Milwaukee, 371 F. Supp. 1040 (E.D. Wis. 1974), *aff'd in part, vacated and remanded in part*, 521 F.2d 387 (7th Cir. 1975); San Diego Unified Port Dist. v. Superior Ct., 67 Cal. App. 3d 361, 136 Cal. Rptr. 557, *cert. denied*, 434 U.S. 859 (1977).

In *Luedtke*, the Seventh Circuit affirmed the district court's refusal to permit residents who were aggrieved by aircraft noise from seeking, among other remedies, nuisance damages under Wisconsin law. The court stated:

honored. In two 1974 cases,[115] the City of Los Angeles attempted to pass noise damage liability to air carriers, manufacturers, and the federal government. The courts, however, concluded that the airport proprietor was solely liable for failure to acquire air easements.[116]

The city's fortunes remained poor when a group of homeowners adjacent to Los Angeles International Airport sued to recover for injuries from aircraft noise. In *Greater Westchester Homeowners Association v. City of Los Angeles*,[117] the plaintiffs sought damages under both inverse condemnation and nuisance theories. The California Supreme Court rejected the city's claim of federal preemption, concluding that no federal shield existed to insulate the airport proprietor from tort damages. After an exhaustive study of congressional intent, federal and state case law, and FAA regulatory actions, the court determined that neither Congress nor the FAA expressly precluded either local noise abatement actions or concomitant state remedies for personal injury awards arising out of an inverse condemnation suit.[118] Moreover,

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Since the federal laws and regulations have preempted local control of aircraft flights, *Burbank*, *supra*, the defendants may not, to the extent they comply with such federal laws and regulations, be charged with negligence or creating a nuisance. Similarly, § 114.04 of the Wisconsin Statutes cannot be invoked to make unlawful flights which are in accordance with federal laws and regulations. If, as the plaintiffs allege, the aircraft flights have resulted in the "taking" of their property, the plaintiffs have actions at law to recover just compensation from the County, *Griggs*, *supra* . . . . To the extent that the County may be violating the federal laws or regulations, the plaintiffs should . . . exhaust their administrative remedies.

521 F.2d at 391.

115. City of Los Angeles v. Japan Airlines Co., 41 Cal. App. 3d 416, 116 Cal. Rptr. 69 (1974) (city as owner-operator of Los Angeles International Airport liable because California statute provided a mechanism for city to acquire air easements; absent contractual agreements or legislative mandate, air carriers did not have to indemnify city); Aaron v. City of Los Angeles, 40 Cal. App. 3d 471, 115 Cal. Rptr. 162, *cert. denied*, 419 U.S. 1122 (1974) (federal control of navigable airspace no defense for airport proprietor's failure to purchase adequate air easements—as held in *Griggs*).

116. 41 Cal. App. 3d at 425-29, 116 Cal. Rptr. at 78; 40 Cal. App. 3d at 486-87, 115 Cal. Rptr. at 172-73.

117. 26 Cal. 3d 86, 603 P.2d 1329, 160 Cal. Rptr. 733 (1979), *cert. denied*, 449 U.S. 820 (1980).

118. *Id.* at 100, 603 P.2d at 1336, 160 Cal. Rptr. at 739. In a concurring opinion, Chief Justice Bird disagreed with the majority's reliance upon inverse condemnation law to support its holding that federal legislation had not preempted the aviation noise abatement field. *Id.* at 104-05, 603 P.2d at 1339, 160 Cal. Rptr. at 742-43 (Bird, C.J., concurring). She argued that the city was liable because of its failure to take actions, such as construction of ground barriers or soundproofing of homes, to reduce airport noise. These actions, the Chief Justice noted, would have been within the spirit of, and consistent with, federal and state laws. *Id.* at 108, 603 P.2d at 1340, 160 Cal. Rptr. at 744.

Chief Justice Bird's concurring opinion suggests the possibility that had the proprietor done all it could, it may have been absolved of liability. *Id.* at 105, 603 P.2d at 1340-41, 160 Cal. Rptr. at 744. Furthermore, her statement that "federal regulations cannot preempt con-

the court believed that airport proprietors had the power to limit their liability under *Griggs* because Congress had preserved proprietary control over airport design, planning, and use.[119] This limited power of airport proprietors to impose certain controls doomed them. After finding "no appellate agreement on the scope of the so-called 'proprietor exception' to the federal preemption rule [of *Burbank*] and its effect on the tortious liability of airports,"[120] the California Supreme Court[121] found no basis for federal preemption of personal damage awards.[122]

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situationally protected rights." *Id.* at 105, 603 P.2d at 1339, 160 Cal. Rptr. at 742, implies that perhaps the federal government should be jointly liable for inverse condemnation damages.

119. *Id.* at 97, 603 P.2d at 1334, 160 Cal. Rptr. at 738.

120. *Id.* at 96, 603 P.2d at 1333-34, 160 Cal. Rptr. at 737.

121. *Id.* at 100, 603 P.2d at 1336, 160 Cal. Rptr. at 739. The city's argument for preemption was as follows: (1) *Burbank* provides that a nonairport proprietor cannot regulate aircraft noise, (2) the State of California is a nonairport proprietor, (3) the award of tort damages is a form of regulation, and, therefore, (4) the State of California is preempted from imposing tort damages on an airport proprietor.

Authority for the proposition that the award of tort damages is a form of regulation is found in San Diego Bldg. Trades Council v. Garmon, 359 U.S. 236 (1959). In *Garmon*, the Supreme Court, speaking through Justice Frankfurter, held that because it was arguable that certain union activities involved in that case fell within the ambit of the "concerted activities" or the "unfair labor practice" provisions of the National Labor Relations Act, state jurisdiction to award tort damages was preempted. Concerning this issue, Justice Frankfurter wrote:

> Nor is it significant that California asserted its power to give damages rather than to enjoin what the Board may restrain though it could not compensate. Our concern is with delimiting areas of conduct which must be free from state regulation if national policy is to be left unhampered. Such regulation can be as effectively exerted through an award of damages as through some form of preventive relief. The obligation to pay compensation can be, indeed is designed to be, a potent method of governing conduct and controlling policy. Even the States' salutary effort to redress private wrongs or grant compensation for past harm cannot be exerted to regulate activities that are potentially subject to the exclusive federal regulatory scheme. [citations omitted]. It may be that an award of damages in a particular situation will not, in fact, conflict with the active assertion of federal authority. The same may be true of the incidence of a particular state injunction. To sanction either involves a conflict with federal policy in that it involves allowing two law-making sources to govern.

Id. at 246-47.

122. No longer can it be asserted that this problem is isolated to the peculiar proclivities of California tort law. Fomented by *Greater Westchester*, the state of Georgia has aligned itself with California in a case almost identical to it. In Owen v. City of Atlanta, 157 Ga. App. 354, 122 S.E.2d 338 (1981), *cert. denied*, 50 U.S.L.W. 3916 (U.S. May 12, 1982), the Supreme Court of Georgia held that the City of Atlanta, as proprietor of Hartsfield Atlanta International Airport, was subject to state tort liability because residents in the vicinity of the airport were allegedly injured by noise emanating from aircraft using its airport.

Other courts are also taking the precepts enunciated in *Greater Westchester* seriously. In a recent small claims case heard in South San Francisco Municipal Court, for example, a judge awarded 150 residents $750.00 each because they were annoyed by aircraft noise near San Francisco International Airport. Most troubling are Judge Duncan's reasons for awarding the damages. He appeared particularly disturbed that the airport proprietor had neither

Not only are there noise problems in Burbank and San Diego, but in Santa Monica as well. In *Santa Monica Airport Association v. City of Santa Monica*,[123] a federal district court upheld, *inter alia*, a proprietor-imposed night departure curfew and the use of a SENEL standard while striking down the airport's total ban on jet aircraft.[124] Judge Hill upheld the night departure curfew and the 100 dBA SENEL despite commerce clause, equal protection, and supremacy clause arguments from the plaintiffs, Santa Monica Airport Association, and plaintiffs-intervenors, National Business Aircraft Association and General Aviation Manufacturers Association.[125]

One interesting aspect of the *Santa Monica* case concerns the issues of federal preemption and implied liability. The FAA, in its *amicus* brief, urged the court to hold the SENEL unconstitutional because it invaded a federally preempted area. The FAA justified this conclusion by arguing that Congress had intended that the FAA control all matters affecting aircraft in flight[126] and that because pilots try to "beat the meter" which measures the single noise event, the SENEL "affects aircraft in flight" and is thus preempted. Despite the FAA's explicit advancement of federal preemption, Judge Hill upheld the Santa Monica SENEL. To do so, Judge Hill implicitly must have found Santa Monica potentially subject to *Griggs*-type liability in order to permit it to go so far as to *limit* its liability by imposing a SENEL. Thus, the question raised is whether the local proprietor or the federal government should have *Griggs*-type liability for noise damages resulting from aircraft in flight.

All of this remains rather perplexing because neither the judiciary nor Congress has adequately dealt with the subject of liability. The FAA, interpreting the federal role, has acknowledged that "although many aspects of the aircraft noise problem are appropriate for local control, the range of remedial measures available to the airport proprietor has been somewhat limited by the exercise of the paramount au-

adopted a limited curfew nor prohibited the noisiest aircraft. *See* Workmen, *Residents Win $720 Each in S.F. Jet Noise Case*, San Francisco Chron., Jan. 23, 1982 at 1, col. 1.

Judge Hill is not the only one who is on the "horns of a particularly sharp dilemma." *National Aviation*, 418 F. Supp. at 424. Should the airport proprietor take the initiative and impose strict noise regulations en route to being second-guessed by the FAA, or do something in between and be second-guessed by judge and jury? The airport proprietor must walk a fine line.

123. 481 F. Supp. 927 (C.D. Cal. 1979), *aff'd*, 659 F.2d 100 (9th Cir. 1981).

124. *See id.* at 938-39, 941, 943.

125. *Id.* at 935.

126. *See* Brief of the United States of America, *Amicus Curiae*, at 10-20, Santa Monica Airport Ass'n v. City of Santa Monica, 481 F. Supp. 927 (C.D. Cal. 1979).

thority of the United States to regulate commerce."[127]

One point seems clear, however. If airport proprietors are eventually shackled with sole liability for property damages and personal injuries resulting from aircraft noise, they will, in self-preservation, devise airport use restrictions with only their local interests in mind, thus destroying the hope for a uniform national air transportation system.

IV. Recommendations—The Search For Smooth Air

To say the least, it is not an easy task to summarize this complex subject and to fashion simple recommendations. Exploration of the major congressional acts dealing with aviation noise and discussion of the myriad of relevant court opinions reveal that a heated controversy exists over whether the FAA should be the country's leading proponent for ensuring a coordinated effort to reduce aircraft noise.

While the FAA is perfectly willing to share responsibility, on its own terms, it, along with Congress, dreads the thought that the federal government should help pay for the current shortcomings in the national aircraft noise abatement effort. Moreover, the courts have supported the federal government's position and have made airport proprietors the scapegoat for damages caused by aviation noise. As a result of the courts' refusal to place a portion of the liability on the federal government, airport proprietors face the unenviable honor of being solely liable for potentially *unlimited* damages, even though they have only limited rights to impose use restrictions to minimize aviation noise.

Not only does this shared responsibility/sole liability scheme impose liability on the least likely candidates—those with the least financial resources, the least power, and the least knowledge—it is inherently unfair. The remaining portion of this article will discuss two alternative approaches that would more equitably apportion the cost of reducing aircraft noise and the payment of noise damages.

A. The Federal Government Should Share Liability

The federal government should accept liability for the aviation noise damages caused by situations under its control, such as aircraft in flight. Alternatively, the courts should impose liability on the federal government if it refuses to accept such liability.

This shared responsibility/shared liability approach would reflect

127. *Id.*

the divisions within the aviation noise abatement effort. The airport proprietor's sphere of influence in the noise abatement field generally encompasses airport site location and design, adequate zoning and procurement of air easements, fair and reasonable access to the airport, and management of ground facilities. Conversely, the federal government's role encompasses noise abatement actions related to quieter engines, aircraft operational procedures and flight patterns, review and approval of local use restrictions, and management of the air traffic control system.[128] Airport proprietors should be liable only for the aviation noise damages they actually cause or fail to prevent. In turn, the FAA should be held proportionately liable for aviation noise damages caused by situations over which it has control.[129] This division is similar to a comparative negligence approach.

The judiciary must be made aware that there exists a rationale for a shared responsibility/shared liability approach. For this concept to become a reality, *Griggs* would not have to be overturned per se. It simply must be viewed in the context of present—day conditions. *Griggs* was decided in 1962, well before the enactment of most of the airport noise legislation that has been reviewed. A fresh look would reveal that the federal government's involvement in this area has become pervasive. The CAB certifies airlines for economic fitness; the FAA certifies airlines, airports, and airplanes, and controls the flight of aircraft from the clouds to the runway. The federal government should be liable if it has "pervasive control" of the situation but fails to fulfill its responsibility to reduce or avoid aviation noise damage.[130] Rather than being detrimental to the national interest, shared liability would prompt the federal government to take a more assertive role in the effort to reduce aircraft noise.

Congress may not have intended complete federal preemption, but

128. NOISE ABATEMENT POLICY, *supra* note 1, at 5.

129. The Air Transport Association (ATA) has argued that the imposition of liability on the FAA is preferable to the strangulation of the national air transportation network by a maze of locally imposed airport use restrictions. For example, in a recent petition to the FAA urging it to adopt noise abatement rules, the ATA discussed federal responsibility and potential liability:

> [E]ven if the courts . . . determine that liability should attach to the Federal Government by virtue of the FAA's affirmation and assertion of federal preemption, it would be a small price to pay to prevent uncoordinated and unilateral restrictions at various [sic] airports from working separately [sic], or in combination, to endanger the maintenance, promotion and development of the national air transportation system.

44 Fed. Reg. 52,076, 52,081 (1979).

130. *See* American Airlines, Inc. v. Town of Hempstead, 272 F. Supp. 226, 232 (E.D.N.Y. 1967), *aff'd*, 398 F.2d 369 (2d Cir. 1968), *cert. denied*, 393 U.S. 1017 (1969).

neither has it discouraged shared liability. The legislators probably were unaware that airport proprietors would be saddled with complete liability for the failures of the federal government. Yet the FAA continues to imply, not necessarily in specific terms, that the only way for the federal government to assume any liability would be for it to assume complete preemptory status.[121] However, the FAA has not explained why its liability cannot coexist with airport proprietors' liability. Room exists for compromise, but the FAA has chosen an all or nothing approach. The consequence of this position is that federal leadership in aviation noise abatement is being stifled because of a fear of liability.[122]

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131. *See* NOISE ABATEMENT POLICY, *supra* note 1, at 34, where the FAA magnanimously proclaims:

> Our concept of the legal framework underlying this policy statement is that proprietors retain the flexibility to impose such restrictions if they do not violate any Constitutional proscription. We have been urged to undertake—and have considered carefully and rejected—full and complete federal preemption of the field of aviation noise abatement. In our judgment the control and reduction of airport noise must remain a shared responsibility among airport proprietors, users, and government.

132. The federal presence, or lack thereof, in the form of active leadership in aviation noise abatement, is an interesting adjunct to another California case, San Diego Unified Port Dist. v. Gianturco, 457 F. Supp. 283 (S.D. Cal. 1978), *aff'd*, 651 F.2d 1306 (9th Cir. 1981). The California Department of Transportation (CalTrans) conditioned its grant of a CNEL noise variance to the Port District for its operation of Lindbergh Field on the District's extension of its voluntary curfew from six to eight hours. *Id.* at 286. After receiving the variance from CalTrans, the Port District sued for injunctive and declaratory relief on the ground that the "curfew condition" was unconstitutional because it invaded a field preempted by the federal government. *Id.* at 286–88. The district court found that CalTrans' attempt to extend San Diego's curfew was a nonproprietor regulation of an airport prohibited by *Burbank*, *id.* at 292, and granted the Port District's application for a preliminary injunction. *Id.* at 295.

While the court's decision was clear, the FAA's conduct in this case is not easily understood. Before Judge Schwartz heard the merits of the case, he ruled that the Port District was required to exhaust its administrative remedies by complying with a CalTrans request that it seek FAA review of the curfew extension. *Id.* at 286 n.1. However, after being provided with full background information on the issue by all the parties, the FAA announced that "it would not provide any response and that no written statement concerning its review would be forthcoming." *Id.* at 287. The FAA's refusal to respond clearly violated its 1976 Noise Abatement Policy which encouraged such requests. *See* NOISE ABATEMENT POLICY, *supra* note 1, at 39.

One additional point stands out. When San Diego originally established the voluntary night curfew in 1975, the FAA "expressed the 'hope' that Port District would suspend the night restriction pending completion of the FAA's efforts to develop a noise policy under which all parties concerned could move together in a comprehensive nationwide noise abatement program," and that while the FAA would publish the curfew it "would not 'deny take-off or landing clearances' because to do so might give the appearance of tacit approval of the restriction by FAA." Brief for United States of America, *Amicus Curiae*, at 11, San Diego Unified Port Dist. v. Gianturco, 457 F. Supp. 283 (S.D. Cal. 1978). Yet when the Port

The entire aviation community depends upon an integrated, comprehensive, and safe national air transportation system. The traveling public and airport neighbors want a safe system too, but they also would appreciate a quieter environment. Consequently, no party can or should be permitted to shirk its responsibilities or hide from its liabilities. Unless some positive national leadership is assumed by the FAA, all hopes for maintaining a modicum of order and for avoiding potential systemwide chaos will be dashed.

Although the Supreme Court ultimately may resolve the responsibility/liability issue, continuous resort to the courtroom is not the most efficient way to run a national air transportation system. It is time for federal authorities, within constitutional limits, not only to take charge but also to assume their liability, if necessary, through appropriate legislation.

B. An Aviation Noise Abatement Trust Fund

If the shared responsibility/sole liability concept persists, airport proprietors will continue to incur judgments for the diminution in value of private property and, in some jurisdictions, for the personal injury damages caused by noise emanating from aircraft utilizing their facilities. In response, airport proprietors will continue and, perhaps, increase their efforts to promulgate noise abatement programs designed to reduce their liability exposure. These efforts, which may include the institution of curfews, jet bans, prohibitions against all but Part 36 aircraft or limitations on service, will be parochial in nature.[133] Little effort will be exerted to consider their impact on the nation's air transportation system. As a result, Congress' attempt to achieve a uniform national transportation system will be thwarted.

What else might be done to prevent the balkanization of the air transportation system? One option is the creation of a program that

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District asked the FAA for advice, three years after the FAA had published its Noise Abatement Policy, the FAA refused to respond.

133. Examples of completed or proposed airport use restrictions by airport proprietors to reduce aircraft noise include: (1) Nighttime operating restrictions (Lindbergh Field, San Diego, California; Pearl Harbor, Oahu; Washington National, Washington, D.C.), (2) total jet ban (Santa Monica Municipal Airport, California; Watertown Municipal Airport, Wisconsin), (3) excluding non-Part 36 aircraft (Los Angeles International, Logan International, Boston), (4) limiting the number of aircraft operations (Stewart Airport, New York), (5) excluding particular types of aircraft (Los Angeles International and Logan International have prohibited SSTs), (6) limiting number of nighttime operations (Minneapolis—St. Paul), (7) operational noise limits (JFK International), (8) displaced threshold (Logan International and many more), and (9) preferential runways (Atlanta; Miami; Tampa; San Juan; O'Hare, Chicago; Denver; Moisant, New Orleans; Newark and many more).

would satisfy the concerns of both those in and those affected by the air transportation industry. The FAA should remain at the helm of any program so that the transportation industry remains both national and uniform; airport proprietors should not be the sole entity to bear the liability burden; air carriers should not be faced with the uncertainty resulting from locally designed noise abatement rules and regulations; noise impacted residents should not continue to be subjected to high levels of aircraft noise; and, most importantly, the *users* of the system, passengers, the airline industry, and others, should pay for the damages caused by aircraft noise.

These concerns can be satisfied by the creation of a federal matching grants program similar to the plan created by the Airport and Airway Development Act. However, the framework established in AADA is not adequate. For one reason, although currently more than three billion dollars remain in the Airport Trust Fund,[134] the FAA presently has authority to award only minor grants for noise abatement projects. Second, user taxes are no longer funneled into the Trust Fund; since September 30, 1981, they have been siphoned off into the general fund.[135] The following is a compendium of the essential components of a noise abatement program that should satisfy most of the concerns of all parties involved:

1. A Noise Abatement Trust Fund (NATF) should be created. The NATF must be separate from the Trust Fund established by AADA or its replacement. Additionally, the AADA Trust Fund should no longer fund the limited noise abatement projects it now funds. A certain portion of the existing AADA Trust Fund should be transferred to NATF to put NATF solidly on its feet from its inception.[136] This amount should approximate the amounts that would reasonably have been allocated to noise projects from the AADA Trust Fund. Moreover, the NATF should be scrupulously administered so that the monies received are actually spent on valid noise abatement projects and not squandered in the federal treasury or spent for non-trust fund purposes.

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134. As of October 31, 1980, the Airport and Airways Trust Fund balance was $5.36 billion, down from $5.44 billion at the end of September, 1980. In addition, no user taxes were collected during October, 1980. 253 AVIATION DAILY 4 (1981). As of May, 1981, $3.6 billion remained. Creedy, *Vital Issues Up For Grabs in Legislative Grist Mill*, COMMUTER AIR, May 15, 1981, at 55 [hereinafter cited as Creedy].

135. Creedy, *supra* note 134, at 55.

136. This may prove difficult, however. Capitol Hill sources indicate there may be a battle over what happens to the Airport Trust Fund proceeds, and it does not appear that noise abatement has high priority on the allocation list. *Id.* at 54.

2. The current "user taxes" established by AADA must continue with a portion of the revenues going to the AADA Trust Fund and a portion to the NATF. The prohibition against state and local "head taxes" should continue, so that the user taxes will remain uniform throughout the United States. Whether such taxes should be increased or decreased would depend on projected needs.

3. The FAA should continue in its role of determining which noise abatement projects should be funded. Thus, most of the FAA's decisions in this area would remain discretionary. However, where there is an overriding public necessity, the FAA would be mandated to make specific noise abatement grants.[137]

4. No airport proprietor or other governmental agency should be eligible for grants unless the airport proprietor first submits a "noise exposure map" and an "airport noise compatibility plan" as currently outlined by both the Aviation Safety and Noise Abatement Act of 1979 and its implementing regulations.[138] Several airports are in the process of preparing such plans.[139]

5. All legitimate noise claims within a certain noise exposure area would be eligible for grants once an appropriate "Airport Noise Compatibility Plan" is approved by the FAA. These grants should be funded from the NATF. Legitimate claims would include only those permitted by that particular state, thus new causes of action would not be created. Preferably the entire claims system would be administrative, perhaps modeled after the workers compensation claim process. The LdN 65 noise contour[140] proposed in Part 150 would be an adequate compromise. It is envisioned that an airport proprietor's airport noise compatibility plans will contain alternative noise abatement rec-

137. This suggestion is not unlike that made by FAA Administrator J. Lynn Helms in a recent speech in Dallas, Texas. Mr. Helms indicated that the FAA is preparing legislation for presentation to Congress this summer that would require some form of FAA review and approval of local airport restrictions. Mr. Helms stated that the FAA's perspective in this review process would be "national in scope . . . recognizing that the closing of an airport even for one hour has effects on the national air transportation system well beyond the local community." *See* Simison, *FAA Fighting 'Unrealistic' Airport Noise Regulations*, Daily News (Van Nuys, Cal.), Feb. 19, 1982 at 1, col. 4.

138. 46 Fed. Reg. 8,338 (1981) (to be codified in 14 C.F.R. § 150).

139. For example, Los Angeles International Airport has its Airport Noise Control and Land Use Compatibility Study (ANCLUC) in progress. Representatives of the cities of Los Angeles, Inglewood, El Segundo, and Hawthorne, as well as the County of Los Angeles, meet on a regular basis to gather data in order to prepare a noise exposure map and the required noise compatibility plan. It should be completed within a year. Statement of Maurice Laham, Los Angeles International Airport Environmental Coordinator, to John M. Werlich (July 1, 1981).

140. *See supra* note 20 for a discussion of LdN.

ommendations. Such recommendations would be made by the airport proprietor after consultation with representatives of noise-affected communities and other public interest groups within the 65 LdN contour. The recommendations might urge soundproofing certain homes and/or schools, construction of sound barriers on or near the airport, land conversion of one form or another, acquisition of air easements by the airport proprietor, condemnation of the most severely impacted residential properties, or, perhaps even the institution of a "dollars for decibels" fee at a particular airport.[141] The FAA would have discretion in determining what is a legitimate claim. Most likely, it would be guided by the number of claims in a particular area, and perhaps it would place limits on the amount a claimant could receive for non-physical (e.g., emotional distress) personal injury claims. After all, in part, the purpose of the NATF is to pay for noise damage and reduce the impact of aircraft noise.

6. In order to qualify for grants, the airport proprietor would have to follow the reasonable recommendations of the FAA with reference to noise abatement procedures that must be instituted by the proprietor. For example, if the FAA approves a plan to construct a sound barrier, the airport proprietor would have to comply or risk not only being declared ineligible for a specific grant, but also risk absorbing 100% of future noise damage claims.

7. The federal government would be legally liable only for the payment of airport noise-related damage claims as provided for in the NATF program. Thus, within constitutional limitations the federal government could not be made a defendant in an aircraft noise suit.

V. CONCLUSION

Throughout this article it has been assumed that Congress wishes to maintain a uniform national air transportation system. If this is correct, something must be done before the system becomes chaotic. The concept of sole liability hangs over the heads of airport proprietors like the sword of Damocles, and they can react in only one way: self-defense. The authors' recommendations offer a reasonable compromise between total preemption and complete federal abdication. The former

141. Some commentators have suggested that noise-based landing fees, keyed to the noisiest aircraft, should be part of a comprehensive plan for the abatement of aircraft noise. *See* Bauer & Aitken, *Legal Aspects of Airport Noise*, 15 J.L. & ECON. 1, 70 (1972); Ellingsworth, *Noise Policy Sets Industry/DOT Debate*, AVIATION WEEK & SPACE TECH., Dec. 6, 1976, at 24; Bell & Bell, *Airport Noise: Legal Developments and Economic Alternatives*, 8 ECOLOGY L.Q. 607, 608 (1980).

is probably too costly and ignores local prerogatives, while the latter is equally costly at the local level and is potentially destructive of any national transportation scheme. Either the institutionalization of shared liability or the creation of proper noise abatement funding would go a long way toward helping to prevent the fractionalization of the nation's air transportation system by nonuniform local or court-imposed solutions to airport noise problems. Simultaneously, the adoption of either approach would eliminate the airport proprietors' greatest continuing fear: shared responsibility/single liability.

SECTION 4

OPERATIONAL CONSIDERATIONS

R E S E R V E D

TO BE INSERTED AT A LATER DATE

AIRCRAFT PERFORMANCE CONSIDERATIONS FOR NOISE ABATEMENT CLIMB PROFILES

William W. Melvin

Figure 1 shows the resolution of forces along the direction of motion of a vehicle as it climbs a hill. Thrust must overcome drag as well as the component of weight acting opposite to thrust. Excess thrust can either accelerate the vehicle or cause it to climb a steeper hill. If the vehicle descends a hill, the weight component acts in the same direction as thrust so thrust must be decreased to maintain a constant speed.

Aircraft can make their own hill to climb or descent a constant speed within the limitations of their thrust and drag capabilities. It should be noted that aircraft not changing the direction of their inertial trajectory are in one G flight condition when G is measured normal (perpendicular) to the direction of flight. This means that climbing aircraft do not require more lift than descending aircraft. It does require a change in G or lift to change the direction of the inertial trajectory, but to sustain a climb or descent at a constant airspeed requires a balance of thrust and drag for the required condition.

An aircraft's drag is composed of two basic parts. One is profile drag which increases as a square function of an increase in airspeed. The other drag is that which is induced by the generation of lift and is called induced drag. As air encounters a moving airfoil, it is deflected downward as shown in Figure 2 if positive lift is generated. This deflection of the air causes the airfoil to see an angle of attack relative to the local air flow that is different from the angle of attack relative to the remote free stream air. Using the definition of lift being perpendicular to the relative air flow, the lift vector can be expressed as relative to the remote free stream air, which is the generally accepted use of the term, and also expressed as relative to the local induced flow. The vector difference between the two lift vectors is the direction of drag is defined an induced drag and is a necessary consequence of producing lift. Induced drag increases as a function of the reciprocal of the square of the airspeed. One purpose for defining it separately is to understand the shape of the drag curve where drag increases from the minimum value with either an increase of a decrease in airspeed.

A total drag curve for a typical aircraft is as shown in Figure 3. The net thrust over drag margin defines the aircraft's capability to climb or its flight path angle. Note that the miximum climb angle for jet aircraft will occur at the minimum drag point and that either an increase or decrease from that condition will result in a lower climb angle capability. This is not usually true for propeller aircraft because they often times have large increases in propeller thrust with decreases in air speed.

If an aircraft increases its bank angle the induced drag will increase and shift the minimum drag point to a higher airspeed with a total increase in drag which reduces the aircraft's climb capability. This is the reason for limiting an aircraft's bank angle with an engine failure to 15 degrees. At this level the induced drag only increases about 7 percent and since induced drag is only one half of total drag at the minimum drag point, aircraft climb

capability is not appreciably affected. However, at a 30 degree bank angle the induced drag inncreases about 33 percent for a total drag increase of more than 15 percent which is intolerable in the engine out case. With a 30 degree bank the increase in stall speed is only about 15 percent, so contrary to popular belief, the 15 degree limit for engine out flight is to limit drag instead of being for stall protection.

It is the position of the Airworthiness and Performance Committee that noise abatement depatures requiring 30 degree bank angles are satisfactory so long as the pilot is not required to maintain a 30 degree bank in the event of an engine failure. Most such cases are to avoid populated areas where there is no real physical obstacle so if an engine fails the pilot has no safety problem in ignoring the noise abatement track. However, certain noise abatement departures are selected where physical obstacles are limiting such as the shoreline and quiet departures at SFO. In these cases we insist that performance accountability be taken for the engine out case with the required bank angle to miss the obstacle.

Not all airlines do this. The departure plate for the Shoreline and Quiet departures at SFO requires a 7 percent climb gradient (420 feet per nautical mile), but the straight out departure for runway 28 only requires a 5 percent climb gradient (300 feet per nautical mile). Some airlines use the climb gradient requirements for a straight out departure to limit the takeoff on runway 28 with no account for the Shoreline or Quiet gradients. Thus if an aircraft is weight limited for the takeoff and uses the Shoreline or Quiet departure, the pilot will be in deep trouble if an engine fails and he is committed to make the turn to avoid Mt. San Bruno.

Back to the main topic at hand. It is clear than an aircraft will achieve its best climb angle with the maximum margin of thrust over drag. If thrust reductions are used to reduce noise, the aircraft will have a performance advantage if it has reduced its drag from the initial condition. The twin engine aircraft has brilliant performance with both engines running and very limited performance with one shut down. For this reason we are opposed to extending the exposure time to the risks of engine failure in takeoff drag configuration and advocate a reduction of drag at the earliest possible opportunity.

Unfortunately, many pilots see the reduction of drag from the takeoff condition as a requirement to lower the pitch to about one half of the original value and accelerate. Although this is one procedure in use by some airlines it should not be considered a requirement when at low altitudes. If an aircraft has had a normal takeoff it will usually have a speed of about V2 + 10 knots after the climb is stabilized. This is usually sufficient to reduce the drag by the first increment which will offer a significant safety advantage in the event of subsequent engine failure. However, if a pilot interprets this as a signal to reduce the pitch by one half he will be most reluctant to do so at low altitude.

The 400 foot level above the takeoff surface has been used by some as a reference to reduce thrust, turn on airfoil anti-ice and disarm autopack trip systems. This is based upon a misunderstanding of the certification process.

From certification tests, aircraft are weight restricted so that twin engine aircraft demonstrate a 2.4 percent climb gradient with an engine failure in the takeoff condition with the gear retracted. Three engine aircraft must have a 2.7 percent capability and four engine aircraft a 3.0 percent capability. These requirements came from the ICAO Standing Committee on Performance report of 1953 and were based upon a mathematical probability study to not penetrate an arbitrary one percent surface more frequently that the design incident probability that was selected. If the design incident probability of one event in 10 million takeoffs is selected then the above numbers fall out. The higher values for greater numbers of engines is due solely to the fact that there is a greater probability of an engine failure as the number of engines increases.

The transition from the second segment to the final or enroute segment cannot begin before 400 feet nor later than 1500 feet according to certification criteria. But remember that this criteria is based upon the assumption of an engine failure. For certification, the drag reduction is always associated with a level or nearly level segment where a total transition to the clean configuration occurs. Intermediate drag levels are not considered. In real life though if an aircraft has in fact achieved a speed suitable for a drag reduction and an engine fails, the aircraft will achieve a greater climb gradient by taking the incremental reduction in drag and continuing the climb until clear of obstacles.

However, many airlines have worked this in the direction opposite to the safest approach. Instead of using an early drag reduction to reduce risks in the event of engine failure, they have reduced thrust to barely meet the enroute gradient requirements. In addition pilots are advised they can disarm the autopack trip systems and use airfoil anti-ice. It is our contention that this is not allowed by the certification criteria, i.e., there is no provision for a thrust reduction in the second segment configuration even if clear of obstacles. Disarming the autopack trip and using airfoil anti-ice is based upon being out of the second segment configuration which can occur only after an initial drag reduction. However, some have made the interpretation than an aircraft is out of the second segment after 400 feet or clear of obstacles. This is clearly not the intent of the certification rules.

Second segment engine out climb requirements are minimum requirements derived from a safety analysis to not penetrate the arbitrary one percent surface and are not the minimum requirements for obstacle clearance which are specified in the operating rule. The excess thrust that exists to meet the climb gradient requirement is that which is used to accelerate the aircraft in a level condition for flap retraction. If this thrust margin is significantly reduced by only requiring an engine out gradient that is less than one half of the certification minimum (enroute instead of second segment) then the capability to accelerate to the clean configuration is greatly reduced. With autopack trip disarmed, the aircraft could be in a position from which it could not accelerate in level flight to conform to the flap retraction schedule. The pilot would have to increase thrust and/or manually trip the AC/pressurization pack. Likewise, if airfoil anti-ice had been selected it might have to be turned off until the aircraft achieved a sufficient performance margin by drag reduction to tolerate the thrust drain.

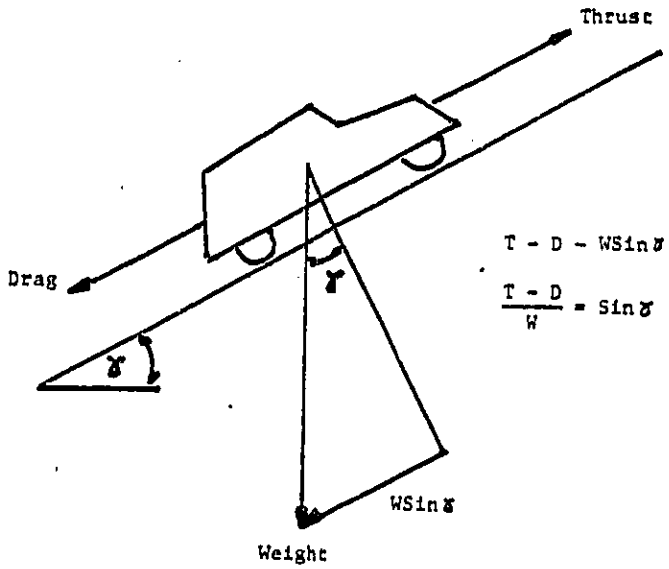
The above situation where a pilot is required to perform unusual tasks in the worst case is clearly not in the best interest of air safety. The

Airworthiness and Performance Committee recommends a procedure that is consistent with what would be required in the worst case of engine failure. This is to reduce drag at the earliest opportunity. We prefer to clean the aircraft up before reducing thrust which produces the best performance margin at reduced thrust as well as being the safest procedure. There is no conflict in this case with disarming the autopack trip or in using airfoil anti-ice. It should be noted though that in any drag condition if the aircraft is operated significantly faster than the minimum drag point then climb gradient capability suffers and more noise is perceived on the ground.

Some procedures are very complicated and require large changes in pitch and thrust to comply with. However, a very simple and safe procedure would not have to be so encumbered with specific altitude limits. Our recommendation is that when a normal rotation results in an airspeed that is appropriate for a drag reduction, the pilot should take that reduction as soon as he feels comfortable. If 400 feet makes him comfortable, that is fine. He should not reduce pitch to accelerate unless he is above the obstacle clearance altitude or clean up altitude used for the engine failure case. When above the engine out clean up altitude the pilot should further reduce drag, preferably to the clean configuration, and then reduce thrust for noise abatement.

Because most aircraft use large incremental drag reductions there usually occurs in the retraction schedule a requirement for a large speed increase which imposes a constraint upon the most desirable procedure when noise sensitive areas are very close to the take off point. We feel that if the aircraft is not in the enroute configuration (clean) that thrust should never be reduced below the requirement for the appropriate second segment or obstacle clearance requirement in the event of an engine failure unless the aircraft is above an altitude that can be safely used to return to the airport for landing and at an appropriate drag condition for such operation. This allows some flexibility for the close in sensitive area when a total drag reduction would occur too late to be of practical benefit. However, we caution against reducing the thrust to the enroute engine out level when not in the enroute configuration (clean) and at an altitude too low to be safely used to return for a landing.

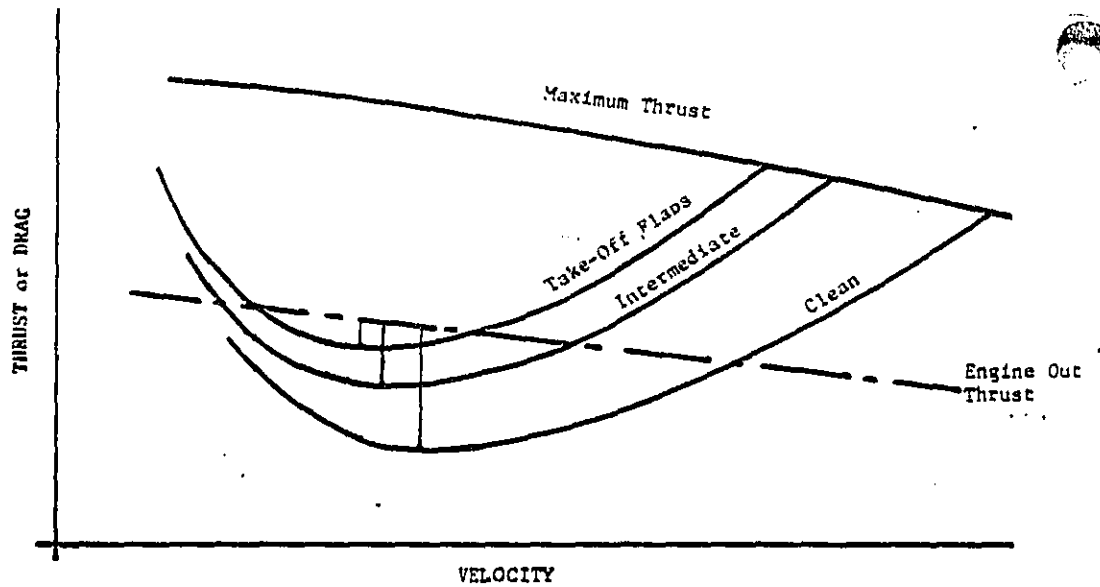
If the thrust is set for the engine out enroute gradient after attaining a safe altitude for return, allowance should be made to account for the facts that autopack trip may have been disarmed and airfoil anti-ice selected.



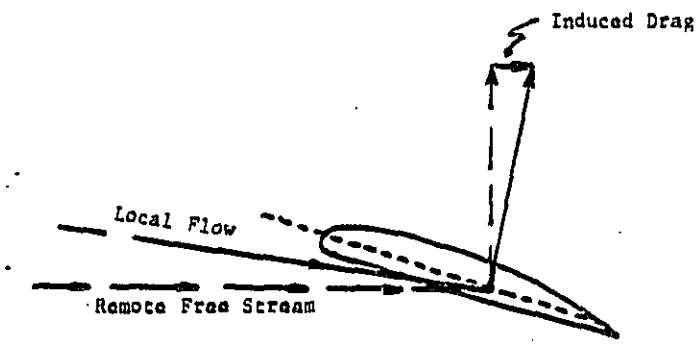
$$T - D - W\sin\gamma = 0$$

$$\frac{T - D}{W} = \sin\gamma$$

Angle of Climb Determination
Figure 1.



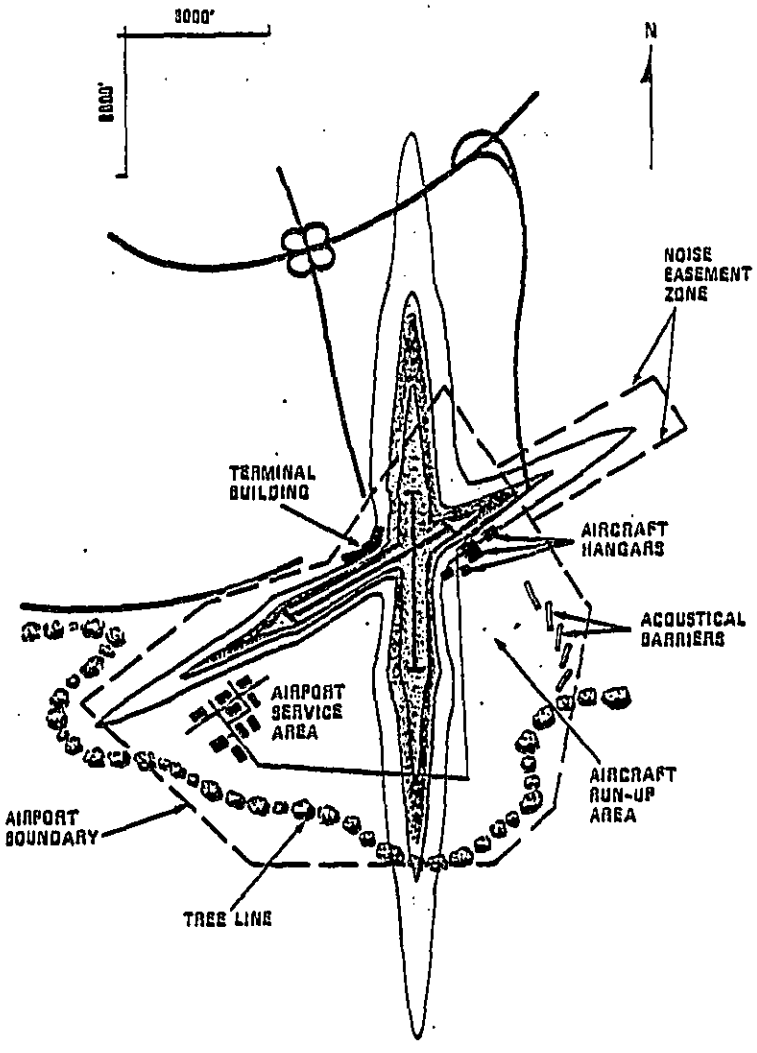
Typical Drag Curve for Jet Aircraft
Figure 3.



Induced Drag
Figure 2.

SECTION 5

BACKGROUND OF INM



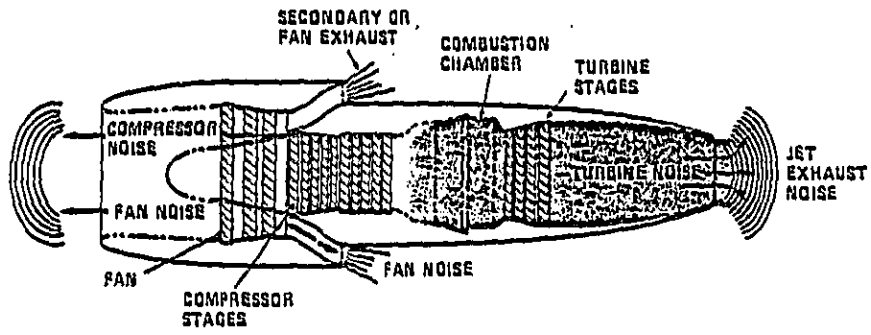
INTEGRATED NOISE MODEL

The Cause of Jet Airplane Noise - The Engine

The vast majority of aircraft noise disturbances near airports are due to the operation of commercial jet air carrier airplanes. Although the movement of an aircraft flying at subsonic speed generates some noise due to turbulence, the primary source of jet aircraft noise is the engines.

The two principal sources of noise from turbofan engines are the jet exhaust and the fan/compressor, as shown in Figure 1. Jet exhaust noise-the roar of the primary jet exhaust-comes from turbulent mixing of high-velocity exhaust gases with the ambient air. The jet exhaust generates sound energy over a wide band of frequencies. During a fly-over, the exhaust noise will increase after the aircraft has passed overhead, and reach a maximum when the listener is located at approximately a 45-degree angle to the jet exhaust axis. Turbo-machinery noises of the jet engine are generated within the fan, compressor, and turbine rotating elements. The sounds from the turbo-machinery encompass many frequencies and may contain high frequency tones that screech and are particularly annoying.

FIG. 1



ENGINE NOISE SOURCES

The perceived noise from any source decreases as the distance is increased between that source and people. Aviation noise is a problem near airports, where aircraft are flying near the ground as they depart or arrive.

Characteristics of the Takeoff and Landing Operations

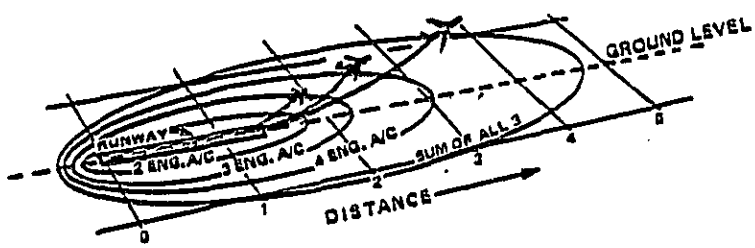
Takeoff Noise

Aircraft use their highest power during takeoff. While the level of this power varies with the type and size of the airplane, all are at their noisiest during takeoff. Typical patterns of noise reaching the ground for various types of airplanes during takeoff are illustrated in Figure 2.

FIG. 2

NOISE PATTERNS

TAKEOFF



Since the noise heard depends on both the intensity of sound at the source and the distance between the source and the receiver, it is important for the airplane to reach optimum altitude before overflying residential areas. At certain airports where residential communities are close to the runway, flexibility in the takeoff procedure allows power cutbacks (see Figure 3), which can be initiated after the airplane has reached a safe altitude in order to reduce the source noise (Figure 4).

FIG. 3

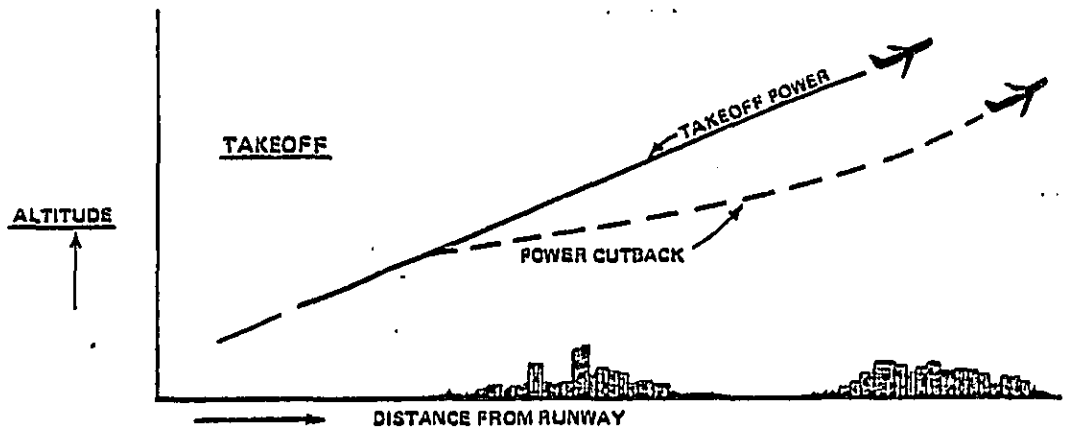
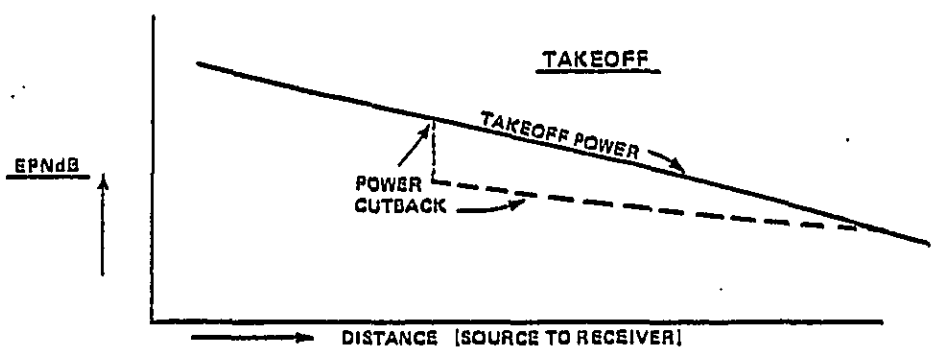

TAKEOFF
ALTITUDE
TAKEOFF POWER
POWER CUTBACK
DISTANCE FROM RUNWAY

FIG. 4


TAKEOFF
EPNdB
TAKEOFF POWER
POWER
CUTBACK
DISTANCE [SOURCE TO RECEIVER]

The power cutback procedure, however, reduces the airplane's rate of climb. This results in the airplane being at a lower altitude over areas farther away from the runway (see Figure 3) thus exposing those areas to more noise than if the original climb-power had been sustained. The best solution depends on the location of noise-sensitive areas, and will differ from site to site.

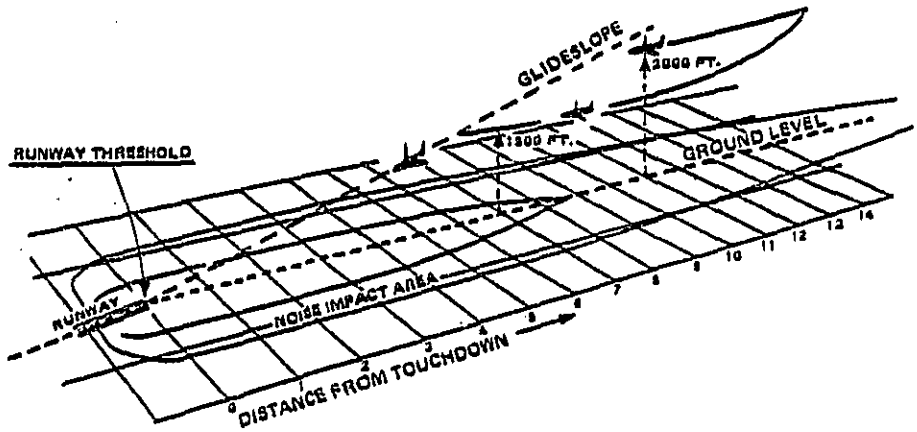
Additional flexibility exists for takeoffs in that flight tracks may be prescribed which permit airplanes to avoid flying over noise-sensitive areas after safe altitudes have been attained.

Landing Noise

Airplane engines produce less noise during the approach-to-landing operation because lower power is required. However, the noise produced from the fan-compressor in some airplanes may be more annoying because of its screech or whine characteristics. Additionally, less flexibility is afforded in this operation compared to the takeoff procedure since a gradual descent for a landing usually begins 5 to 10 miles away from the airport, normally following a 3 degree "glideslope." This results in a constantly increasing noise level on the ground, as the aircraft comes closer to the airport. The noise diagram for this operation is depicted in Figure 5, which shows a 1500 ft. glide slope intercept as well as a 3000 ft. intercept. This higher flight track reduces the noise level on the ground.

FIG. 5

APPROACH-TO-LANDING



A Simulation Model to Define Airport Noise Impacts

Noise impact of any one airplane takeoff and/or landing depends on many factors. The noise generated by the specific airplane, the power being used, the airplane's performance, and the airplane's flight path in the air are all pertinent. Where more than one airplane is in operation, additional parameters must be considered to define noise impact. Such parameters are the total airport mix of airplane types and the varying flight tracks; the operational procedures; the total number of takeoff and landings by airplane type; and, the time of day of each takeoff and landing. Only after consideration of all pertinent factors can a full understanding be achieved of the noise impact of a given airport's operation.

Airport noise impact can be expressed in a number of "noise metrics" depending on the preference of the user, the ultimate objective of the impact assessment, or both. The INM, developed to satisfy user requirements, provides these metrics.

Noise metrics available from the model are "cumulative metrics", such as the Noise Exposure Forecast (NEF), Day-Night Average Sound Level (Ldn), Equivalent Sound Level (Leq), Community Noise Equivalent Level (CNEL), and "exposure metrics" in Time Above (TA) a number of user specified A-weighted sound levels in decibels, e.g., dBA (TA_{85}, TA_{95}, etc.). See Appendix A for further discussion of these metrics.

Noise contours can be computed and printed at selected map scales. The user may plot contours of any of the four cumulative energy metrics or contours of equal exposure in minutes for TA specified A-weighted sound levels. The user will normally choose the single metric of greatest interest for contour plotting, but more than one metric may be used.

The model automatically provides numerical listings of the calculated noise values at all intersecting points on a grid, which encompasses the airport and surrounding neighborhoods. This printed output includes computations of any or all of the four metrics based on accumulated acoustical energy, and Time Above A-weighted sound levels for six selected noise thresholds, from 65 decibels to 115 decibels. The time of exposure calculations are further broken down into three daily periods: 1) a 24-hour day, 2) evening hours (7 p.m. to 10 p.m.) and 3) night hours (10 p.m. to 7 a.m.).

The model's data base contains common flight profiles and noise characteristics for numerous aircraft types. Changes to this built-in aircraft noise and performance data base can be accomplished through user option commands.

The noise file for each aircraft consists of noise-vs-slant-range (distance between airplane and the receiver) curves for several thrust settings. The user options are designed so that changes can be made to data from these files, if necessary. The scale of the contour map can be specified by the user as well as the spacing of the grid points for which numerical answers are provided.

INM Outputs

The program output consists of a printout of the input data, plotted noise contours, and computed noise levels at the grid points. With the input data listed prior to calculations, the user may check for possible errors which occurred while assembling or entering the data.

The contours for a sample case are shown in the figure on page 8. Included in this example are equal noise coordinates for any of four cumulative energy metrics and Time Above 65, 75, 85, 95, 105 and 115 dBA. The user may specify the contour plot scale so it matches the scale of a desired map. The runways are drawn on the contour to provide visual orientation and reference when the contours are used as overlays on maps of the same scale.

Calculations of grid points specified by the user are printed in tabular form as shown on page 9. A lettered code relates the tabular data to grid intersections on the contour map. This facilitates the location of user specified grid points on the contour plot. For example, the coordinate (1,D) as seen on the grid-tabulated form shows the following information about that location for a 24-hour period:

(1) Time Above 75 dBA = 30.3 min/24 hrs; 4.4 min/evening; 3.6 min/night
(2) Time Above 85 dBA = 9.8 min/24 hrs; 1.3 min/evening; 1.3 min/night
(3) Time Above 95 dBA = 0.9 min/24 hrs; .2 min/evening; .1 min/night
(4) Leq = 70.8;
(5) Ldn = 73.9;
(6) NEF = 38.8; and,
(7) CNEL = 74.5.

This, plus additional information is shown in tabular form on page 9.

This location can be referenced on the contour map by locating the coordinate (1,D) and should agree with any contour point if computed for that location. The grid analysis is particularly suited to determine the noise impact of specific locations without computing unnecessary information.

How the INM May Be Used

Various individuals or organizations may have use for the INM including:

(1) airport proprietors - to gain a better understanding of the noise impacts of the operation of their airport or in the preparation of an environmental impact statement;

(2) airport consultant - to better assist their clients in planning for future expansion or revision of current airport operations;

(3) state or local authorities - to identify sensitive noise areas which can then be appropriately zoned for compatible land use; or,

(4) the FAA - as an aid to assess the impacts of proposed revised terminal area operating procedures.

In addition to the above, a land planner or developer would find the INM a useful tool to determine the specification he should use for noise transmission by structures planned for construction near an airport. Additionally, private citizens may avail themselves of the use of the INM.

Several specific uses of the INM suggest themselves from the preceding illustration:

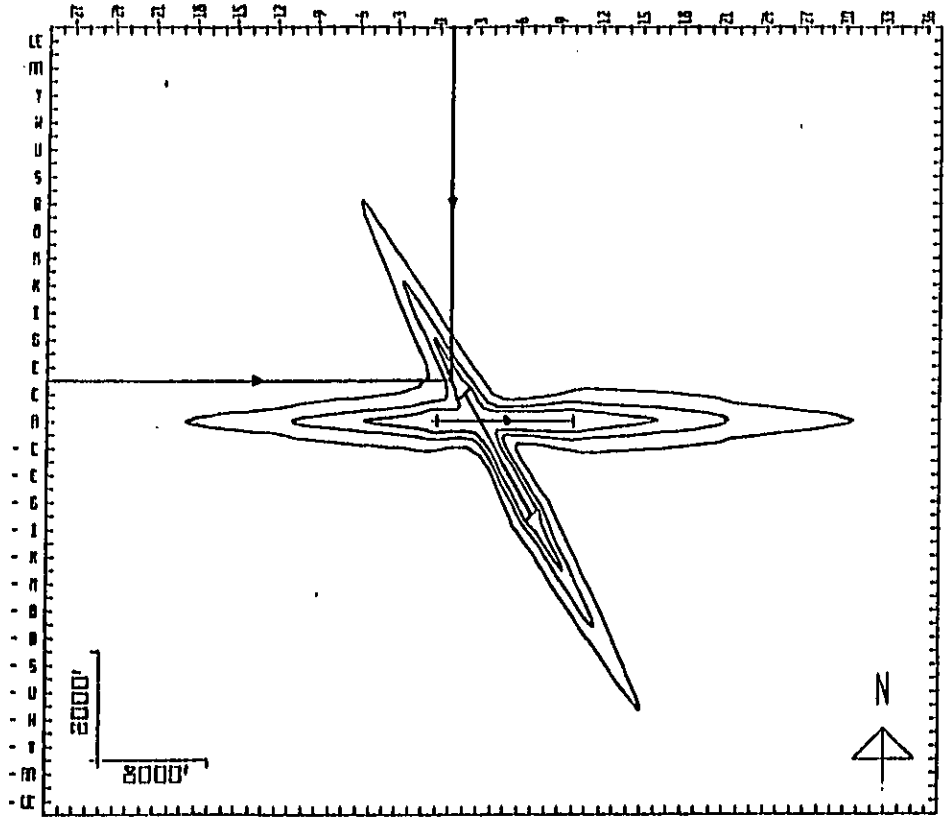
- Development by local governments of land use controls or limits on utility hookups to bring about noise compatibility.
- Comparison of different aircraft types and fleet mixes which could use the airport, including alternative schedules for their use.
- Comparison of aircraft operational procedures and flight tracks.
- Use in Noise Control and Land Use Compatibility Plans.
- Use in assessing noise impacts when necessary for environmental impact statements.
- Identification of future noise easement or airport land acquisitions.
- Determination of optimal locations for on-airport acoustical barriers.
- Development of dedicated restricted areas of on-airport noise - causing operations, e.g., engine runups.

INM Enhancements

Comprehensive as the capabilities of the INM are, improvements or new uses involving increased flexibility are important in improving the state-of-the-art. Based on day-to-day applications of the INM, work will continue to expand its scope, improve its functional efficiency, and provide new parameters to further serve the user's needs.

Availability

The Integrated Noise Model is currently available for use from time-sharing vendors. The FAA encourages Federal, state, and local officials and other interested parties to use the INM for aviation noise assessments. Additionally, the program for the model is available from the FAA on a loan basis. For information concerning use of the model, please refer to the "FAA Integrated Noise Model Version I: Basic User's Guide" (Report FAA-AEQ-78-01, January 1978). Comments, suggestions or other inquiries concerning the INM may be sent to the Federal Aviation Administration, Office of Environmental Quality, AEQ-110, 800 Independence Avenue, SW., Washington, D.C. 20591.



FEDERAL AVIATION ADMINISTRATION INTEGRATED NOISE MODEL 1.2

XXX THIS IS A RUN FOR THE EXAMPLE AIRPORT
NEF 300 35.0 40.0

12/21/77.

FEDERAL AVIATION ADMINISTRATION INTEGRATED NOISE MODEL 1. 2
THIS IS A TEST OF MULTIPLE POINT GRID OUTPUT

12/28/77.

INTERSECTION	OFFSET	PERIOD	TIME IN MINUTES ABOVE INDICATED DNA LEVEL 65	75	85	95	105	115	LEQ	LDN	NEF	CNEL
0.	B	24 HOUR	65.3	31.2	13.4	4.4	0.0	0.0	71.9	75.1	34.1	75.6
		EVENING	9.4	4.5	2.0	.7	0.0	0.0				
		NIGHT	8.3	3.8	1.8	.5	0.0	0.0				
1.	B	24 HOUR	67.4	35.3	14.1	4.0	0.0	0.0	71.2	74.4	34.4	74.9
		EVENING	9.5	5.1	2.2	.6	0.0	0.0				
		NIGHT	8.5	4.3	1.5	.4	0.0	0.0				
0.	C	24 HOUR	67.5	33.3	13.1	0.0	0.0	0.0	66.4	69.7	31.1	70.1
		EVENING	9.8	4.9	2.0	0.0	0.0	0.0				
		NIGHT	8.5	4.1	1.5	0.0	0.0	0.0				
1.	C	24 HOUR	70.7	34.2	13.8	1.3	0.0	0.0	69.3	72.4	36.4	73.8
		EVENING	10.0	5.0	2.1	.2	0.0	0.0				
		NIGHT	8.9	4.1	1.6	.1	0.0	0.0				
0.	D	24 HOUR	66.2	31.7	10.3	.1	0.0	0.0	65.1	68.4	32.0	68.8
		EVENING	9.8	4.6	1.3	.0	0.0	0.0				
		NIGHT	8.5	3.9	1.3	.0	0.0	0.0				
1.	D	24 HOUR	68.8	30.3	9.8	.9	.0	0.0	70.8	73.9	38.8	74.5
		EVENING	9.9	4.4	1.3	.2	.0	0.0				
		NIGHT	8.7	3.8	1.3	.1	0.0	0.0				
0.	E	24 HOUR	65.4	29.9	5.0	.4	0.0	0.0	68.6	69.8	34.0	70.3
		EVENING	9.4	4.4	.7	.1	0.0	0.0				
		NIGHT	8.3	3.8	.7	.0	0.0	0.0				
1.	E	24 HOUR	68.7	29.0	4.8	1.2	.1	0.0	73.5	76.6	42.8	77.3
		EVENING	9.5	4.2	.7	.2	.0	0.0				
		NIGHT	8.4	3.5	.6	.1	.0	0.0				
0.	F	24 HOUR	59.5	27.5	4.0	1.1	.1	0.0	69.6	72.7	38.3	73.4
		EVENING	8.5	4.1	.6	.2	.0	0.0				
		NIGHT	7.4	3.4	.5	.1	0.0	0.0				
1.	F	24 HOUR	62.7	28.8	4.0	.6	.0	0.0	67.4	70.6	35.3	71.2
		EVENING	8.9	4.2	.6	.1	0.0	0.0				
		NIGHT	7.8	3.6	.5	.1	0.0	0.0				

X-START	Y-START	X-STEP	Y-STEP	NX	NY	OPTIONS
0.00	1000.00	1000.	1000.	2	5	*****

APPENDIX A

This appendix presents an overview of the noise metrics which are contained in the INM. A brief discussion of each noise metric is provided. The discussion includes definitions, additional descriptive language concerning each metric, a brief treatment of the use of different INM outputs, and correlations between the metrics.

DEFINITIONS

The noise metrics available in the INM may be defined as follows:

Leq (Equivalent A-weighted Sound Level) - unit is dB

Leq is the average (i.e., the average on an energy basis) noise level (usually A-weighted sound level) integrated over some specified amount of time. The A-weighted sound level (LA) is a sound pressure level which has been fitted or weighted to approximate the human ear's perception of sound. Leq provides a single number measure of time-varying noise for a predetermined time period.

Ldn (Average Day-Night A-weighted Level) - unit is dB

Ldn is the average (i.e., on an energy basis) A-weighted sound level integrated over a 24-hour period, with an arbitrary weighting applied for the noise levels occurring in nighttime periods.

Its purpose is to provide a single number measure of the impact of time-varying noise over a 24-hour period. It was developed for noise exposure surveillance and as an aid in land use planning.

NEF (Noise Exposure Forecast) - scale is in dB

NEF is the cumulative impact of aircraft noise over a 24-hour period (weighted for the time of day) of Effective Perceived Noise Level (EPNL). NEF is used to determine the relative noise impact of aircraft noise.

CNEL (Community Noise Equivalent Level) - unit is dB

CNEL is the average (i.e., average on an energy basis) A-weighted sound level for a 24-hour period with different weighting factors for the noise levels occurring during the day, evening, and nighttime periods. The CNEL is used in the assessment of noise impact areas around airports.

TA (Time Above a Threshold of A-Weighted Sound Level) - unit in minutes

TA is the total time that a preselected, A-weighted sound level is exceeded due to aircraft operations during a specified period of time.

Description of Metrics

The noise metrics available in the INM deal basically with two characteristics of noise: the noise intensity and the number of occurrences of the noise events. Metrics in the INM which have the ability to deal with specific divisions of time of day are NEF, Ldn, CNEL and TA. The metrics in the INM can account for the acoustical effects of nonstandard conditions of field elevation and temperature; however, they do not account for seasonal effects. Based on these considerations, the metrics can be grouped under three headings:

a. NEF includes a methodology that accounts for the number of occurrences by logarithmic summation of the noise intensity of all events measured in terms of Effective Perceived Noise Level (EPNL) in units of EPNdB.

b. Ldn, Leq and CNEL are based on methodologies that utilize logarithmic summation of the noise intensity of all events measured in terms of A-weighted sound pressure level in units of dBA.

c. TA is based on a methodology that measures noise intensity and accounts, by a linear summation, for the total time above a selected A-weighted sound level.

USE OF DIFFERENT INM OUTPUTS

Different INM outputs will be relevant for use for specific situations. Several examples will illustrate this principle:

1. Peak levels, reflected in the time above (TA) metric, will provide the actual noise levels at specific locations. This information will be useful for many purposes including levels of soundproofing attenuation necessary to achieve a desired interior level of noise. For instance, a concert hall will be designed according to maximum exterior noise levels in relation to the need for a quiet interior. Peak noise levels will be pertinent to the evaluation of attenuation methods. As another example, with a 15-20 dB acoustic reduction from housing structures, an indoor awakening threshold 70-75 dBA is not likely to be exceeded for those areas where outdoor noise levels do not reach 85 dBA. With the same 15-20 dB acoustic benefit from housing structure, indoor speech interference levels (approximately 65 dBA) at a separation of 8 feet should not generally be exceeded for areas where the outdoor noise level does not reach 85 dBA.

2. The time of day will be relevant to other determinations. For instance, schools are generally not sensitive to night operations. The nighttime weighting for the cumulative metrics may be misleading as applied to school locations.

3. Cumulative metrics, such as NEF or Ldn, are valuable for showing the relative impact of alternative actions. This assists the analyst in evaluating alternative courses of action.

CORRELATION BETWEEN METRICS

There are correlations among the various cumulative noise metrics. NEF is equivalent to CNEL or Ldn minus 35, plus or minus 3. For example, Ldn 65 and CNEL 65 are approximately equal to NEF 30. Basically, Ldn, CNEL and Leq are similar, within numerical constants, and differ either in the manner evening noise is weighted or in the time-of-day corrections.

SECTION 6

GLOSSARY OF TERMS

GLOSSARY OF TERMS

Annual Average Busy Day - The number of annual average busy day operations is the average of the twelve monthly averages of workday operations.

Audible Range (of Frequency) (Audio-Frequency Range) - The frequency range 16 Hz to 20,000 Hz (20kHz). This is conventionally taken to be the normal frequency of human hearing.

A-Weighted Sound Level, A-Level (AL) - The ear does not respond equally to sounds of all frequencies, but is less efficient at low and high frequencies than it is at medium or speech range frequencies. Thus, to obtain a single number representing the sound pressure level of a noise containing a wide range of frequencies in a manner approximating the response of the ear, it is necessary to reduce, or weight, the effects of the low and high frequencies with respect to the medium frequencies. Thus, the low and high frequencies are de-emphasized with the A-weighting.

The A-scale sound level is a quantity, in decibels, read from a standard sound-level meter with A-weighting circuitry. The A-scale weighting discriminates against the lower frequencies according to a relationship approximating the auditory sensitivity of the human ear. The A-scale sound level measures approximately the relative "noisiness" or "annoyance" of many common sounds.

Broad-Band Noise - Noise whose energy is distributed over a broad range of frequency (generally more than one octave).

Composite Noise Rating (CNR) - CNR is a measure of the noise produced by aircraft operations over a 24-hour annual average busy day. The CNR is calculated from aircraft noise expressed in PNdB, and the number of operations in daytime and nighttime periods. Both nighttime and ground runup operations are penalty weighted. The CNR has been utilized by the Department of Defense and the FAA to define the noise environment about airports since the early 1960's.

Continuous Noise - On-going noise whose intensity remains at a measurable level (which may vary) without interruption over an indefinite or a specified period of time.

C-Weighted Day-Night Average Sound Level (LCdn) - Refer to the day-night average sound level, L_{dn}. The C-weighted L_{dn} is determined in similar manner, with C-weighting substituted for A-weighting.

C-Weighted Sound Exposure Level (SEL_C) - The C-weighted SEL is the SEL (see definition below), based on the C-weighted level rather than the A-weighted level.

C-Weighted Sound Level, C-Level (CL) - The C-scale sound level is a quantity, in decibels, read from a standard sound level meter with C-weighting circuitry. The C-scale weighting approximates overall sound pressure level for

the average of human hearing and most common noise sources. The C-scale incorporates slight de-emphasis of the low and high portion of the audible frequency spectrum.

Day-Night Average Sound Level (Ldn) - The day-night average sound level is a measure of the noise environment over a 24-hour annual average busy day. It is the 24-hour A-weighted sound level, with a 10dB weighting applied to the nighttime levels. When hourly equivalent level (Le) information is available, the Ldn is calculated as follows:

$$L_{dn} = 10 \log \frac{1}{24} \left[\sum_{i} 10^{L_{ed_i}/10} + 10 \sum_{i} 10^{L_{en_i}/10} \right]$$

where d and n refer to daytime and nighttime periods.

Alternatively, when a noise source produces discrete noise events, the Ldn may be computed by summation of individual SEL values according to:

$$L_{dn} = 10 \log \left[\sum_{i} 10^{SEL_{di}/10} + 10 \sum_{i} 10^{SEL_{ni}/10} \right] - 49.4$$

Decibel (dB) - The decibel is a logarithmic unit of measure of sound pressure, calculated according to a formula (see sound pressure level). One decibel is the level of the squared sound pressure that is $10^{1/10} = 1.259$ times the squared reference sound pressure; also, one decibel is the level of the sound pressure that is $10^{1/20} = 1.122$ times the reference pressure.

Effective Perceived Noise Level (EPNL) - EPNL is a single number rating of the noisiness of complex aircraft flyover noise signals. It is calculated by the integration with time of the tone-corrected perceived noise levels (PNLT) during a single noise event, such as an aircraft flyover. The EPNL includes adjustments for the relative duration of the noise signal and presence of audible pure tones or discrete frequencies (such as the whine of a jet engine compressor or fan). The reference signal duration is 10 seconds.

For the case where the PNLT values are measured at 0.5 second intervals during the noise event, the computational formula for EPNL is:

$$EPNL = 10 \log \left[\sum_{k=0}^{2d} 10^{\frac{PNLT(k)}{10}} \right] - 13$$

where the summation extends over the time period of the signal between the first and last times at which PNLT (k) is within 10 dB of the maximum PNLT; and

d is the duration, in seconds, between the first and last values of PNLT (k) are within 10 dB of the maximum PNLT.

The EPNL is formally defined in ANSI S6.4-1973 "Definition and Procedures for Computing the Effective Perceived Noise Level for Flyover Aircraft Noise".

Equivalent Sound Level (Leq) - The equivalent sound level, Leq, is the level of a constant sound which, in a given situation and time period, has the same sound energy as does a time-varying sound. Technically, equivalent sound level is the level of the time-weighted, mean square, A-weighted sound pressure. The time interval over which the measurement is taken should always be specified.

The energy averaging is given explicitly by:

$$L_e = 10 \log \frac{1}{t_2 - t_1} \int_{t_1}^{t_2} 10^{AL(t)/10} dt$$

where the averaging is performed over the period $t_2 - t_1$.

The typical averaging time for the equivalent level is a period of one hour. However, the time period can be altered to meet one's needs.

For noise sources which are not in continuous operation, the equivalent level may be obtained by summing individual SEL values and normalizing over the appropriate time period.

Frequency - Number of complete oscillation cycles per unit of time. The unit of frequency often used is the Hertz (Hz).

Frequency Band - Difference in Hertz between the upper and lower frequencies that delimit a band, or the interval in octaves between the two frequencies. The band is located frequency-wise by the geometric mean frequency between the two band-edge frequencies. Examples are: "an octave centered at 500 Hz", or more simply, "the 500 Hz octave band".

Hertz - Unit of frequency equal to one cycle per second.

Impulse Noise (Impulsive Noise) - Noise of short duration (typically less than one second) especially of high intensity, abrupt onset and rapid decay, and often rapidly changing spectral composition. Impulse noise is characteristically associated with such sources as explosions, impacts, the discharge of firearms, the passage of supersonic aircraft (sonic boom) and many industrial processes.

Infrasonic - Having a frequency below the audible range for man (customarily deemed to cut off at 16 Hz).

Intermittent Noise - Fluctuating noise whose level falls one or more times to low or unmeasurable values during an exposure.

Noise Exposure - The cumulative acoustic stimulation reaching the ear of a person over a specified period of time (e.g., a work shift, a day, a working life, or a lifetime).

Noise Exposure Forecast (NEF) - NEF is a measure of the noise environment over a 24-hour annual average busy day. It is based upon summation of individual noise events over the 24-hour period, with adjustments applied for nighttime noises and aircraft ground runups. EPNL is the basic noise event measure. The nighttime adjustment differs from that used in calculation of L_{dn}.

$$NEF = 10 \log \left[\sum_{I} 10^{EPNL_{dI}/10} + 16.67 \sum_{I} 10^{EPNL_{nI}/10} \right] - 88$$

Noise Hazard (Hazardous Noise) - Acoustic stimulation of the ear which is likely to produce noise-induced permanent threshold shift in some portion of a population.

Noise Level Reduction (NLR) - NLR is the difference in decibels, between the A-weighted sound level outside a building and the A-weighted sound level inside a designated room in the building. The NLR is dependent upon the transmission loss characteristics of the building surfaces exposed to an exterior noise source, the particular noise characteristics of the exterior noise source and the acoustic properties of the designated room in the building.

Overall Sound Pressure Level (OASPL) - OASPL level is the sound-pressure level measured in a broad frequency band. This band is often taken to extend from approximately 25 Hz to 10,000 Hz.

Perceived Noise Level (PNL) - PNL is a rating of the "noisiness" of a sound calculated from acoustic measurements. The unit is the perceived noise decibel (PNdB). The perceived noise level is calculated from sound pressure levels measured in octave (or 1/3-octave) frequency bands. This rating is most accurate in rating the noisiness of broadband sounds of similar time duration which do not contain strong discrete frequency components.

The PNL is formally defined in the Society of Automotive Engineers (SAE) Aerospace Recommended Practice 865A "Definitions and Procedures for Computing the Perceived Noise Level of Aircraft Noise".

Pythagorean Theorem - A theorem in geometry, the square of the lengths of the hypotenuse of a right triangle equals the sum of the squares of the lengths of the other two sides.

Sound Exposure Level (SEL) - The sound exposure level (SEL) is a measure of single noise events, such as an aircraft flyover. It is the A-weighted sound level integrated over the duration of a noise event (referred to a reference time of one sound). Hence, it gives the equivalent level of a continuous signal of one second duration for the event.

For purposes of aircraft noise evaluation, SEL is computed from A-levels sampled at discrete intervals of 0.5 seconds or less. Thus, the working expression for SEL becomes:

$$SEL = 10 \log \sum_{k=0}^{k=\frac{d}{\Delta t}} 10^{\frac{AL(k)}{10}} + 10 \log \Delta t$$

where d is the time interval during which AL(k) is within 10 dB of the maximum A-level, and t is the time interval between noise level samples.

Sound Level Meter - A sound level meter is an instrument that provides a direct reading of the sound pressure level at a particular location. It consists of a microphone and electronic amplifier together with a meter having a scale graded in dB. Using appropriate built-in electrical filters, it is possible to directly measure the overall, the A- or D-weighted sound pressure levels. Standard sound level meters must satisfy the requirements of American National Standards Institute (ANSI) Specification for Sound Level Meters, S1.4-1971.

Sound Pressure - The sound pressure at a point in a sound field is a measure of the fluctuating variations in pressure from the static value (i.e., atmospheric pressure) caused by the presence of the sound field. For most complex sound sources, the sound pressure contains energy over a broad frequency range audible to humans.

Sound Pressure Level (SPL) - The range in sound pressures from the minimum audible sound waves to those existing in the vicinity of a modern jet airplane is greater than a factor of one million. A measure of the sound pressures is therefore more convenient on a reduced scale. Consequently, a logarithmic scale is used in which equal increments correspond to equal multiples of souund pressure; the reference pressure corresponds approximately to the minimum audible sound pressure. This is a convenient scale to use since the ear responds to sound waves in a similar manner. On such a scale, the measurement of sound pressure is termed SPL, the units being the decibel or dB.

In more formal mathematical formulation, the sound-pressure level of a sound, in decibels, is 20 times the logarithm to the base ten of the ratio of the pressure of this sound to the reference pressure [dB = 20 (log Po)]. the common reference pressure for acoustics in air is 20 micropascals (20 micronewtons per square meter). In English units this quantity is approximately 4.2×10^{-7} pounds per square foot.

Sound Transmission Class (STC) - STC is a single-figure rating of the soucound insulating properties of a partition as determined by methods described in "Determination of Sound Transmission Class", American Society of Testing and Materials Designation E413-73.

Sound Transmission Loss (STL) - STL is a measure of the sound insulating properties of a wall, floor, ceiling, window, door, that are characteristics of the partition itself and not the room of which it is a part. The STL may be

calculated from the noise reduction between two rooms, in a specified frequency band, plus ten times the common logarithm of the ratio of the area of the partition to the total sound absorption in the receiving room, as determined by methods described in "Measurement of Airborne Sound Insulation in Building", American Society of Testing and Materials Designation E90-70 or latest revision thereof.

Standard Land Use Coding Manual (SLUCM) - Standard system for identifying and coding land use activities. Published by U.S. Department of Commerce in 1965.

Steady State Noise Level (L_s) - L_s is the A-weighted noise level produced in the space by the ventilation or mechanical systems (or other interior noise sources) which operate more or less continuously. The L_s value for design should be the noise level produced in the space by the equipment during the most usual mode of operation during the time of occupancy.

Tone-Corrected Perceived Noise Level (PNLT) - The tone-corrected perceived noise level is the perceived noise level adjusted for the presence of audible discrete frequency components which increase the noisiness of the sound signal. The PNLT was developed to aid in assessing the perceived noisiness of aircraft or vehicle noises which contain pure tones or have perceived irregularities in their spectrum.

The PNLT is formally defined in ANSI S6.4-1973 "Definition and Procedures for Computing the Effective Perceived Noise Level for Flyover Aircraft Noise".

SECTION 7

PART 150 STUDY CHECKLIST

PART 150 STUDY CHECK LIST
THIS CHECK LIST IS FOR ALPA REPRESENTATIVES ONLY .

As a guide to representing ALPA at any noise study, be it a Part 150 Airport Noise Study, an Airport Master Plan Study, or a Follow-Up Study to either of the above, ALPA has developed a "check list" to help the ALPA Representative in attendance. It is important to remember that the attendee must represent ALPA and not merely his or her airline or his or her personal feeling. It is important that the ALPA Representative read this handbook and be as familiar with it's contents as possible. You must be aware that the ALPA policies, positions and statements included in this handbook have been developed through years of work and interaction with other ALPA committees and have been formulated through the process of development, ratification and approval before any item is an official ALPA policy, position or statement. Therefore caution should be taken when speaking for ALPA, so that only ALPA policies and positions are expressed. When circumstances arise that call for statements or positions not covered in this handbook, make no comment until you have received help or clarification. When situations do arise where additional information is required, contact the ALPA Staff Engineer or any of the ALPA Noise Abatement Committee members. It is also important to be sure, at the beginning of a noise study that you set a tone of cooperation. ALPA wants to be a good airport neighbor, we want to cooperate and do as much as we can to help alleviate unwanted aircraft noise. We want to ensure that unsafe flight procedures and profiles are not used, considered or developed.

In the process of a noise study, generally a technical or operations committee or panel will be formed.. It is important that ALPA be represented on this very critical committee. If you are not assigned to it, ask to be. This is where the potentially critical flight procedures and criteria are developed or rejected and ALPA should actively participate in and monitor this most important phase of a noise study.

The following is a "check list" to follow when you are assigned as an ALPA representative to a noise study at a given airport.

1. Contact the airport manager/director by phone. Inform him that you are requesting to be included as an ALPA representative to the upcoming noise study (Part 150, Master Plan or Update). Request that he inform the head of the study to notify both yourself and ALPA Headquarters of dates and locations of the meetings. (See Appendix ? for addresses.)

2. Familiarize yourself with the airport, environs and geography of the area, and local committees as much as possible. Use your Jeppesen charts and maps as an aide and take them with you to the meetings. They are very helpful in addressing questions that might arise. If you do not have a complete set for the airport involved contact the ALPA Noise Committee Staff Engineer for copies.

3. Read and familiarize yourself with the ALPA Noise Abatement Handbook, especially the section on ALPA policy and positions. If questions arise as to the meaning or application of any part of this section, clarify it with ALPA Headquarters or an ALPA Noise Abatement Committee member <u>before</u> attending your meetings.

4. Prior to attending your first meeting contact the ALPA Noise Committee staff member to coordinate any transportation, housing, or related expenses.

5. Attend an many noise meetings as possible. Attendance at the first meeting is desired to ensure being included as a member of the study. It is also at this first meeting that a copy of the ALPA policies and positions on noise abatement and related matters can be given to the study chairman for inclusion in the study documents. (Section 2 of the Handbook).

6. When attending meetings or in correspondance with the study group it is important to adjust remarks so as to conform with ALPA's position, as opposed to personal or company views. When in doubt either make no statement or delay reply until after consultation with other appropriate ALPA personnel.

7. Please attempt to ensure ALPA is on the mailing list for any documents, notices or material relating to the study and that both yourself and the ALPA Washington staff are informed as to meeting dates and places in a timely fashion.

8. When timing is apropriate ask to have ALPA included as a member of the "technical" or "operations" working committee or panel.

9. After each meeting, if possible, contact either the ALPA Noise Abatement Staff Engineer or a Noise Abatement Committee member with progress or update reports. This can be accomplished by either a short informal memo or telephone call.

10. If unable to attend a meeting contact ALPA staff or another Noise Abatement Committee member as soon as possible prior to the meeting to consider availability or need of an alternate representative to attend.

11. If during the progress of a noise study you are faced with any press or news media for comments or statements and you don't feel you want to respond, refer that question or questions to the ALPA Public Relations Department in Washington, D.C. at (202) 797-4000.

SECTION 8

APPENDICES

APPENDIX 8-A

DOT AVIATION NOISE POLICY

DEPARTMENT OF TRANSPORTATION
UNITED STATES OF AMERICA

AVIATION NOISE ABATEMENT POLICY

November 18, 1976

OFFICE OF THE SECRETARY FEDERAL AVIATION ADMINISTRATION

CONTENTS

CONTENTS
(continued)

PART ONE

INTRODUCTION AND SUMMARY OF AVIATION NOISE ABATEMENT POLICY

I. INTRODUCTION

Aircraft noise is a significant annoyance for six to seven million Americans. The annoyance is particularly serious at many of our major airports, including those in large metropolitan areas from coast to coast. But noise constitutes a present or potential problem for residents living near many other airports across the nation, and as air travel increases it will become a serious problem at some of these other airports as well.

The aircraft noise issue became increasingly apparent in the early 1960's with the advent of jet aircraft and was soon magnified by the rapidly increasing number of commercial operations in the latter part of the decade. Because of its adverse effect on people, aircraft noise was recognized as a major constraint on the further development of the commercial aviation network, threatening to limit the construction and expansion of airports and access to them. Joint action by government and the private sector was taken to address it. The engine manufacturers and the federal government both engaged in extensive research into quieting jet engines. In 1969, Congress gave the Federal Aviation Administration ("FAA") the responsibility to regulate aircraft design and equipment for noise reduction purposes. The FAA then embarked upon a long-term program of controlling aircraft noise at its source.

A regulation promulgated in 1969 established noise standards for turbojet aircraft of new design effective December 1, 1969; an amendment in 1973 extended the same standards to all new aircraft of older design. The third step in the source noise control program is a regulation requiring compliance with noise standards by jet aircraft already in the fleet. Initially called the "retrofit" rule, it has been the subject of two major FAA rulemaking proposals, a notice of proposed rulemaking published in 1974 and a similar Environmental Protection Agency (EPA) proposal published in 1975. The FAA noise proposal for operating aircraft was the product of considerable study and analysis and was submitted by the Federal Aviation Administrator to the Secretary of Transportation in January because consultation with the Secretary is required by the Noise Control Act of 1972, and because the FAA concluded that some form of federal financing might be required to complete that program.

Intensive review of various proposals by the Secretary of Transportation, with the support of the FAA Administrator, led to a far-ranging analysis of the aircraft noise problem, alternative methods of dealing with it, and the economic consequences of imposing a rule applicable to operating aircraft as well as to newly certificated aircraft.

On October 21, 1976, President Ford advised us that, after considering the proposal we jointly presented to him, and the views of other interested agencies, including EPA, he had accepted our recommendation that action should be taken to extend current noise standards to domestic U.S. commercial airplanes in not more than eight years. He directed that the FAA promulgate its noise compliance rule not later than January 1, 1977. Our statement today announces that action, and the companion measures we believe are an integral part of a comprehensive aviation noise abatement policy.

The scope of the noise problem, the interrelationship and special responsibilities of the many parties concerned with it, and the general confusion and prevalent uncertainty about what it is possible to achieve and who is responsible have led us to conclude that the federal government should address the overall noise problem with a more comprehensive approach than mere promulgation of a new regulation. From recognition of the need for a comprehensive response to the noise problem, this policy statement will analyze the aviation noise problem, and delineate the shared responsibilities of those who must act to alleviate it - industry, government and private citizens.

Although progress has been made in the development of quieter aircraft, much remains to be accomplished. Aircraft noise, of course, cannot be completely eliminated unless we go back to the glider; its adverse effect on people can only be reduced. The complex division of legal authority and practical responsibility among airport proprietors, federal and local government agencies, air carriers, and manufacturers calls for a clearer understanding, first, of what is technologically and financially attainable and, second, of how each of these parties can and must perform those functions for which it is uniquely suited. Only if each party assumes responsibility and acts on the basis of complete cooperation and coordination will we achieve significant and measured progress in reducing the impact of aircraft noise on airport neighbors.

As the federal officials principally concerned with aviation noise, it is our duty to provide leadership in a national effort to reduce aircraft noise. The aviation noise abatement policy that follows represents our views about what action should be taken. Within the constraints of technology, productivity, and financing, it clarifies the responsibility of the federal government to reduce aircraft noise at its source, to promote safe operational procedures that abate the impact of noise on populated areas and to promote positive efforts to attain compatible land use in areas adjacent to airports. It deals realistically with the time that will be required to bring the current fleet of aircraft into compliance with noise level standards that are now technologically feasible and with the financial requirements necessary to make compliance possible.

Those who anticipate a complete federal solution to the aircraft noise problem misunderstand the need for federal, local and private interaction. The primary obligation to address the airport noise problem always has been and remains a local responsibility. Consequently, we have also set forth what we believe to be the legal and proper responsibilities of the airport proprietors, air carriers and other aircraft operators, aeronautical manufacturers, state and local governments, and private citizens. The full benefit of a federal plan of action will be realized only if complementary action is taken by all these participants.

Local capability to plan and take action will be enhanced by a clearer understanding of what the federal government intends to do. As the federal government reduces cumulative noise exposure by controlling the source of noise, so must local governments and airport proprietors, with federal financial assistance in some instances, acquire land and assure compatible land use in areas surrounding the airport in order to confine severe noise exposure within the boundaries of the airport and to minimize the impact of noise beyond those boundaries.

Because of the complexity of the noise problem, we have set forth the following synopsis of our Aviation Noise Abatement Policy which summarizes the key responsibilities of each participant and highlights the federal action program. The analysis of the noise and financing problems that led to the formulation of this policy, the legal foundation upon which the policy rests, and the specific explanation of how certain timing, noise levels and policy conclusions were reached are set forth in Part Two. Accordingly, we invite your attention to Part Two and the underlying rationale that we believe will clarify and support the conclusions set forth in the following section.

John L. McLucas
The Federal Aviation Administrator

William T. Coleman, Jr.
The Secretary of Transportation

* The summary of the policy probably should follow Part Two, which defines the terms, quantifies the problems and explains both the analytical process by which the conclusions were reached and the reasons for them. In this town, however, people have become accustomed to receiving their information quickly and concisely. Consequently we have conceded that a number of readers may not follow us through to the end and have put the proverbial cart before the horse.

II. AVIATION NOISE ABATEMENT POLICY

A. Basic Policy Principles

- Because aircraft noise adversely affects a significant portion of the nation's population, a nationwide commitment, involving federal, local and private resources, is required to reduce the impact of aviation noise on the people who live in areas surrounding airports.

- Public understanding is essential to an effective program to reduce aircraft noise so that we do not raise the expectations of airport neighbors for noise reductions beyond the levels which technology and reasonable cost-effectiveness make possible.

- Each of the participants in the noise abatement effort - the airport users, aircraft manufacturers, the airport proprietors, federal, state and local governments, and residents in communities surrounding airports - must take specific steps that are essential in reducing the number of people adversely affected by noise and the severity of the effect on all people.

- Planning and acting in coordination, each of these parties should move toward the goal of confining severe aircraft noise exposure levels around U.S. airports to the areas included within the airport boundary or over which the airport has a legal interest, and of reducing substantially the number and extent of areas receiving noise exposure levels that interfere with human activity.

B. Authorities and Responsibilities Under the Policy

The Federal Government has the authority and responsibility to control aircraft noise by the regulation of source emissions, by flight operational procedures, and by management of the air traffic control system and navigable airspace in ways that minimize noise impact on residential areas, consistent with the highest standards of safety. The federal government also provides financial and technical assistance to airport proprietors for noise reduction planning and abatement activities and, working with the private sector, conducts continuing research into noise abatement technology.

- Airport Proprietors are primarily responsible for planning and implementing action designed to reduce the effect of noise on residents of the surrounding area. Such actions include optimal site location, improvements in airport design, noise abatement ground procedures, land acquisition, and restrictions on airport use that do not unjustly discriminate against any user, impede the federal interest in safety and management of the air navigation system, or unreasonably interfere with interstate or foreign commerce.

- State and Local Governments and Planning Agencies must provide for land use planning and development, zoning, and housing regulation that will limit the uses of land near airports to purposes compatible with airport operations.

- The Air Carriers are responsible for retirement, replacement, or retrofit of older jets that do not meet federal noise level standards, and for scheduling and flying airplanes in a way that minimizes the impact of noise on people.

- Air Travelers and Shippers generally should bear the cost of noise reduction, consistent with established federal economic and environmental policy that the adverse environmental consequences of a service or product should be reflected in its price.

- Residents and Prospective Residents in areas surrounding airports should seek to understand the noise problem and what steps can be taken to minimize its effect on people. Individual and community responses to aircraft noise differ substantially and, for some individuals, a reduced level of noise may not eliminate the annoyance or irritation. Prospective residents of areas impacted by airport noise thus should be aware of the effect of noise on their quality of life and act accordingly.

C. Federal Action Plan to Implement These Policies.

1. Aircraft Source Noise Regulation

a. Currently Operating Aircraft

The Federal Aviation Administration will promulgate a rule requiring that subsonic jet airplanes with maximum weight in excess of 75,000 pounds that do not meet the present Federal Aviation Regulations Part 36 noise levels must be retired from the fleet or modified ("retrofitted") to meet those levels in accordance with the following schedule. To bring about the earliest reduction of noise levels possible, the phased-in compliance deadlines for each aircraft type have been established on the basis of what is technologically practicable and economically reasonable. The deadlines are:

747s within six years, with one-half to be completed within four years;

727s, 737s, DC-9, BAC 1-11s within six years, with one-half to be completed within four years; and

720s, 707s, DC-8s, CV-990s within eight years, with one-quarter to be completed within four years, and one-half to be completed within six years.*

These time periods will start to run with the issuance of appropriate regulations to be effective January 1, 1977. In accordance with such procedures as are authorized by law and FAA regulations, persons subject to these regulations may petition for an exemption. In evaluating petitions for an exemption, the FAA will consider the economic ability of the petitioner to meet the regulatory timetable and whether the petitioner is able to operate the airplanes for which an exemption is sought into airports where a significant noise problem does not exist. As a matter of policy, it is our view that such exemptions should not in any event extend to more than one-third of the JT8D powered airplanes in an operator's fleet.

In conjunction with the issuance of the Part 36 compliance regulation, the United States will work through the International Civil Aviation Organization to reach agreement with other nations on means to abate aircraft noise. If agreement is not reached in three years, it is the intention of the federal government to require aircraft flown by carriers of other countries to meet U.S. established noise levels at the end of five additional years. For the time being, aircraft operated by foreign carriers and that portion of the fleets of U.S. air carriers used in international service will not be covered by the noise regulations issued pursuant to this statement.

b. Future Design Aircraft

The FAA will complete, by March 1, 1977, its consideration of new, more stringent noise standards for new aircraft designs that reflect recent advances in noise suppression technology and are technologically practicable, economically reasonable, and appropriate for the particular type of aircraft. These regulations will be applicable to subsonic aircraft developed for the replacement of the old four-engine jets and to airplanes type certificated after the effective date of the regulation.

* In the establishment of the eight year deadline for the older four-engine jets, we considered, for example, the time required to develop and certificate for production a retrofit kit for the 707 (two years) and the DC-8 (36 months) and the time required to produce and install enough kits to bring these planes into compliance (there are currently over 500 in operation).

c. Supersonic Aircraft

Using information that is now available on a continuing basis from the Concorde demonstration, the FAA, not later than thirty days after the conclusion of the sixteen month demonstration periods, will act to promulgate a noise rule applicable to supersonic aircraft that is necessary to protect the public health and welfare and that is consistent with the statutory requirement that the Administrator consider technological practicability, economic reasonableness, and appropriateness to aircraft type.

2. Operating Procedures

The FAA has evaluated a number of concepts for aircraft operating procedures designed to abate noise. The FAA has taken regulatory action this week to maximize the noise reduction benefits of new aircraft and retrofitted aircraft, consistent with the highest degree of safety. Additional analysis and evaluation is underway which is expected to lead to future regulatory action.

3. Airport Development Aid Program

Under the new authority granted in the 1976 Amendments to the Airport and Airway Development Act, the FAA will establish a high priority for the allocation of discretionary Airport and Airway Trust Funds for airport land acquisition to ensure compatible use of land near airports, the purchase of noise suppressant equipment, the construction of physical barriers and other noise reduction activities.

The Department of Transportation, in appropriate cases, will encourage the development of new airports to replace some of the older airports in areas with large populations adversely affected by noise. In the development of new airports, federal financing will be conditioned on effective noise abatement planning. Federal funding for new airport development and for airport expansion and improvement will require documentation that the proprietor is taking all reasonable steps to ensure that the use of land areas exposed to serious levels of noise is restricted to uses compatible with airport operations projected for the foreseeable future.

The Administration will request the Congress to amend further the Airport and Airway Development Act to include among airport proprietor activities eligible for federal-aid funding the acquisition, installation and operation of airport noise monitoring equipment. Use of such equipment is vital to

assist airport proprietors in quantifying noise exposure, identifying specific airplanes and operators that are major contributors to community noise, and developing programs to reduce aircraft noise exposure.

4. Airport Noise Policy

To bring about further relief from excessive aircraft noise, airport proprietors are encouraged to develop aggressive noise abatement programs for their airports. The FAA will assist proprietors in attaining their noise abatement goals and will advise them on how their proposed plans affect the overall air transportation system. The FAA will accept preliminary proposals from airport sponsors for comprehensive noise abatement plans and will fund a select number of innovative noise abatement model plans and demonstrations. In addition, the FAA will encourage noise abatement plans from airport proprietors in conjunction with both applications for major airport development grants and proposals to establish use restrictions, such as curfews or scheduling and equipment restrictions. The FAA will advise airport operators whether proposed use restrictions are unjustly disciminatory or place an undue burden on interstate or foreign commerce because of their impact on the national air transportation system. Where necessary, the FAA will seek adjudication of the constitutional issues involved if it believes that a use restriction established at an airport is unjustly discriminatory or creates an undue burden on interstate or foreign air commerce.

D. Air Carrier Action Plan

1. Aircraft Compliance

Under the federal rule described above, the older, noisier four-engine jets using the JT3D and similar engines (707s, DC-8s, CV-990s) must be modified to meet Part 36 noise levels or they must be retired from operation within eight years. Many of the four-engine jets are old and relatively inefficient to operate. After weighing the advantages of modification and replacement, the Secretary of Transportation and the Administrator of the Federal Aviation Administration have concluded that it would be in the public interest if most of these aircraft were replaced by new airplanes, particularly by new airplanes that incorporate new technologies currently under development. Replacement would reduce further noise and pollution emissions levels. In addition, replacement would increase energy efficiency, accelerate introduction of advanced safety and design technologies, increase employment opportunities, improve service for the air traveller, and improve prospects for exports by the American aerospace industry.

2. Financing

To ensure that the air carriers can meet the new aircraft noise standards within the deadlines established by regulation, President Ford directed me, as Secretary of Transportation, to hold a public hearing on December 1, 1976, to determine whether any additional financing arrangements may be necessary. Further details on this hearing and the issues to be addressed are set forth in separate documentation.

E. Local Actions

While federal action will form the basis of our program, substantial local action will be necessary to complement the noise reduction actions of the federal government and air carriers. Since a federal program would be significantly less effective without commensurate local actions, we have delineated those actions we believe local authorities should take.

The FAA will encourage airport proprietors, who are legally responsible for the effect of aircraft noise on the surrounding community, to assess their particular noise problem and, where local authorities determine that there is a significant problem, to develop an action plan to reduce the impact of noise. That action plan should include a program to ensure maximum land use compatibility with airport operations both by the acquisition of easements or other rights in the use of land or airspace and by encouraging local governments to adopt and enforce zoning or other land use controls. It should also address other actions that may be taken, such as the establishment of a formal noise abatement runway system, control of ground operations, and preferential arrival and departure routes. The proprietor may wish to propose to the FAA special landing and takeoff procedures to deal with any unique conditions around his airport.

In addition, state and local governments with jurisdiction over property adjacent to airports must take action of their own, preferably in cooperation with the local airport proprietor. State and local governments are directly and uniquely responsible for ensuring that land use planning and zoning and land development activities in areas surrounding airports are consistant with the objective of ensuring land use that is compatible with present and projected aircraft noise exposure in the area. Construction standards for new buildings should ensure appropriate insulation from aircraft noise, and programs to insulate existing public and residential buildings should be advanced where needed.

State and local governments also should require that appropriate notice of airport noise exposure be provided to the purchasers of real estate and to prospective residents in areas near airports to ensure awareness of the nature of the airport environs.

F. Concluding Note

With realistic public appreciation for the complexity of the task to be performed and with full and open communication and cooperation among the participants, the actions that each of us take separately pursuant to this policy will contribute toward significant and reocognizable progress in the reduction of the adverse effect of aircraft noise on airport neighbors.

PART TWO

ANALYSIS OF THE NOISE PROBLEM, LEGAL FRAMEWORK, AND DESCRIPTION OF THE FEDERAL ACTION PROGRAM

I. STATEMENT OF THE PROBLEM

In determining what action can and should be taken at the federal and local levels and in the private sector to reduce the adverse effect of excessive aircraft noise, a full understanding of this multidimensional problem is essential. In this part, we will explain the underlying rationale that supports the conclusions set forth in our Aviation Noise Abatement Policy and the federal action program to implement it. In describing the noise problem, we will explain first the technical framework for measuring the noise problem, how it affects people and how they react to it, how many people are subjected to excessive noise and where they live, and how actions to reduce noise affect interstate commerce. Because progress in noise reduction is heavily dependent upon the financial ability of airlines to modify or replace their old, noisy airplanes and on the ability of manufacturers to design, produce, and sell less noisy airplanes, we also will consider the financial condition of the airlines and the impact of proposed actions on the aerospace industry.

The responsibilities of federal and local governments, airport proprietors, and industry in responding to the noise problem are defined in large measure by statutory and case law. Accordingly, the legal framework set forth in this part establishes the foundation upon which the federal program must be constructed. Finally, the federal response summarized in this policy is described in greater detail in terms of the precise nature of the noise problem it is designed to address and the financial and technological constraints within which progress must be made.

A. The Noise Problem

1. How Noise is Described

People's reactions to noise differ widely. It is difficult, therefore, to derive a simple mathematical formula that accurately represents human reaction to noise ananoyance. For example, it remains uncertain whether people, in reacting to aircraft noise, are more annoyed by the number of aircraft noise events or the noise levels of individual events. To help measure, quantify and understand the effects of noise on people, there has been a proliferation of approaches, the acronyms of which threaten to challenge the supremacy of the federal bureaucracy in this regard. Rational public discourse is not greatly aided by a debate over the relative merits of expressing noise impact in terms of dB, dBA, dBD, PNL, EPNL, EPNdB, SEL, SENEL, CNR, NEF, CNEL, ASDS, Ldn, and Leq. In this policy statement, we have relied primarily on the two most common measurements of noise: noise generated by a single event (expressed in EPNdB, usually at the Part 36 measuring points) and cumulative noise exposure (expressed in Noise Exposure Forecast or NEF).

Human response to single-event jet aircraft noise is best represented in terms of Effective Perceived Noise Level, expressed in units of EPNdB. This unit of perceived noise takes into account the actual sound energy received by a listener, the ear's response to that sound energy, the added annoyance of any pure tones or "screeches" in the noise, and the duration of the noise. In any discussion of aircraft noise abatement, a key consideration is the difference in noise level which a listener is able to perceive and find meaningful, in terms of both the single event and the cumulative exposure. Few humans can detect differences between single events of aircraft noise of less than about 5 EPNdB. However, an increase of 10 EPNdB is usually perceived as a doubling in loudness.

The Part 36 measuring points are standardized locations from which aircraft noise is measured for certification purposes. Such measurements are specified at three points: one under the approach path,* one under the takeoff path.** and one to the side of the runway at the point of maximum noise during takeoff.*** Although the Part 36 values do not give a complete picture of the total noise impact at an airport, they do provide a standardized method of measuring aircraft noise, and are useful in comparing noise levels of different aircraft.

In general, if noise events, such as aircraft flyovers, are infrequent, the peak noise level of the individual events will probably determine individual reactions to that noise. If the noise events are relatively continuous or repetitive, however, the total noise "dose" or cumulative noise exposure becomes a more important factor in people's reactions to aircraft noise. Noise Exposure Forecast (NEF) provides a measure of the total aircraft-generated noise energy received at locations near an airport during a typical 24-hour period. The NEF value at a given point near an airport is calculated by summing the noise energy received at that point from all of the aircraft operating into and out of that airport during a day, with an added penalty for nighttime noise (flights after 10 p.m.). Points of equal NEF value are then joined to form contours of equal noise exposure. Calculation of these values requires knowledge of the number and type of aircraft operating, the noise characteristics of each aircraft, the flight paths they follow, the time of day they fly, and the manner in which they are operated (for example, power settings during takeoff and landing).

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* One nautical mile from the runway threshold.
** 3.5 nautical miles from the start of the takeoff roll.
*** 0.35 nautical miles to the side of the runway for four-engine aircraft, 0.25 nautical miles for two- and three-engine aircraft.

The NEF procedure has been developed over the last decade for land use planning around airports as the number of jet aircraft has increased and their noise has become more of an annoyance. It is particularly meaningful in measuring the overall impact that residents around busy airports might experience, and research into human reaction to aircraft noise indicates that cumulative noise exposure is the most useful measure of public reaction to aircraft noise.*

*References for Cumulative Measure Support

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2. Connor, William and Patterson, Harrold: Community Reaction to Aircraft Noise Around Smaller City Airports. NAS CR 2104, 1972.

3. Galloway, W. and Bishop, D.E.: Noise Exposure Forecasts: Evolution, Evaluation, Extensions and Land Use Interpretations. FAA Report No. FAA-NO-70-9, August 1970.

4. McKennell, A.C.: Aircraft Noise Annoyance Around London (Heathrow) Airport. S.S. 337, Central Office of Information, 1963.

5. MIL Research Ltd.: Second Survey of Aircraft Noise Annoyance Around London (Heathrow) Airport. Office of Population Censuses and Surveys, Social Surveys Division. HMSO (London), 1971.

In assessing community reaction to aircraft noise exposure, the following interpretations of NEF values are often used:

Less than NEF 30	Essentially no complaints expected; noise may interfere with community activities.
NEF 30 to NEF 40	Individuals may complain; group action possible.
Greater than NEF 40	Repeated vigorous complaints expected; group action probable.

A reduction of one NEF unit is equivalent to a reduction of about two percent in the number of people highly annoyed and equal to a reduction of about 14 percent in the area exposed to the same level of noise exposure.* A difference in noise level below 5 EPNdB may not be significant as a single event, but if there are frequent occurrences the cumulative effect of that difference may be substantial, and the change in NEF value would reflect this.

The NEF method has been adopted by the Department of Housing and Urban Development. It will not guarantee mortgages on properties within NEF 40 and normally considers properties within NEF 30 unacceptable. NEF and other descriptors of cumulative noise exposure** are useful in determing the effect of federal noise control activity on airport communities and in commensurate local land use development and planning.

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* The relationship between NEF reduction and land area reduction is logarithmic - i.e., a 50 percent reduction in land area is approximately equivalent to a 4.5 NEF unit reduction, while a 25 percent reduction in land area is approximately equal to a 2.0 NEF unit reduction.

** The Environmental Protection Agency has recommended that cumulative noise exposure be expressed by a measure called Day/Night Average Noise Level (Ldn). The equivalent values are:

NEF 30 = Ldn 65; NEF 40 = Ldn 75

2. How Noise Affects People

Aircraft noise disturbs the normal activities of airport neighbors--their conversation, sleep, and relaxation--and degrades their quality of life. Depending on the use of land contiguous to an airport, noise may also affect education, health services, and other public activities.

Although there may be indirect and subtle social and psychological harms, aircraft noise is predominantly an annoyance problem. It does not present any direct physical health danger to the vast majority of people exposed.

3. Whom Does Noise Affect and Where Do They Live

Approximately six million U.S. citizens currently reside on 900,000 acres of land exposed to levels of aircraft noise that create a significant annoyance for most residents.* Of this number, approximately 600,000 citizens reside within areas that are severely impacted by aircraft noise; that is, areas in excess of NEF 40.

The subjective reactions of individuals to aircraft noise vary substantially.** These differences become increasingly apparent in the comparison of noise problems surrounding specific airports, taking into consideration the number and kind of local complaints about noise, the political pressures on the airport operator to take unilateral action to restrict use of the airport, and the environmental and social contexts--climate, lifestyles, community concern--in which noise is perceived.

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* Over NEF 30.

** The 1973 Annual Housing Survey conducted by the Bureau of the Census for the Department of Housing and Urban Development, indicated that of those surveyed:

20.2 percent experienced noise from airplane activity in the vicinity of their home. Of those experiencing noise, 34.2 percent considered the noise to be disturbing, harmful or dangerous; 6.3 percent felt airplane noise to be so objectionable that the household would like to move from the neighborhood.

In some communities, people's reaction to aircraft noise is increasingly being expressed in the courtroom where homeowners are receiving awards for nuisance and for diminution of property value (inverse condemnation). Over the past five years, airport proprietors have paid out over $25,000,000 in legal judgments or settlements in noise-related suits and have spent over $3,000,000 in legal fees, expert testimony and similar defense efforts.

The absence of lawsuits in some severely impacted areas and the recent occurrence of the most significant court precedents cause some observers to consider the pending suits to be merely the "tip of the iceberg," with substantial potential liabilities yet to arise. Others consider the concentration of lawsuits in certain areas to be an indication of the diversity in community response to aircraft noise, concluding that noise is not yet perceived as a substantial problem around many airports.

Partly as a reaction to such lawsuits, some airport proprietors have acquired substantial residential areas near their boundaries. The largest such programs have been undertaken by Seattle-Tacoma International and Los Angeles International Airports. Los Angeles alone has spent over $130 million to purchase private residences and plans to spend $21 million on sound-proofing schools and other public buildings near the airport.

Because the magnitude of the noise problem at any particular airport is a function of many factors, there is not any single criterion that defines a "noisy" airport. Depending on which criteria are used, the number of airports that are categorized as: "noisy", "noise sensitive", "noise problem", or "impacted by excessive noise", will vary. For example, the Air Transport Association (ATA) has identified 26 airports as "noise sensitive." On the other hand, the Airport Operators Council International has indicated that all airports receiving jet air carrier service now are or soon will be "noise impacted." By any definition, however, it is clear that an acute noise problem exists at many airports located in metropolitan areas.

Based on an analysis of citizen and Congressional complaints, the imposition of airport use restrictions, litigation and the number of people affected, the FAA has identified 100 airports where noise is in varying degrees an issue. A 1974 DOT study

of 23 major U.S. airports identified eight airports that have neighboring populations of over 25,000 residing within the NEF 40 contour (extremely serious problem), and 13 airports with at least 100,000 residing within the NEF 30 contours (considerable annoyance).* For the 23 airports surveyed, five million people live within NEF 30 and a half a million within NEF 40. Clearly the vast majority of people exposed to serious levels of noise live near the major metropolitan airports.** The following chart tabulates the number of people exposed to serious aircraft noise within the NEF 30 and 40 contours around the 23 airports included in DOT's study.

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* These airports, in the order of the number of people affected, are: LaGuardia, O'Hare, Kennedy, Newark, Boston, Los Angeles, Miami, Denver, Cleveland, San Francisco, Seattle, Buffalo, and St. Louis.

** "Airport Noise Reduction Forecast," Report DOT-TST-75-3, October 1974.

EXTENT OF NOISE PROBLEM AT 23 MAJOR AIRPORTS

	Airport	1972 Number of People ** (1000) NEF 30	NEF 40	Court-suits	Restric-tions
1.	*Atlanta	99.8	27.0	Yes	
2.	*Boston	431.3	32	Yes	
3.	*Buffalo	113.8	9.7		
4.	Chicago-Midway	38.5	1.8		
5.	*Chicago-O'Hare	771,7	66.6		
6.	Cleveland	128.7	11.2		
7.	*Denver	180.3	28.3		
8.	Dulles	3.5	0		
9.	*J.F. Kennedy	507.3	111.5		
10.	*LaGuardia	1057.0	17.1		
11.	*Los Angeles	292.4	51.1	Yes	
12.	*Miami	260.0	29.7	Yes	
13.	*Minneapolis-St. Paul	96.7	8.8	Yes	Yes
14.	*Newark	431.9	27.5		
15.	New Orleans	32.5	8.9	Yes	
16.	Philadelphia	76.9	0.3		
17.	*Phoenix	20.5	6.2		
18.	Portland	1.2	0.3	Yes	Yes
19.	*San Diego	77.3	24.0	Yes	
20.	*San Francisco	124.1	11.4		
21.	*Seattle	123.2	17.3	Yes	Yes
22.	St. Louis	100.0	8.5	Yes	
23.	*Washington National	24.4	2.0	Yes	Yes
TOTAL		5.0M	0.5M		
All other airports		1.1M	.1M		
GRAND TOTAL		6.1M	0.6M		

* Identified by Air Transport Association as being "noise sensitive." Other airports on the current ATA list but not included in the study are: Detroit, Honolulu, Memphis, Las Vegas, Tampa, Ft. Lauderdale, San Juan, Oakland, and San Jose.

** Estimated from 1970 Census data

In response to public opposition to noise, some airports have imposed or are considering various use restrictions.* These measures include curfews, restrictions on the use of certain equipment, and limitations on operations. Such restrictions may have a substantial effect on interstate commerce and on the air navigation system.

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* Major examples of completed or proposed actions by airport owners to reduce noise levels by restricting the use of the airport are:

- Night Time Operating Restrictions - Lindbergh Field in San Diego, California; Pearl Harbor, Oahu; Washington National
- Total Jet Ban - Santa Monica Municipal Airport, California; Watertown Municipal Airport, Wisconsin
- Exclude non-Part 36 Jet Aircraft - Los Angeles International, Logan International, Boston
- Limit Number of Aircraft Operations - Stewart Airport, N.Y.
- Exclude Particular Types of Aircraft - Los Angeles International and Logan International have prohibited SSTs, JFK International is considering a similar ban
- Limit number of nightime operations - Minneapolis-St. Paul
- Operational Noise Limits - JFK International
- Displaced Threshold - Logan International and many others
- Noise Preferential Runways - Atlanta, Miami, Tampa, San Juan, Boston-Logan, Hartford-Bradley, O'Hare, Midway, Cleveland Hopkins, Detroit-Wayne County, Minneapolis-St. Paul, Moisant-New Orleans, Denver, Pittsburgh, LaGuardia, Newark, Los Angeles, San Francisco and others.

In some of the above cases, the restrictions have been developed voluntarily through operator/users agreements, while in others they have been imposed unilaterally by the airport proprietor.

Curfews at large, medium and small hubs could have very serious effects. New York City is an illustration:

- Air cargo shipments by weight remain at a relatively constant level for 24 hours at Newark and Kennedy. Accordingly, restrictions on night operations would severely disrupt freight shipment and handling. During May 1974, 37 percent of the total New York air cargo was transported between 10 p.m. and 7 a.m. local time. With a nationwide curfew applying to the same time period, the foreclosure of freight traffic to New York would extend to the hours during which 49 percent of the New York cargo moves.

- A curfew's impact on mail shipments would also be significant. The movement of mail between 10 p.m. and 7 a.m. at New York amounted to 23 percent of the daily air transported mail for the sample studied. A nationwide curfew would curtail flights for the hours in which 35 percent of the New York mail moves.

- Five to 13 percent of all passenger movements would be affected by similar New York and nationwide curfews. Much of the night passenger travel makes use of the reduced night coach fare structure enabling those with less financial resources to travel by air.

Other disbenefits are also likely if curfews are widely adopted. A substantial number of airplane operations might have to be shifted to earlier hours, which, while eliminating noise at night, would result in congestion and delays and an increase in the noise exposure during daylight and evening hours. Airlines would require more aircraft, more expensively operated, to overcome positioning problems if even one or two major hubs were curfewed. Time zone differences would cause additional scheduling problems. A curfew at O'Hare, for example, would cause a major restructuring of most of the domestic air transportation system.

4. The Source of Aircraft Noise: Composition of the Fleet

Some have argued that normal attrition will eventually take care of the aircraft noise problem, as the older, noisier planes are phased out of the fleet. The evidence indicates, however, that unless federal action is taken, the problem of airport noise will remain and, with increasing operations occurring at more airports, will be exacerbated. At the end of 1975, only 494 of the 2,148 jet airplanes in the U.S. air carrier fleet (about 23 percent) complied with the noise levels of Part 36. It bears repeating that the 77 percent of the fleet that exceed Part 36 levels were not required to meet those standards since they were produced prior to the effective date

of Part 36. Of the 1,654 aircraft in the fleet that do not meet Part 36 noise levels, 523 or 30 percent are the noisiest, four-engine models (Boeing 707s and 720s, Douglas DC-8s). Assuming normal attrition, the FAA projects that in 1990 48 percent of the air carrier fleet still will not meet Part 36.*

Since 1972, there has been a reduction in cumulative aircraft noise exposure around airports due in part to the introduction of new quieter jet aircraft and in part to the slowed rate of increase in passenger growth. Because of forecasted aviation growth, the airport noise problem is expected to increase in the future despite the introduction of quieter aircraft. Between 1975 and 1990, annual air carrier operations are estimated to increase from 10 million to 16 million, creating additional noise exposure that, without federal action, could more than offset the reduction in noise levels resulting from the replacement of the older airplanes by newer, quieter models. The major reason why progress in the replacement of older airplanes has been slow is the financial condition of the air carrier industry, to which we now turn.

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* Details concerning the aircraft currently operating that do not meet Part 36 noise levels and an FAA projection of the non-Part 36 aircraft that will remain in commercial service in 1984 is set forth in the Environmental Impact Statement issued in conjunction with the Part 36 compliance regulation.

B. The Financial Problem

1. Ability of Airlines to Finance Aircraft Replacement

As older noisier airplanes are modified or replaced with new planes that meet or better Part 36 standards, the cumulative noise exposure around major airports will be reduced. The degree and speed with which this occurs depends upon the financial capability of the air carriers to modify or replace their older airplanes. Since additional noise reduction and other benefits accrue from replacement rather than retrofit of these planes, replacement appears to be a more desirable goal. But since replacement requires a much greater capital outlay than retrofit, the forecasted economic environment for the airline industry becomes doubly important.

In recent years many major airlines have experienced very serious difficulty in obtaining from private capital markets the financing necessary for equipment and other needs. Some have found themselves short even of working capital to continue operations. Between 1970 and 1975, the trunk carriers spent $14.6 billion on capital needs: $8.7 billion for aircraft, equipment and property; $1.7 billion for leases of aircraft and engines; and most of the rest for debt service. The sources of this financing were mainly depreciation ($5 billion to $7 billion) and new long term debt ($4 billion), with earnings contributing only about $400 million. Equity financing was insignificant in this period, and low earnings and existing high debt levels forced some carriers to lease rather than purchase new aircraft. In addition, because of their recent earnings records, conventional sources of debt financing also have been effectively foreclosed to some carriers. Insurance companies and banks have been unwilling or unable to make further financing commitments and in recent months have stated publicly that, until the airlines' financial situation is sufficiently improved, new loans will not be forthcoming. In this financially strained economic environment, some carriers have been forced to resort to existing revolving credit arrangements to raise working capital.

The 1974/1975 period was particularly difficult for the industry. The sudden and substantial increase in fuel prices that began in 1974, accompanied by inflation in other cost categories, forced carriers to raise fares sharply. This coincided, unfortunately,

with the economic recession of 1974-75 when demand was already softening, and traffic levels were driven down even further. Moreover, many airlines in the late 1960s had purchased equipment to meet a predicted demand growth that never occurred, leaving them for a time with substantial excess capacity. The airlines' financial problems were exacerbated by the existing economic regulatory system which does not normally allow for timely fare increases, and denies airlines the pricing and management freedom available to other industries.

The airline industry's financial performance has been showing steady improvement since the end of the recession, however, and prospects for increased earnings over the next few years are good. Traffic growth is expected to resume, though at a long-term rate about equal to GNP growth, in contrast to more rapid growth rates in the past. Since, at present, the airlines have relatively few new aircraft on order, any near term traffic growth will be accommodated largely through increases in aircraft productivity. Load factors are likely to increase, earnings should remain fairly stable at a relatively high level, and new capital needs should be relatively modest until 1980.

After 1980, however, traffic growth will begin to press against the fleet's capacity, and airlines will begin to require new capital to finance the replacement of aging aircraft and to meet the growth demand. Leaving aside the new noise requirements, the Department estimates that between 1976 and 1985 the trunk carriers will need from 700 to 800 new aircraft and will require between $22 and $30 billion dollars to finance this acquisition (based on estimates by Government and private sector financial analysts). About $6 billion will be needed for debt repayment and other uses. A mid-range estimate of total capital needs, therefore, would be $32 billion.

Depreciation and sales of used aircraft can be expected to generate about $15 billion of this amount, leaving $17 billion to be financed through earnings and external sources. If earnings in the period were to rise to $6 billion which implies a 9 percent return on equity, as contrasted with the average 2.8 percent return of the past five years, external financing needs would be $11 billion. The airlines would probably be able to obtain this financing from conventional financial sources. The following table summarizes these estimates:

Sources and Uses of Funds (Mid-range Estimate)

Uses of Funds:	($ Billions)
Property, Plant and Equipment	$26
Debt Repayment and Other	6
	$32
Source of Funds:	
Depreciation and Sales of Used Aircraft	$15
Amount Required from Earnings and External Sources	$17
Earnings Assumption	6
External Financing Requirement	$11

It is unlikely that capital needs can be met in this manner, however, if the industry does not achieve $6 billion in earnings by the end of 1985. As indicated, this level of earnings implies an average annual return on equity three times as large as that earned over the last five years. It also assumes no unexpected negative developments, such as another recession or substantial new increases in fuel or other costs. These or other events would materially reduce the ability of the industry to earn a 9 percent return on equity.*

Under one scenario for meeting the new noise abatement regulation schedule, the "regular" 707s and DC-8s are retired and replaced with a new technology airplane and the stretched DC-8s and the remainder of the noncomplying fleet are retrofitted. This would increase the trunk carriers' capital requirements to 1985 by between $5.5 and $7.6 billion, an increase of 20 to 27 percent more than the amount required as discussed above. An incremental capital requirement of this magnitude would appear to be clearly beyond the industry's ability to finance, given the other financing burdens they will face in the early 1980s.

* It must be noted that the above estimates of financial needs and sources are predicated on industry-wide estimates. Carriers that are in relatively inferior financial position will have greater difficulty in obtaining needed funds than will other carriers.

We believe passage of regulatory reform bill (the proposed Aviation Act of 1977) to be reintroduced by the Administration in early 1977 will help the airlines with their overall financing problem. If the carriers had been operating under the regulatory environment envisioned in the proposed legislation they would not face major difficulty in adjusting prices to anticipate needed capital investment requirements and in obtaining the needed financing for the rule. Under the cost-based guidelines now used by the Civil Aeronautics Board in evaluating requests for fare increases, the capital outlay for new equipment, about a third of which is made before the aircraft is delivered, cannot be recovered through fare increases until the aircraft is delivered and in operation. Thus if today's economic regulatory environment continues, it may be impossible for the industry to commit to the manufacturers the substantial amount of cash necessary to get a new technology aircraft into production and delivered soon enough to replace the DC-8/707 fleet by the end of 1984.* Complicating the problem is the fact that a number of carriers are significantly weaker than others and it is these carriers who are the owners of large numbers of noisy aircraft and thus face some of the largest financing requirements.

It is clear that over the period in which the noisy aircraft must be modified or replaced, timely passage of the Aviation Act of 1977 should make a large difference in the carriers' ability to finance new aircraft purchases. However, this very desirable change in regulatory policy would not go into effect for at least a year, and if, as expected, its provisions are phased to allow amply time for adjustment to the new operating environment, its full effect will not be felt for several years.

2. The Aerospace Industry

Lasting noise reduction benefits will be achieved with newer, quieter technology, but a major new aircraft has not been developed in the United States for almost 10 years. In that time, important design and technological advances have been made -- many specifically intended to meet the new economic, operating, and environmental constraints dictated by rising labor costs, energy shortages, environmental requirements, and changing market demands.

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* A large number of firm orders from U.S. air carriers are required by manufacturers before they can start production of a new aircraft. The cost of developing the new aircraft alone is put at $500 million to $1 billion.

In past programs to develop a new aircraft, American manufacturers have had enough preproduction sales to U.S. airlines to provide a solid base for financing front-end costs and to insure a near break-even position without foreign sales. This is not the case today, largely because of the financial condition of several of the largest U.S. airlines, which traditionally have led the way with new purchases. Although the carriers gradually are replacing their older inefficient jets, they are doing so with existing model aircraft, and these only in small numbers. The aircraft available now to replace four-engine jets are improperly sized for some markets (e.g., 727s, 747s L-1011s, or DC-10s). Most U.S. airlines would prefer to wait for a family of new, higher technology aircraft, if it were probable that these airplanes would be available within a few years.

Moreover, the public interest is served by the substantial and long term noise benefits available from new technology aircraft. The new technologies that will be utilized in meeting the stricter FAA noise regulations for new aircraft types to be promulgated by next March will bring about an average reduction of 12 to 16 EPNdB from the noise levels of the 707. The accelerated introduction of these quieter replacement planes offers obvious advantages.

Although we are concerned primarily in this policy statement with reducing the impact of aircraft noise, it would be myopic, if not negligent, for us to overlook opportunities for achieving other important national objectives as well. Consequently, we have considered, in addition to the noise benefits accruing from replacement of four-engine aircraft, the energy conservation benefits of improved fuel efficiency, the increasing importance of aeronautical exports to our aviation industry, the declining role of aerospace research and development as a percentage of national defense and NASA outlays, the stimulation of employment in the aerospace and related industries, and the advantages to the consumer of more advanced design and lower operating costs.

How the carriers choose to comply with our noise rules will have long range effects on the development of U.S. technology, employment, the viability and competitiveness of national aerospace industry, and the long term noise benefits that are to be realized. The sum of total benefits, however, mandates a careful assessment of the relative merits of retrofit or replacement by new technologies.

II. LEGAL FRAMEWORK

A. Legal Responsibilities of the Federal Government

The principal aviation responsibilities assigned to the Federal Aviation Administrator, and since 1966 to the Secretary of Transportation, under the Federal Aviation Act of 1958, as amended, concern safety and the promotion of air commerce. The basic national policies intended to guide our actions under the Federal Aviation Act are set forth in section 103, 49 U.S.C. 1303, which provides public interest standards, including:

(a) The regulation of air commerce in such manner as to best promote its development and safety and fulfill the requirements of national defense;

(b) The promotion, encouragement, and development of civil aeronautics;

(c) The control of the use of the navigable airspace of the United States and the regulation of both civil and military operations in such airspace in the interest of the safety and efficiency of both; and

(e) The development and operation of a common system of air traffic control and navigation for both military and civil aircraft.

To achieve these statutory purposes, sections 307(a) and (c) of the Federal Aviation Act, 49 U.S.C. 1348(a), (c), provide extensive and plenary authority to the FAA concerning use and management of the navigable airspace and air traffic control. The FAA has exercised this authority by promulgating wide-ranging and comprehensive federal regulations on the use of navigable airspace and air traffic control.* Similarly the FAA has exercised its aviation safety authority, including the certification of airmen, aircraft, air carriers, air agencies, and airports under Title VI of the Federal Aviation Act, section 601 et seq., 49 U.S.C. 1402 et seq, by extensive federal regulatory action.** In legal terms the federal government, through this exercise of its constitutional and statutory powers, has preempted the areas of airspace use and management, air traffic control and aviation safety. The legal doctrine of preemption, which flows from the Supremacy Clause of the Constitution, is essentially that state and local authorities do not have legal power to act in an area which already is subject to comprehensive federal regulation.

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* See 14 C.F.R. Parts 71, 73, 75, 91, 93, 95 and 97.

** See 14 C.F.R. Parts 21 through 43, 61 through 67, 91, 121 through 149.

Because of the increasing public concern about aircraft noise that accompanied the introduction of turbojet powered aircraft into commercial service in the 1960s and the constraints such concern posed for the continuing development of civil aeronautics and the air transportation system of the United States, the federal government in 1968 sought - and Congress granted -- broad authority to regulate aircraft for the purposes of noise abatement. Section 611 of the Federal Aviation Act, 49 U.S.C. 1431, constitutes the basic authority for federal regulation of aircraft noise. In 1972, displaying some dissatisfaction with the FAA's methodical regulatory practice under section 611, the Congress amended that statute in two important respects. To the original statement of purpose -- "to afford present and future relief from aircraft noise and sonic boom" -- it added consideration of "protection to the public health and welfare." It also added the Environmental Protection Agency (EPA) to the rulemaking process. Section 611 now requires the FAA to publish EPA proposed regulations as a notice of proposed rulemaking. Within a reasonable time of that publication, if the FAA does not adopt an EPA proposal as a final rule after notice and comment, it is obliged to publish an explanation for not doing so in the Federal Register.

Whether considering a rule it proposes on its own initiative or in response to the EPA, the FAA is required by section 611(d) to consider whether a proposed aircraft noise rule is consistent with the highest degree of safety in air commerce and air transportation, economically reasonable, technologically practicable and appropriate for the particular type of aircraft.

The FAA acted promptly in implementing section 611. On November 18, 1969, it promulgated the first aircraft noise regulations, Federal Aviation Regulations, Part 36, 14 C.F.R. 36, which set a limit on noise emissions of large aircraft of new design. It reflected the technological development of the high-bypass ratio type engine, and was initially applied to the Lockheed 1011, the Boeing 747, and the McDonnell-Douglas DC-10. The Part 36 preamble announced a basic policy on source noise reduction and a logically phased strategy of bringing it about. The Part 36 standard would serve as the basic standard for aircraft engine noise and was initially applicable to new types of aircraft. As soon as the technology had been demonstrated, the standard was to be extended to all newly manufactured aircraft of already certificated types. Ultimately, the preamble indicated, when technology was available the standard would be extended to aircraft already manufactured and operating. The last step would require modification or replacement of all aircraft in the fleet which did not meet the Part 36 noise levels. The first two steps have already been accomplished. This third step is being taken now.

Part 36 is commonly misunderstood. Many believe that it established a federal standard of acceptable noise emissions. It did not. Part 36 basically established the quietest uniform standard then possible, taking into account safety, economic reasonableness and technological feasibility. Many think it is a standard that all American aircraft must meet. It is not. Part 36 to date has been applicable only to newly manufactured aircraft and is not applicable to aircraft manufacturered before 1973. Nearly eighty percent of the present fleet is not obliged to and does not meet the Part 36 standard. Many think that it is an operating rule -- that is, that planes that do not meet it in daily operations may not fly. It is not. Part 36 applies to aircraft at the time of their manufacture, and does not apply at all to foreign-manufactured aircraft operated by foreign carriers.*

In addition to its regulatory authority over aircraft safety and noise, the FAA has long administered a program of federal grants-in-aid for airport construction and development. Through its decisions on whether to fund particular projects, the FAA has been able, to a degree, to insure that new airports or runways will be selected with noise impacts in mind. That indirect authority was measurably strengthened when in 1970 the Airport and Airway Development Act expanded and revised the FAA's grant-in-aid program for airport development and added environmental considerations to project approval criteria. 1976 Amendments to the 1970 Act have increased funding levels and provided new authority to share in the costs of certain noise abatement activities, but the ability of the FAA to provide financial assistance remains limited in terms of both percentage of project costs and the types of projects eligible for federal aid.

B. Legal Responsibilities of State and Local Governments

While the federal government's exclusive statutory responsibility for noise abatement through regulation of flight operations and aircraft design is broad, the noise abatement responsibilities of state and local governments through exercise of their basic police powers are circumscribed. The scope of their authority has been most clearly described in negative terms, arising from litigation over their rights to act.

The chief restrictions on state and local police powers arise from the exclusive federal control over the management of airspace. Local authorities long have been preempted by the federal assumption of authority in the area from prohibiting or regulating overflight for any purposes. That principle was found in 1973 to include any exercise of police power relating to aircraft operations in City of Burbank v. Lockheed Air Terminal, 411 U.S. 624 (1973). In the Burbank

* Annex 16 to the Chicago Convention provides an international noise certification standard.

case, the Supreme Court struck down a curfew imposed by the City in the exercise of its police power. The Court's reliance on the legislative history of section 611 and the 1972 amendments to it indicate that other types of police power regulation, such as restrictions on the type of aircraft using a particular airport, are equally proscribed. The Court, however, specifically excluded consideration of the rights of an airport operator from its decision.

There remains a critical role for local authorities in protecting their citizens from unwanted aircraft noise, principally through their powers of land use control. Control of land use around airports to insure that only compatible development may occur in noise-impacted areas is a key tool in limiting the number of citizens exposed to noise impacts, and it remains exclusively in the control of state and local governments. Occasionally, it is a power enjoyed by individual airport operators; some operators are municipal governments that can impose appropriate land use controls through zoning and other authority. But even where municipal governments themselves are operators, the noise impacts of their airports often occur in areas outside their jurisdiction. Other police power measures, such as requirements that noise impacts be revealed in real estate transactions, are also available to them. Finally, local governments have legal authority to take noise impacts into account in their own activities, such as their choice of location and design for new schools, hospitals, or other public facilities, as well as sewers, highways and other basic infrastructure services that influence land development.

C. Legal Responsibilities of Airport Proprietors

The responsibilities of state and local governments as airport proprietors are far less restricted. Under the Supreme Court decision in Griggs v. Allegheny County, 369 U.S. 84 (1962), proprietors are liable for aircraft noise damages resulting from operations from their airport. The proprietor, the court reasoned, planned the location of the airport, the direction and length of the runways, and has the ability to acquire more land around the airport. From this control flows the liability, based on the constitutional requirement of just compensation for property taken for a public purpose. The Court concluded: "Respondent in designing the Greater Pittsburgh Airport had to acquire some private property. Our conclusion is that by constitutional standards it did not acquire enough." The role of the proprietor described by the Court remains the same today.

But the proprietor's responsibilities do not end there. A three-judge district court observed in Air Transport Association v. Crotti, 389 F. Supp. 58 (N.D. Cal., 1975):

> "It is now firmly established that the airport proprietor is responsible for the consequences which attend his operation of a public airport; his right to control the use of the airport, is a necessary concomitant, whether it be directed by state police power or by his own initiative.... That correlating right of proprietorship control is recognized and exempted from judicially declared federal preemption by footnote 14 [of the Burbank opinion] . Manifestly, such proprietary control necessarily includes the basic right to determine the type of air service a given airport proprietor wants its facilities to provide, as well as the type of aircraft to utilize those facilities...."

The Crotti case upheld in part a California airport noise statute imposing noise abatement duties on airport proprietors and established the principle that a state statute could reach proprietors that are governmental agencies and hence arms of the state. The Burbank preemption rule thus has not extended to proprietors, except with respect to regulations that actually affect the flight of aircraft. The portion of the California statute struck down by the court provided for criminal sanctions against the operator of an aircraft that exceed a single-event noise standard on takeoff or landing, a clear interference with the FAA's control over flight operations in the navigable airspace.

The Crotti principle has recently been upheld in National Aviation v. City of Hayward, No. C-75-2279 RFP (N.D. Cal., July 13, 1976), a case in which an air freight company sought to enjoin a curfew on noisier aircraft imposed at the municipally owned Hayward Air Terminal in California. The court addressed squarely the legal issue of the rights of a proprietor and found that the curfew had not been preempted:

> [T]his court cannot, in light of the clear Congressional statement that the amendments to the Federal Aviation Act were not designed to and would not prevent airport proprietors from excluding any aircraft on the basis of noise considerations, make the same findings [as the Burbank Court] with respect to regulations adopted by municipal airport proprietors..." Slip opinion, 14, citing S. Rep. No. 1353, 90th Cong., 2d Sess., 6-7.

The court went on to indicate that the FAA had the authority to preempt such proprietor regulation, although it had not yet exercised it. The court also found that the ordinance, which required some of the plaintiff's aircraft to use another airport between 11 p.m. and 7 a.m., had an effect on interstate commerce, but that the effect was:

> "...incidental at best and clearly not excessive when weighed against the legitimate and concededly laudable goal of controlling the noise levels at the Hayward Air Terminal during late evening and morning hours." Slip opinion, 19.

The power thus left to the proprietor - to control what types of aircraft use its airports, to impose curfews or other use restrictions, and, subject to FAA approval, to regulate runway use and flight paths, is not unlimited. Though not preempted, the proprietor is subject to two important Constitutional restrictions. He first may not take any action that imposes an undue burden on interstate or foreign commerce and, second may not unjustly discriminate between different categories of airport users.

These limitations on the proprietor's control over the use of the airport have not been addressed by the Supreme Court, and it remains unclear the extent to which Constitutional limitations would prevent some of the restrictions that have been imposed or proposed by proprietors in recent years.

Our concept of the legal framework underlying this policy statement is that proprietors retain the flexibility to impose such restrictions if they do not violate any Constitutional proscription. We have been urged to undertake - and have considered carefully and rejected - full and complete federal preemption of the field of aviation noise abatement. In our judgment the control and reduction of airport noise must remain a shared responsibility among airport proprietors, users, and governments.

The legal framework with respect to noise may be summarized as follows:

1. The federal government has preempted the areas of airspace use and management, air traffic control, safety and the regulation of aircraft noise at its source. The federal government also has substantial power to influence airport development through its administration of the Airport and Airway Development Program.

2. Other powers and authorities to control airport noise rest with the airport proprietor - including the power to select an airport site, acquire land, assure compatible land use, and control airport design, scheduling and operations - subject only to Constitutional prohibitions against creation of an undue burden on interstate and foreign commerce, unjust discrimination, and inteference with exclusive federal regulatory responsibilities over safety and airspace management.

3. State and local governments may protect their citizens through land use controls and other police power measures not affecting aircraft operations. In addition, to the extent they are airport proprietors, they have the powers described in paragraph 2.

III. THE FEDERAL RESPONSE

Consistent with the legal principles set forth above, this section explains in greater detail the program we intend to implement and our reasons for adopting it.* The cornerstone of the federal program is the requirement that airplanes comply with Part 36 noise standards within six to eight years. This policy clarifies the relative responsibilities of all participants in achieving reduced aircraft noise exposure. The way in which the air carriers meet this requirement for particular types of aircraft will have substantial implications not only for noise reduction but also for other national objectives - energy conservation, employment, and export promotion - as well. Moreover, the effectiveness of any resource commitment which may be required to meet this standard is contingent upon complementary action by airport proprietors and local government, actions that will be encouraged with federal financial assistance, other incentives, grant conditions and technical assistance. Complementary federal action includes noise abatement procedures, research and development and stricter noise standards for new technologies. The complete comprehensive strategy to bring about substantially reduced noise impact on residential populations is set forth in the following federal action program.

A. Quieting the Air Carrier Fleet

1. Federal Regulation of Existing Aircraft

Federal action is required to ensure that commercial aircraft meet Part 36 noise levels within the next decade. The normal incentives of the private marketplace do not operate to achieve optimal noise reduction. Noise is an "external cost" of providing certain goods and services. In the case of aircraft noise, the recipient of the noise -- such as the resident under the flight path -- is most often not a party to the market transactions (e.g., the purchase and sale of aircraft and of aircraft passenger tickets) that result in the noise that affects him. The purchasers of aircraft service -- the aviation passengers -- are not necessarily the recipients of the aircraft noise, and therefore the provider of that service (the airline) does not have a normal market incentive to reduce noise. Because the market place does not compensate airport neighbors for noise damages, they may seek redress from the courts. However, law suits are an expensive, time consumming and uneven way of dealing with the problem, and damage payments may drain away scarce resources that could be applied to reducing noise impact.

Because there are important differences among the airplanes that do not meet Part 36, it is useful to consider them separately.

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* The projections set forth in this document are based on the best available data. We realize it is subject to continuing refinement and improvement.

A significant problem is posed by the older, four-engine models (707s, 720s, DC-8s) in the current fleet. These aircraft are, for the most part, powered by JT3D turbofan engines and impose the most severe noise insult on airport neighbors because they cause the noisiest single events (10 to 12 EPNdB over Part 36). They are perceived to be at least twice as loud as the new wide-body aircraft. They are particularly significant contributors to the overall noise level at major airports having serious noise problems.

Replacement or acoustic modification (retrofit) of these older four-engine jets must be given high priority. Acoustic modification or retrofit consists of the addition of quiet nacelles using sound absorbing material (SAM) that reduces significantly the noise levels of these four-engine aircraft to at least the Part 36 noise levels. This approach, however, is subject to the availability of retrofit kits and, has been shown to be somewhat fuel inefficient. Because of the environmental benefits of replacement, discussed below, retirement of most of these older aircraft is clearly preferable.

The older two- and three-engine aircraft (727s, 737s, DC-9s, BAC 1-11s, mainly powered by JT8D turbofan engines) are not as noisy on single events. But, because they are medium and short-range models, they take off and land more than four times as often per day as the long-range four-engine models. Since they are also more pervasive in our domestic system, they account for most of the air carrier operations (80 percent) nationwide.*

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* Scheduled Air Carrier Jet Operations**
Average Daily, 1975

Airplane Type	Number of Operations	Percent	Percent Meeting Part 36 Noise Standards
707/DC-8	2225	10	0
747	411	2	54
DC-10/L-1011	1340	6	100
727	9208	41	26
737/DC-9/BAC 1-11	9334	41	8
Total	22518	100	21

** An operation is a takeoff or a landing.

Although the technology to retrofit these JT8D aircraft is available, the resulting reductions in noise levels is not as large as the reductions for the JT3Ds. A modified JT8D airplane is significantly quieter than an unmodified JT8D airplane, especially on approach.* We estimate that the cost of retrofitting all of these airplanes will be about $223 million in 1976 dollars. Since most of these airplanes have a long remaining useful life, we anticipate that they will be modified rather than replaced.

Because of their larger numbers, more frequent operation, and more widespread use, the cumulative effect of reducing the noise of these JT8D aircraft is greater than that for the four-engine aircraft alone. By requiring that both the two/three- and the four-engine aircraft meet Part 36 noise levels, we will realize significantly greater reduction at the 25 largest air carrier airports at the time compliance is completed. Additionally, many more air carrier airports would benefit from quieting of the two- and three-engine airplanes. Without including the two- and three-engine jets, which constitute 70 percent of that part of the operating fleet that does not meet Part 36 and which account for 80 percent of the air carrier operations nationwide, 75 percent of the air carrier airports in the country would not receive any noise benefit and 85 percent would not receive any significant benefits.

There are also about 50 early 747s that do not meet Part 36 noise levels. Economics clearly make retrofit the logical alternative for these aircraft, which have a long remaining useful life, and a retrofit kit for modification of these aircraft has been included in later production versions of the 747.

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* Noise measurements taken during routine airline operations at airports in the New York City area showed that 727-200 aircraft with SAM retrofit treatment operated at 6.5 PNdB (estimated from dBD measurements) lower levels on approach than did 727-200 aircraft without retrofit.

The following table illustrates the comparative reductions expressed in EPNdB of the retrofit of those airplanes that do not meet FAR 36.

Aircraft	Condition	FAR 36 Limit	Non-Retrofit	Full Retrofit
707-320B	Takeoff	103.7	113.0	102.2
	Approach	106.3	116.8	104.0
	Sideline	106.3	102.1	99.0
DC-8-61	Takeoff	103.5	114.0	103.5
	Approach	106.2	115.0	106.0
	Sideline	106.2	103.0	99.0
727-200	Takeoff	99.0	101.2	97.5
	Approach	104.4	108.2	102.6
	Sideline	104.4	100.4	99.9
737-200	Takeoff	95.8	92.0	92.0
	Approach	103.1	109.0	102.0
	Sideline	103.1	103.0	103.0
DC-9	Takeoff	96.0	96.0	95.0
	Approach	103.2	107.0	99.1
	Sideline	103.2	102.0	101.0
747-100	Takeoff	108.0	115.0	107.0
	Approach	108.0	113.6	107.0
	Sideline	108.0	101.9	99.0

The following table provides an estimate of the numbers of airplanes to be modified acoustically or replaced. Also included are what the associated capital costs of retrofit would be if the turbofan-powered 707s and DC-8s are not retired or replaced earlier than they otherwise would have been as a result of the new federal regulation.

Airplane Type	Number to be modified	Average Cost (million $)	Total Cost (million $)	1975 Present Value (million $)
727	454	.225	102	60
737 & DC-9	448	.27	121	71
747	45	.25	11	6
707 & DC-8	270	1.2	324	159
TOTAL	1217		558	296

These costs are in constant 1975 dollars, and do not include any tax benefits or changes in operating costs. The present values were computed using a 10% discount rate before inflation. If changes in operating costs are also included, the 1975 present value costs increase to a total of $440 million. These operating cost increases are primarily the result of the increased fuel inefficiency of modified 707s and DC-8s and include the cost of an additional 320 million gallons of fuel which would be consumed by these airplanes.

2. Economic Benefits from a Mixed Replacement and Modification Program

Despite the arguments that the variables and projections are uncertain, cost-benefit analysis is a useful tool to compare means of reducing aircraft noise. Our analysis indicates that replacement of all JT3D aircraft and acoustic modification of the JT8D aircraft will yield positive net benefits of $350 million to the airlines* whereas altering the scenario by retrofitting the JT3D airplanes instead would cost them $440 million. The primary reasons for these differences are varying fuel consumption and maintenance costs.

A replacement program also produces many benefits that are difficult to calculate, but which would be significant.

- The noise benefit from replacing these jets with new aircraft or new technology will range from a 12 to 16 EPNdB improvement over current 707/720 and DC-8 airplanes.
- Replacement would offer substantial advantages in increased fuel efficiency over the 707/720 and DC-8, 20 percent with currently-available replacement models, and as much as 30 percent for the new-technology airplanes compared to a fuel penalty of approximately one percent for modified 707 and DC-8 airplanes.
- Replacement would provide aircraft that will meet the new, rigorous air pollutant emissions standards effective in 1979.

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* See the FAA benefit-cost study published as an attachment to the Final Environmental Impact Statement issued November 17, 1976.

- Replacement would strengthen the aerospace industry, stimulating the purchase orders to begin manufacture of aircraft of new design, which the airframe manufacturers cannot undertake now because of the lack of firm orders from their customers.

- Replacement would contribute to the development of aviation technologies for export. Aerospace products have been second only to agricultural products as the nation's leading exports. Foreign operators own over 500 JT3D airplanes for which U.S. replacements sized for many of the markets being served are not now available. Most of these airplanes would be replaced if a properly sized replacement were available.

- Replacement would provide many more jobs - each billion dollars in aircraft sales generates 60,000 job-years directly or indirectly in aerospace or related industries.

- Replacement would offer to the carriers the advantage of more economic aircraft configurations resulting from the application of advanced technologies. These include new aerodynamic concepts, lighter propulsion systems, improved safety from inflight control systems, and new structural materials. With enactment of regulatory reform, many of these economies would be reflected in the fares.

In light of these benefits, we believe that it would be economically preferable for the Nation if most of the four-engine aircraft are replaced with new technology aircraft.

3. Time Frame

Since some combination of replacement and retrofit is advantageous in bringing current airplanes into compliance with the noise standards of Part 36, we have considered what would be a reasonable time frame to require such action.

In establishing a deadline, we have been concerned with the length of time needed to develop, certificate, produce, and install retrofit kits for those airplanes for which the operators decide that retrofit is best. The manufacturers have indicated that it will take six years to complete retrofit of the 747s,

727s, 737, and DC-9s, six to eight years to complete the 707s and DC-8s, including kit production* and installation time.

Retrofit kits are currently certificated and ready for installation for the two- and three-engine aircraft and the 747s, and are being installed on those aircraft that are currently in production. It may take 28 months and 36 months, respectively, to design and certificate kits for the 707s and DC-8s, with fabrication and installation time to follow. Thus, time to fabricate the required number of kits, and to install them during refurbishment periods for fleet aircraft must govern the mandatory compliance periods. Given these considerations, we have concluded that aircraft should be required to meet Part 36 noise levels within certain time periods.

The Federal Aviation Administration will promulgate a rule requiring that subsonic jet airplanes in domestic** service with maximum weight in excess of 75,000 lbs., that do not meet the present Federal Aviation Regulations Part 36 noise levels, must meet those noise levels or be retired from the fleet within six to eight years in accordance with the phased-in schedule set forth on pages 5-6 of this policy statement.

These time periods, which are established on the basis of the time it would take to complete the development, production, and installation of retrofit kits for most of the existing fleet, will start to run on January 1, 1977. These time periods are also adequate to enable the development of new technologies for replacement of older, four-engine aircraft if adequate financing is available. Measures imposed by other jurisdictions that would require more accelerated compliance with Part 36 requirements would conflict with the purpose of this federal regulation.

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Airplane	From Production Decision to First Kit Delivery	Production Rate Ship Sets Per Month
707	2-1/3 yrs	22
DC-8	3 yrs	8.5
727	1-1/2 yrs	38
737	1-1/2 yrs	10
DC-9	1-3/4 yrs	15
747	1 yr	5

** Domestic service as used here includes flights to U.S. territories outside continental United States, generally classified as "overseas".

4. International Air Carriers

The United States will seek early agreement through the International Civil Aviation Organization (ICAO) on noise standards and an international schedule for compliance with Annex 16 or Part 36. In the event that agreement is not reached within three years, from January 1, 1977, then regulatory action will be taken to require all airplanes operated by all international operators to meet the noise level standards of Part 36 or Annex 16 during the five-year period thereafter at a phased rate of compliance similar to that established for domestic operations. The ultimate requirements applied to U.S. international flag carriers will not be any more stringent than those applied to foreign air carriers, because it would place the U.S. international flag carriers at a competitive disadvantage if they had to comply with the noise standards sooner than their foreign competition. Where U.S. air carriers serve both domestic and foreign routes, the delayed international requirements will be applied only for that percentage of total operations that are in international sevice. These requirements may be superseded by agreement reached through ICAO, in which the United States concurs and which does not discriminate against U.S. carriers.

B. Financing Mechanism

President Ford has instructed the Department of Transportation to promulgate rules to require that all aircraft in domestic service meet noise standards within eight years. He indicated at that time that he would again urge the Congress to enact his aviation regulatory reform measure to create an improved economic climate for the airline industry that would enable it to comply with these standards. He further directed the Secretary to begin public hearings promptly to assess whether additional financing assistance, if any, may be necessary to guarantee compliance with these standards within eight years.

At the public hearing, scheduled for December 1, 1976, we must first consider whether any financing arrangements at all are necessary. If there is persuasive evidence and documentation that such assistance is necessary, alternative financing proposals must be weighed against certain goals.

First, we would prefer that the costs of noise abatement be borne by users of air transportation, passengers and shippers. Any shift of that burden to the general public must be avoided. Second, enough financing must be available to enable the carriers to replace a significant portion of their noisy four-engine jets with a new generation

airplane but not so much financing as to encourage the purchase of excess capacity. Third, federal involvement in any financing mechanism should be limited and not disturb unduly the mechanism of the private capital markets, nor unreasonably constrain the flexibility of air carrier management in determining how to comply with the noise regulation. Fourth, the cost of transportation to the passenger and shipper should not be increased. Fifth, assuming the enactment of aviation regulatory reform, we should consider both the need for additional financing in the improved aviation economic environment that will emerge and the consistency of any proposal with a less regulated aviation system. Finally, we should consider and assess the additional benefits to the public that would accrue from a replacement program, and the accelerated production of new technology airplanes, and determine whether these benefits outweigh the cost of such a program.

To address these issues and hear recommendations from concerned parties, a public hearing will be conducted on aviation noise financing on December 1, 1976.

C. Additional Federal Action

1. Source Regulation for Future Aircraft

The development of jet engine noise source technology since the high-bypass ratio engine was first produced will allow further reduction of noise emissions from aircraft designed in the future. Therefore, FAA proposed to reduce the Part 36 noise levels for future design aircraft in NPRM 75-37 issued October 29, 1975. While recognizing that the full benefit of such a rule will not be felt until the next generation of aircraft enter regular service in substantial numbers, the FAA will soon complete its consideration of new, lower noise standards for future design aircraft. These standards will require that recent advances in noise suppression technology be employed if they are practicable, economically reasonable, and appropriate for the particular type of aircraft. These regulations would be applicable to all newly designed subsonic aircraft type certificated after the effective date of the regulation. The FAA plans to issue these regulations by March 1, 1977.

On September 30, 1976, the EPA submitted a proposed regulation to FAA on the subject of source regulation for future design aircraft. That proposal has been published by FAA as a notice of proposed rulemaking (41 F.R. 47358) and a public hearing will be held on December 14, 1976. The only difference between the FAA regulatory proposal and that of EPA is in the establishment of noise levels for aircraft designed for the 1980-1985 time period and beyond 1985 as well. While these EPA proposals are

being considered, the FAA believes it is important and prudent to establish lower noise levels for future designed aircraft and continue to analyze the technological developments to determine if even further reduced noise levels can be established.

In addition, the FAA is working through the International Civil Aviation Organization to obtain international agreement on noise standards which would make internationally established standards virtually identical to United States noise standards. This proposal was presented for public comment in the Federal Register on October 28, 1976, as NPRM 75-37C. Both of these important proposals and the comments received on them will be thoroughly considered and carefully analyzed before final action is taken.

The FAA has already established noise standards on the subject of noise produced by propeller driven airplanes. In developing those standards, the FAA received a number of suggestions from the EPA which were adopted and incorporated into the final rule. These included the use of six rather than four noise certification test overflights and the use of longer standard takeoff distances in calculating performance corrections. These suggested improvements were submitted to FAA in the course of FAA's rulemaking action on this subject and were subsequently included as part of a formal EPA noise regulatory proposal submitted to FAA. The proposed disposition of the EPA regulatory proposal has been forwarded by FAA to the EPA for consultation pursuant to the provisions of the Noise Control Act. The time for this consultation has been extended by FAA at the request of the EPA and therefore the FAA is deferring its final action on this proposal at this time at the request of the EPA.

Using information being acquired on a continuing basis from the Concorde demonstration, the FAA will act consistent with the statutory requirements to promulgate a noise rule applicable to supersonic aircraft not later than thirty days after the conclusion of the 16-month demonstration periods.

2. Aircraft Operating Procedures

Operational procedures for the control of aircraft departures and arrivals at airports can effectively complement the reduction of aircraft source noise emissions. For example, operational controls that apply reduced thrust settings near the ground augment the noise reduction achieved through retrofitting because with the sound absorbing material or "quiet nacelle" modification of the JT3D and JT8D aircraft the noise reduction achieved becomes more effective at lower thrust levels. It must be clearly understood that, although much can be gained by operational procedures, they are not alternatives to reducing noise at the source by replacing or retrofitting the noisier airplanes.

Many air traffic and airspace management operational procedures are now used at particular airports to meet their particular needs. For some airports, normal approach paths cover substantial residential populations (Los Angeles); others are partiuclarly sensitive to takeoffs (Miami). Where possible, approach paths are designed to avoid residential neighborhoods. At some airports, steep climbs are used on takeoff over water areas so that aircraft will be higher than they would be otherwise when they reach inhabited areas. Where aircraft must climb over residential areas, they often do so with reduced power in order to minimize excessive noise from greater engine thrust.

In addition to these measures, which are used at many airports, two standardized operational procedures have been under consideration by the FAA. One EPA approach proposal involved the development and implementation of the use of a two-segment landing approach path for aircraft. Briefly, that procedure entails the use of a steeper glide slope (e.g., 5 to 6^{0}) during the early stages of approach, followed by stabilization of the aircraft on the normal 3^{0} glide slope for final approach and touchdown. During the steeper portion of the approach, the aircraft is higher from the ground and requires less engine power, thus achieving noise reductions at more distance points from the airport on the approach pattern. However, this would not provide significant noise relief to persons living close to an airport and could exacerbate their problem since there would probably be an increase in power required as the aircraft changes configuration from the steeper glide slope to the reduced glide slope. Additionally, this procedure has an inherent safety problem related to the impact of aircraft wake vortices on aircraft flying a standard 3^{0} approach behind an aircraft utilizing a two-segment approach. Finally, this two-segment approach procedure could be applied at a limited number of airports because of limited equipment availability.

The second standardized approach procedure involves the use of minimum certificated flaps. This procedure was developed by FAA to abate airplane noise and then proposed by EPA as a regulatory action. Through the use of minimum certificated flaps during approach, aerodynamic drag is reduced, whereby less engine thrust is required. This has multiple advantages because reduced thrust results not only in a fuel saving but also a reduction in the source noise of the airplane over the entire approach phase, thereby providing a noise reduction along the entire approach path. Moreover, it is a procedure which can provide noise benefits at all rather than a limited number of airports. Because it is a stablized approach procedure, it reduces cockpit workload in that no transition is required

from a 6° to a 3° glide slope and the inherent potential wake vortex problem a serious safety problem for following aircraft of is eliminated. Final regulations and procedures on a noise abatement approach procedure will be issued by FAA by January 1, 1977.

Several opinions exist regarding the best noise abatement departure procedure following takeoff. The FAA requires that turbine-powered and large aircraft climb as rapidly as possible to 1500 feet above the ground. This procedure provides some noise relief by getting the noise source - the airplane - away from populated areas as rapidly as possible. FAA is in the process of evaluating different departure procedures which could be implemented after the 1500 foot altitude is reached. The issue is complicated by the fact that airports are unique in terms of their surrounding geography and adjacent land use. This means that there may be no single optimum noise abatement departure procedure.

The FAA currently recommends, in Advisory Circular 91-39, (January 18, 1974) a procedure that incorporates a reduction in engine power from takeoff thrust to normal climb power at an altitude of 1500 feet above ground level after takeoff with subsequent acceleration and climb after passing through 3000 feet by changing the deck angle and retracting the flaps. This procedure is generally used by scheduled air carriers. Northwest Airlines regularly uses a somewhat different departure procedure, in which the airplane is accelerated at takeoff power with an accompanying reduction in the deck angle and flap retraction followed by a larger power reduction than with the Advisory Circular procedure. Both procedures have merit in that both provide noise relief by reducing source noise through a reduction in engine power. The degree of perceived noise, however, depends on the location of noise sensitive areas beneath the departure path and the altitude and engine power of the airplane over those areas. The FAA expects to complete regulatory action on this subject by January 1, 1978.

Another operational rule under consideration involves possible restrictions on minimum altitudes in terminal areas by keeping airplanes high. Such restrictions would reduce the noise impact on the ground by maximizing the distance between the airplane and persons on the ground. This has been the FAA "Keep 'Em High" Program. A proposal on this subject to convert it from an air traffic management program to a regulatory requirement was submitted to the FAA by the EPA and was published in the Federal Register on January 6, 1975, as NPRM 75-40.

The design of each terminal area air traffic pattern is carefully constructed to meet the particular characteristics of the airport or airports encompassed within that terminal area. The runway configuration of the airport, character of the surrounding terrain,

proximity of other airports, the requirements to avoid when possible low altitude flight over communities when arriving or departing the airport, are among the many considerations that must be made in designing terminal area procedures. It is not feasible to develop a single rule that would be applicable to all terminal areas for all airports. Regulations, which are relatively difficult to change, could have a severe and far-reaching impact on the air traffic system in the flexibility required to adjust air traffic procedures to compensate for weather changes, traffic congestion and safety considerations. Regulatory action in this area would be unduly restrictive without achieving significant improvements in aircraft noise abatement since the proposed rules were not significantly different from the existing air traffic management program and would have adverse energy and economic impacts through increased flight time and increased fuel consumption.

The FAA concurs with the objective of the EPA proposed regulations, specifically to reduce the noise exposure on the ground. Through recent FAA studies of ways to improve the efficiency of the air traffic control system to conserve fuel, a new procedure has been developed which improves safety through reduced low altitude flying time, standardizes high performance aircraft arrival procedures, equalizes the arrival delays through regulating the traffic flow, and provides for departures to climb to cruise altitude unrestricted. These new procedures will soon be made final in an FAA Order on Local-Flow Traffic Management. The Order will apply to all airports where high performance aircraft operate. The existing "Keep-'Em-High" Order will be phased out as the provisions of the new Order are implemented. A substantial noise benefit can be realized through the implementation of the Local-Flow Traffic Management Order over those benefits achievable under the FAA "Keep-'Em-High" program or the EPA proposed minimum altitude regulatory proposal.

All of these operational procedures designed to provide noise relief have been the subject of a number of discussions with the EPA and have been the subject of formal consultation between the FAA, the EPA and the Secretary of Transportation. That consultation process has been completed and the FAA has taken final action to implement these operational procedures.

3. Federal Research and Development Technology

As is the case with most fields of technology, continuing research and development on aircraft noise is necessary to insure that advances in the state-of-the-art are available for each successive

generation of aircraft. Historically, there has been a ten-year lag in the aircraft industry between demonstration of new technology in the laboratory and the appearance of that technology in commercial airplanes. For example, the present generation of quieter wide-body airplanes, such as the 747, DC-10 and L-1011, which began to enter commercial service in 1970, applied quieter technology of the high-bypass ratio engine developed about 1960. Similarly, more advanced engine quieting technology, which is being developed today, cannot realistically be expected to enter commerical service for at least five to six years.

Aircraft noise is generated primarily by two major sources in the engines: the external turbulent jet exhaust and the internal compressors and combustion process. High-bypass ratio engines, such as the Pratt and Whitney JT9D, the General Electric CF-6 and the Rolls Royce RB-211 now used on the 747, L-1011 and DC-10 aircraft, reduce the primary jet exhaust velocity and thus reduce its noise At the same time, improved sound absorbing materials in the nacelle surrounding the engine absorb much of the internal noise produced by the compressors and the combustion process. Current technology in new engines, such as the Pratt and Whitney JT10D, and the General Electric CFM56, show potential for further reductions in engine noise levels through improved designs of the internal compressors which, if combined with more efficient wing design, and more effective control surfaces (flaps, spoilers, etc.) will require less engine thrust for safe flight, thereby providing further noise reductions.

It is expected that the technology for use in the next generation of commercial airplanes should provide further significant reductions below current noise standards. These will be evaluated carefully in considering both the applicability and scheduling of lower level requirements, such as proposed in NPRM 76-22.

A recent NASA analysis* has shown quite clearly that substantial long-term (through the year 2000) reductions in noise, fuel consumption, and aircraft emissions are achievable through the development and introduction of more advanced technology than that currently available. Realization of potential advantages through the extensive use of composite materials to reduce airframe weight, stability augmentation to reduce drag, and improved performance of advanced-technology engines such as the prop-fan will depend on the research and development necessary to demonstrate these factors. Such features can become available for service in the late 1980s, assuring continuing progress in aircraft quieting along with fuel economy, cleaner operation, and greater productivity.

* "Cost/Benefit Tradeoffs for Reducing the Energy Consumption of Commercial Air Transportation," NASA CR-137877, June 1976.

The federal government will continue to sponsor and support aviation research and development, in cooperation with the aviation industry. As engine noise levels are reduced, the aerodynamic noise from airflow over and around the airframe itself and its necessary appendages, especially at low altitudes, when flaps and landing gear are extended, may become the major approach noise source. Research on this noise source to determine how it may best be reduced is now underway and will continue.

D. Protecting the Airport Environment

There are over 13,000 public airports operated in the United States today and they vary considerably in size, proximity to populated areas and function as well as in the type and volume of operations. For example, only about 500 airports are fully certificated* by the FAA, while another 500 have limited certificates. Only 437 airports have an FAA air traffic control tower. American airports are also the busiest in the world; 84 airports have a total of over 200,000 annual operations,** while 160 airports have 150,000 or more annual operations. Busy airports are not only found in the larger metropolitan areas; while 244 airports have 100,000 or more annual operations, of these only 151 are located in large or medium hubs.*** Most of these operations are general aviation; only the top ranked 24 airports each have 100,000 or more annual air carrier operations.

The variety of airports in the United States demonstrates that an airport noise reduction strategy cannot be completely generalized. The problem must be approached on an airport-by-airport basis, and all levels of government and the private sector should act with the recognition that solutions to the noise problem must be designed to meet the needs of a particular airport environment.

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* Under section 612 of the Federal Aviation Act, 49 U.S.C. 1432, the FAA issues operating certificates to airports served by Civil Aeronautics Board certificated air carriers that the FAA finds "properly and adequately equipped and able to conduct a safe operation."

** An operation is a takeoff or a landing; a flight thus consists of two operations, one takeoff and one landing.

*** A "hub" is defined by the FAA as a city in a standard metropolitan statistical area, as defined by the Bureau of the Census, requiring air service.

1. The Airport Proprietor's Responsibility

Substantial benefits will be achieved through federal actions to abate source noise and control operational flight procedure and airspace, but much of the noise problem is airport-specific and must be addressed by individual proprietors. Noise impact at any airport is in part due to local decisions on airport location, continuation of airport operations on a particular site, the layout and size of and airport and the purchase of buffer areas for noise abatement purposes. It is local decision-making that permits residential development near an airport. For these reasons, the Supreme Court concluded that proprietors are liable for aircraft noise damages. In addition, airport proprietors, particularly those that are public agencies, generally encourage more service to their airports in Civil Aeronautics Board route proceedings.

The need for local action is apparent. Without effective land use planning, the implementation of land use plans and zoning, the benefits achievable from federal source noise reduction requirements could be greatly reduced. Where land use controls have not been imposed, the need for substantial airport land acquisition has increased, and as aircraft operations increase, the need for land acquisition as well as its cost will rise unless source noise levels are reduced.

The airport proprietor is closest to the noise problem, with the best understanding of both local conditions, needs and desires, and the requirements of the air carriers and others that use his airport. The proprietor must weigh the costs the airport and the community must pay for failure to act, and consider those costs against any economic penalties that may result from a decision to limit the use of the airport through curfews or other restrictions for noise abatement purposes.

FAA officials have and will continue to work with and assist airport operators and representatives of communities affected by airport noise to encourage the development of compatible land use controls. What constitutes appropriate land use control action depends on the proprietor's jurisdiction to control or influence land use. This, of course, varies with airport location. Almost all airport proprietors, however, are public agencies with a voice in the affairs and decisions of their respective communities. In some instances they have land use control jurisdiction and are required to document how they will exercise it before receiving federal airport development funds. In other instances, where they lack such direct control,

before receiving federal airport development funds they are required to demonstrate that they have used their best efforts to assure proper zoning or the implementation of other appropriate land use controls near the airport and will continue to do so. Although the airport proprietor may not have zoning authority, he is often the local party in the best position to assess the need for it and to press the responsible officials into action.

2. State and Local Government Responsibility

State and local governments are directly and uniquely responsible for ensuring that land use planning, zoning, and land development activities in areas surrounding airports is compatible with present and projected aircraft noise exposure in the area. They should work closely with airport proprietors in planning actions to be taken in confining serious aircraft noise exposure to within the airport boundary and reducing the number of people seriously affected by airport noise.

State and local governments should support airport land use acquisition programs developed by airport proprietors. As federal noise source regulations shrink the contours of cumulative noise exposure, local governments concurrently should develop complementary land use plans preventing residential development and other incompatible land use in areas adjacent to the airport. Now that the federal government has defined a program extending the application of Part 36 standards, the local authorities will be able to plan effectively on the basis of a reasonable set of assumptions about the shrinkage in noise contours that will occur as a result of the federal action.

State and local governmental agencies can improve the insulation of housing, schools, community facilities, institutions providing health services and public buildings in areas exposed to serious airport noise. To date, such action would have been prohibitively costly. To achieve a 3 to 7 dBA reduction in the level of noise heard inside buildings by insulation would currently cost $1.9 billion nationwide, while a reduction of 8 to 12 dBA would cost $3.8 billion, and a reduction of 13 to 16 dBA would cost $7.2 billion. Given a federal program to require compliance with Part 36, a housing insulation program becomes more manageable and far less expensive. State and local governments should therefore develop appropriate programs to insulate public buildings and to finance insulation by private residents. In this regard, the Department is under a mandate in the Airport

and Airway Development Act of 1976 to study the feasibility, practicality, and cost of insulating schools, hospitals, and public health facilities near airports and report legislative recommendations by July 1977. Local regulations should require proper insulation in the construction of new buildings and insulation of public and residential buildings. State and local governments should help finance the sound insulation of schools, hospitals, libraries, and other noise-sensitive public buildings.

Where appropriate, state and local governments should consider the development of new airport sites so that dense population areas will not be exposed to excessive noise and develop the necessary ground transportation to make them accessible. They should also require that notice of airport noise exposure be given to the purchasers of real estate and to prospective residents in areas near airports so that they will be aware of the problem. Finally, they should support improvements at existing airports which would help reduce the noise impact on surrounding communities.

3. Federal Support for Airport Proprietor and Local Government Noise Abatement Activities

The FAA has long encouraged planning to assure not only that airports will be adequate to provide the service required in the future but that prospective noise impacts are evaluated and minimized In the past this FAA policy has been implemented through three principal methods involving the Airport Development Aid Program (ADAP).

First, under section 16 of the Airport and Airway Development Act, the Secretary may approve a project only if he is satisfied that it is "reasonably consistent" with the plans of planning agencies for the development of the area in which the airport is located. A project may not be approved unless "fair consideration has been given to the interest of communities in or near where the project may be located." The Act further declares as national policy that the projects involving airport location, runway location or a major runway extension shall "provide for the protection and enhancement of the natural resources and the quality of environment of the Nation," and provides that when an airport or runway location or major runway extension will have adverse environmental effect, it may not be approved unless "no feasible and prudent alternative exists and that all possible steps have been taken to minimize such adverse effect." In addition, section 18(4) of that Act provides that among the conditions precedent to project approval are:

> appropriate action, including the adoption of zoning laws, has been or will be taken, to the extent reasonable, to restrict the use of land adjacent to or in the immediate vicinity of the airport to activities and purposes compatible with normal airport operations, including landing and takeoff of aircraft.

While the FAA does not and, in our judgment, should not have the power to control land use around airports throughout the United States, the grant of federal funds for airport development has been and will continue to be conditioned on the application of the foregoing principles.

Second, the FAA has awarded ADAP funds for the development of airport Master Plans. These plans contain an environmental analysis and planning elements to assure that the airport's noise impact is kept to a minimum.

Third, the recent Airport and Airway Development Act Amendments of 1976 (P.L. 94-353) authorize for the first time the use of federal airport development funds on projects designed to achieve noise relief. Specifically, section 11 of the Act now authorizes federal financing of land acquisition to insure compatibility with airport noise levels and the acquisition of noise suppression equipment. We will also seek an amendment of that Act which would authorize the use of ADAP funds for the purchase of noise monitoring equipment.

For the most part, these provisions have led the FAA to concentrate on noise abatement efforts in the context of capital investment. Less attention and financial commitment has been devoted by the federal government to the development by airport proprietors of broader and more comprehensive noise abatement plans. The increase in public concern about the airport noise problem now requires that affirmative federal action be taken beyond the evaluation of airport construction projects. Therefore, FAA is initiating a pilot project to encourage the preparation of comprehensive noise abatement plans by airport proprietors through the planning grant program of the Airport and Airway Development Act.

In formulating this policy to provide a financial incentive for airport noise abatement planning, FAA gave consideration to other alternatives including (1) requiring preparation of such plans by all airports certificated under section 612 of the Federal Aviation Act; (2) requiring the preparation of such plans by the busiest airports in the United States (for example, the top 100

airports by the number of operations); (3) requiring preparation of such plans as a prerequisite to imposition of an airport use restriction by FAA-certificated airports; (4) requiring preparation of such plans as a condition of awarding ADAP funds; and (5) encouraging preparation of such plans and review by FAA without providing federal financial support for this purpose. Although we are still open to further suggestions and comments, these proposals to make airport noise planning mandatory, or a condition of ADAP funding, or a prerequisite to the imposition of use restrictions by an airport proprietor were not adopted at this time because we have not had sufficient experience with this type of noise abatement planning by many airports that either may not have serious noise problems or may have already performed a comparable analysis*. Moreover, we strongly believe that airport proprietors have the incentives, the capacity, and the responsibility to undertake comprehensive noise abatement planning when it is needed, without detailed and duplicative federal oversight. We strongly urge them to do so. We will support them in this effort and provide technical and financial assistance where possible.

The FAA pilot comprehensive noise abatement planning program will have the following elements. Each year, to the extent that funds are available, FAA will award grants for not more than 25 plans on the basis of criteria including the quality of the proposal, the gravity of the noise problem afflicting the applicant airport and the likelihood that the development of such a plan will lead to the implementation of practicable noise abatement techniques of general value and applicability.

The objective of this policy is to promote a planning process through which the airport proprietor can examine and analyze the noise impact created by the operation of his airport as well as the costs and benefits associated with various selected alternative noise reduction techniques, individually and/or in combination. FAA personnel will support and cooperate with this effort through consideration of actions which they can take to reduce noise impacts.

Although FAA has not prescribed particular performance requirements for noise abatement plans funded under this program, the goal of the airport noise planning process should be to eliminate insofar as possible severe aircraft noise exposure and to reduce as much as possible significant aircraft noise exposure in communities adjacent to airports. The objective of airport noise

* In reaching this conclusion, the FAA considered public comments received in response to the July 9, 1975, notice (40 F.R. 28844) and testimony at public hearings held in 25 cities throughout the nation on Airport Noise Policy.

plans prepared under this policy should be to develop noise reduction techniques which, to the maximum extent feasible, confine severe aircraft noise exposure levels, levels of 40 NEF or more, to areas included within the airport's boundary. For areas adjacent to an airport exposed to significant aircraft noise levels of 30 NEF or more, the objective of the airport noise plan should be to develop noise reduction techniques that to the extent possible would confine the area exposed to this level of noise to the airport boundary or land actually being used or which can reasonably be expected to be used in a way compatible with these noise levels.

The Environmental Protection Agency was provided draft copies of this Policy Statement, and a number of informal discussions were held on the FAA's proposed airport policy as it was being developed. The EPA has advised FAA that it considers the FAA's policy a step forward in this area, although it believes further steps are necessary. On October 26, 1976, EPA proposed a regulation under section 611 of the Federal Aviation Act that would require all airports in the United States serving certificated air carriers to develop airport noise abatement plans by July 1979. These plans, developed according to a common methodology and with extensive public participation, would be submitted to the FAA. Unless disapproved by the FAA, each plan would become a part of the airport's operating certificate issued under section 612 of the Act. The EPA proposal, like ours, has as its objective the bringing together of all interested parties with their respective authorities and obligations, thereby facilitating the creation of an agreed-upon abatement plan especially suited to the individual airport location. The EPA proposal has been sent to the Federal Register for publication, and will be the subject of public hearings on January 17 and 18, 1977. On the basis of these hearings and other analysis, the FAA will determine what revisions of the airport policy enunciated in this document are necessary, if any.

In developing an airport noise control plan, the airport proprietor may wish to consider the following categories of action:

a. Actions that the airport proprietor can implement directly:

(1) location of engine run-up areas;

(2) time when engine run-up for maintenance can be done;

(3) establishment of landing fees based on aircraft noise emission characteristics or time of day.

b. Actions that the airport proprietor can implement directly if he has authority, or propose to other appropriate local authorities:

(1) plan and control of land use adjacent to the airport by zoning or other appropriate land use controls, such as utility expenditures and the issuance of building permits;

(2) enact building codes which require housing and public buildings in the vicinity of airports to be appropriately insulated; and

(3) require appropriate notice of airport noise to the purchasers of real estate and prospective residents in areas near airports.

c. Actions that the airport proprietor can implement directly in conjunction with other appropriate local authorities and with financial assistance from the FAA, where appropriate:

(1) acquire land to insure its use for purposes compatible with airport operations;

(2) acquire interests in land, such as easements or air rights, to insure its use for purposes compatible with airport operations;

(3) acquire noise suppressing equipment, construction of physical barriers, and landscape for the purpose of reducing the impact of aircraft noise; and

(4) undertake airport development, such as new runways or extended runways, that would shift noise away from populated areas or reduce the noise impact over presently impacted areas.

d. Actions that the airport proprietor can propose to FAA for implementation at a specific airport as operational noise control procedures:

(1) a preferential runway use system;

(2) preferential approach and departure flight tracks;

(3) a priority runway use system;

(4) a rotational runway use system;

(5) flight operational procedures such as thrust reduction or maximum climb on takeoff;

(6) higher glide slope angles and glide slope intercept altitudes on approach; and

(7) displaced runway threshold.

e. Actions an airport proprietor can establish, after providing an opportunity to airport users, the general public and to FAA to review and advise:

(1) restrictions on the use of or operations at the airport in a particular time period or by aircraft type, such as:

(a) limiting the number of operations per day or year;

(b) prohibiting operations at certain hours - curfews;

(c) prohibiting operation by a particular type or class of aircraft; and

(2) any combination of the above.

f. Actions an airport proprietor can propose to an airline:

(1) Shifting operations to neighboring airports.

(2) Rescheduling of operations by aircraft type or time of day.

The existence, operation and development of an airport provides a service to and is interrelated with both the local community and airport users. These are also the parties who would be most directly affected by the airport operator's noise control plan. We therefore consider it vital that these parties have the opportunity to take part in the planning process. As a condition of FAA noise abatement planning grants, the airport proprietor will be required to provide for reasonable public notice of the plan and provide an opportunity for public participation in the development of the proposed plan. Public notice should describe the plan, the actions proposed, the reasons why these actions are proposed, alternative courses of action considered and why these alternatives were rejected. The FAA also encourages other means of involving the public, both formal and informal, to ensure meaningful public participation in the process.

The FAA will maintain communications with all airports involved in noise abatement planning -- whether or not FAA-funded -- and provide technical advice on the current state-of-the-art in airport noise reduction planning methods that have been successfully used throughout the country. This will include technical information regarding noise reduction and land use planning and guidance on procedures that airports may choose to consider in developing their plans. The FAA and other federal agencies, such as the Department of Housing and Urban Development and the Environmental Protection Agency, may suggest technical methodologies and criteria for land use compatibility that airports and affected local units of government may choose to utilize in their noise reduction planning. Federally funded model noise abatement plans will be monitored and evaluated. Information about successful noise abatement techniques will be disseminated by the FAA to all interested airport proprietors. The FAA will evaluate the model noise abatement planning program as well as the EPA proposal of October 26, 1976, to the FAA and the public comments on it at the conclusion of twenty-four months in order to determine whether broader noise abatement planning requirements should be encouraged or required.

4. FAA Review of Proprietary Use Restrictions

While the airport proprietor is best situated to judge the local noise problem and to determine how to respond to it, he is not always in the best position to judge the impact of his noise reduction proposal on the national and international air transportation systems. Because of the intricacy of those systems, use restrictions at a single airport could, under certain circumstances, cause wide-spread disruption throughout those systems. Pursuant to the general federal interest in the free flow of interstate and foreign commerce, the constitutional principle that states and local entities may not impose undue burdens even where Congress or federal agencies have not acted, and the specific FAA responsibility for regulating the air navigation system, the federal government has the obligation to assure that airport proprietor actions to meet local needs do not conflict with national and international purposes. The proprietor's obligations to refrain from imposing an undue burden on interstate or foreign commerce or discriminating unjustly, and to avoid potential conflicts with the FAA's control of airspace and air traffic, are not difficult to articulate as matters of principle but very difficult to apply to a given factual situtation.

As noted above in the discussion of FAA's program to fund airport noise abatement plans, airport proprietors may propose so-called "use restrictions" or "operating procedures" as the

solution to an aircraft noise problem. Operating procedures, by their very nature, require implementation by the FAA. Indeed, the FAA, on its own initiative, has investigated and applied a number of operating procedures aimed at noise abatement, and has several others under consideration. In the future, where an airport proprietor proposes operating procedures to the FAA as a means of achieving noise relief, the FAA will review them to determine if they may be implemented without creating a safety hazard or significantly affecting the effecient use and management of the navigable airspace. If they are acceptable, the FAA will adopt and take appropriate steps to implement them.

The decision to propose a use restriction rests initially with the airport proprietor. It is expected that airport proprietors will consult and review such proposals with all the air carriers, other airport users and the FAA before any use restrictions are established. Here it is the role of the FAA to review those use restriction proposals and provide advice to the airport proprietor on his proposed actions. By this advice, the FAA will attempt to ensure that uncoordinated and unilateral restrictions at various individual airports do not work separately or in combination to create an undue burden on interstate or foreign commerce, unjustly discriminate or conflict with FAA's statutory regulatory authority.

For these reasons, all airport proprietors serving scheduled air carriers should apprise the Federal Aviation Administrator of their proposal to impose an airport use restriction. Such notification should be made a reasonable time in advance of the date the restriction is to go into effect. In all cases, notification of a proprietary use restriction should occur after and be accompanied by a detailed description of the alternative noise reduction techniques the proprietor has considered and the reasons supporting the adoption of the restriction in question instead of any other alternatives. The FAA will review all such use limitations submitted, advise the airport proprietor if it believes the limitation in question is or is not unjustly discriminatory or detrimental to the national air transportation system.

This review procedure is vital to the maintenance of harmonious relations between airport operators, air carriers and the FAA. By giving the FAA timely notification of use restrictions, supported by a thorough analysis of the alternative courses that have been considered, airport proprietors can assure FAA support, which may be necessary to administer the restriction in question successfully and which will prove valuable in any litigation which may ensue. If litigation over use restrictions does occur, the FAA will in appropriate cases ask the Justice Department to intervene or file amicus curiae in support of use

restrictions it considers valid. On the other hand, an airport proprietor that imposes a use restriction without analyzing alternatives and consulting with FAA cannot expect FAA to provide expert advice or to support its policies. The FAA will not endorse any proposed use restriction that has not had prior review, including public and airport user review as well as FAA review, nor will it recognize as valid any such restrictions that as a result of FAA review are considered to be unjustly discriminatory or a significant disruption of the air transportation system of the United States. In the latter case, the United States may institute or support litigation challenging an unacceptable use restriction.

E. Private Sector Responsibility

Air Carriers are responsible for assuring that the required portion of their operating fleets meet Part 36 noise levels within the time period required by federal regulations. Within that period it is also the carriers' responsibility to assure that an efficient and effective noise reduction plan is established that covers the retirement or retrofit of aircraft not meeting Part 36 as well as the operation of those aircraft in a manner designed to minimize their impact on noise sensitive communities. To this end, air carriers should attempt to schedule the operations of noncomplying airplanes into airports that do not have noise problems.

Air carriers can enter into agreements with airport operators to minimize the impact of aircraft noise through limitations on aircraft use. These agreements, in certain cases, will be subject to FAA review and advice. The carriers should also fly their airplanes on schedules utilizing appropriate noise abatement operating procedures designed to minimize noise impacts.

Air travelers generally should bear the cost of noise reduction, consistent with sound economic principle and federal policy of internalizing the adverse environmental consequences in the price of a service or product.

Residents and prospective residents in areas surrounding airports should seek to understand the noise problem and what steps can reasonably be taken to minimize its effect on people. Recognizing that individual and community responses to aircraft noise differ substantially and that for some individuals, the reduced level of noise resulting from the implementation of this policy may not eliminate the annoyance or irritation. Prospective residents considering moving into airport and noise impacted areas should be aware of the effect of noise on their quality of life.

CONCLUSION

Aircraft noise abatement is a complex and controversial issue. In the wealth of information about the subject and midst the labyrinth of jurisdictional responsibilities, there are a few simple thoughts that should not be forgotten. In a society in which we are making rapid strides to improve the quality of life for all of our people, the continuing annoyance and irritation of excessive aircraft noise is an unwarranted intrusion upon the lives of some six million Americans. The federal government remains committed to taking all technologically feasible and economically reasonable actions to reduce excessive aircraft noise at its source and, working with airport proprietors, to reduce its impact on people.

It is clear, however, that the only successful attack that can be launched on this problem is one that involves the cooperative participation of all levels of government--state, federal and local--as well as airport operators, air carriers, aeronautical manufacturers, and airport neighbors. Only if each of these parties performs all the functions for which it is uniquely suited will we achieve significant and lasting progress in reducing both the number of people exposed to serious levels of aircraft noise and the severity of noise exposure for each and every American.

Although federal action to reduce the noise levels of operating aircraft has been long in coming, we hope that the time has enabled us to develop a policy which will work and will result in less noise exposure over the longer term as well as provide immediate relief. By the actions set forth in this policy, including those directed by the President, we are exercising those federal responsibilities that the Congress has required of us. We have set forth a federal action plan for the future so that other essential parties in the noise reduction effort can take complementary action and make their plans with a clear understanding of what the federal government has done and intends to do. Finally, we have set forth what we believe to be the responsibilities of other parties--airport operators, industry and local government-since the effectiveness of the federal action we take today is contingent on what these other parties do.

We thus invite these other parties to consult with us about their plans and proposals, to suggest innovative ways of meeting the noise problem in their communities, and to tell us how we can do our job more effectively. In turn, we will not hesitate to advise local governments and airport proprietors that they must exercise control over land use development and acquire additional land around airports to ensure that the national objective of confining severe aircraft noise to within the airport boundary is achieved. Nor will we hesitate to inform the air carriers and aeronautical manufacturers what this policy requires of them.

Working together, in the spirit of close cooperation and open communication, we will bring about quieter skies for all American citizens.

APPENDIX 8-8

FAA ORDER 8400.9

ZR-FAA03-084

ORDER DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

3400.9

11/9/81

SUBJ: NATIONAL SAFETY AND OPERATIONAL CRITERIA FOR RUNWAY USE PROGRAMS

1. PURPOSE. The purpose of this order is to provide safety and operational criteria for runway use programs. These criteria are applicable to all runway use programs developed for turbojet aircraft. This order provides parameters in the form of safety and operational criteria which must be used in the evaluation and/or approval of runway use programs.

2. DISTRIBUTION. This Order is distributed to selected offices in Washington and Regional Headquarters, Mike Monroney Aeronautical Center, and FAA Technical Center; Air Traffic Field Offices and Facilities; General Aviation and Air Carrier District Offices, Flight Standards District Offices, Flight Inspection District Offices, Field Offices and Groups, Airports District Offices, and interested aviation public.

3. BACKGROUND.

a. FAA has responsibility to provide the public right of freedom of transit through the navigable airspace of the United States and to regulate air commerce in such a manner as to best promote its development. FAA also has the responsibility for, and must maintain a detailed knowledge of, the safe operation of aircraft at our nation's airports. A primary function of this responsibility is determining under what conditions flight operations may be conducted without causing a degradation of safety.

b. Under ideal conditions aircraft takeoffs and landings should be conducted into the wind. However, other considerations such as delay and capacity problems, runway length, available approach aids, noise abatement, and other factors may require aircraft operations to be conducted on runways not directly aligned into the wind.

c. The Aviation Noise Abatement Policy of 1976 and Order 1050.11, Noise Control Plans, identify airport proprietors as responsible for taking the lead in local aviation noise control plans. Accordingly, airport proprietors may propose specific noise abatement programs to the FAA. Order 1050.11 assigns FAA responsibilities in relation to noise control plans. It requires the Air Traffic Service to "Provide guidance and administer programs for aircraft noise abatement procedures. . . ." Further, it requires that the Office of Flight Operations "Evaluate and make decisions in conjunction with the regional offices, as appropriate, concerning safety factors for flight operational procedures. . . ." The criteria in this order

Distribution: ZFS-840; ZAT-710 (minus field facilities); A-FAT-2,3,4,5,6,8 (STD); A-FFS-1,2,4,7 (STD); A-FAS-1 (STD)
Initiated By: AFO-210/AAT-320

...ll be utilized by Flight Standards personnel in evaluating the safety of proposed programs and by Air Traffic personnel in administering Formal and Informal Runway Use Programs.

d. This order is not intended to restrict a pilot's use of the full certificated capability of an aircraft. This order also does not limit a pilot in the use of instrument approach procedures or any other such factors. Applicable FAR's, flight and operations manuals and advisory material address the necessary safety aspects of aircraft operations for pilots and aircraft operators.

4. EFFECTIVE DATE. January 1, 1982.

5. DEFINITIONS.

a. Runway Use Programs. A noise abatement runway selection plan designed to enhance noise abatement efforts with regard to airport communities for arriving and departing aircraft. These plans are developed into runway use programs and apply to all turbojet aircraft 12,500 pounds or heavier; turbojet aircraft less than 12,500 pounds are included only if the airport proprietor determines that the aircraft creates a noise problem. Runway use programs are coordinated with FAA offices as outlined in Order 1050.11. Safety criteria used in these programs are developed by the Office of Flight Operations. Runway use programs are administered by the Air Traffic Service as "Formal" or "Informal" programs.

b. Formal Runway Use Program. An approved noise abatement program which is defined and acknowledged in a Letter of Understanding between Flight Standards, Air Traffic Service, the airport proprietor and the users. Once established, participation in the program is mandatory for aircraft operators and pilots as provided for in FAR Section 91.87.

c. Informal Runway Use Program. An approved noise abatement program which does not require a Letter of Understanding and participation in the program is voluntary for aircraft operators/pilots.

6. RESPONSIBILITIES.

a. Terminal Facility Chiefs.

(1) Provide technical assistance upon request of the airport proprietor in developing a runway use program.

(2) Before any runway use program is implemented, ensure coordination with, and encourage participation in the development of the program by the airport proprietor, the local community, and aircraft operators who regularly use the airport.

(3) Forward the completed runway use program to the Regional Air Traffic Division for review, further intra-agency coordination, and approval.

b. Regional Air Traffic Division.

(1) Review and coordinate all runway use programs with the regional Flight Standards and Airports Divisions, and the appropriate office for environmental/noise matters. When necessary as outlined in paragraph 8 of this order, or if concurrence cannot be reached within the region, forward the program with comments to the Air Traffic Service, AAT-1, for final approval.

(2) Upon completing proper coordination, return the runway use program to the facility with approval or disapproval and rationale.

(3) Maintain a current status of all runway use programs and periodically review for accuracy and completeness in accordance with this directive.

c. Regional Flight Standards Division. Coordinate with the regional Air Traffic Division on all runway use programs and review them for compliance with the criteria in this order. If the program is within the criteria of this order, return it to the Air Traffic Division with concurrence and supporting rationale. If it is not within the criteria in this order, return it to the Air Traffic Division with nonconcurrence and rationale. If a waiver is requested in accordance with paragraph 8, perform a safety analysis to evaluate the proposed alternate criteria and return the program to the Air Traffic Division with concurrence or nonconcurrence, recommendations, and supporting rationale (see Appendix 2).

7. OPERATIONAL SAFETY CRITERIA FOR RUNWAY USE PROGRAMS. Except as provided for in paragraph 8, the following criteria shall be applied to all runway use programs:

a. Wind Shear or Thunderstorms. There should be no significant wind shear or thunderstorms which affect the use of the selected runway(s) such as:

(1) That reported by an operating Low Level Wind Shear Alert System (LLWSAS), or

(2) Pilot report (PIREP) of wind shear, or

(3) No thunderstorms on the initial takeoff departure path or final approach path (within 5 nm) of the selected runway(s).

b. Visibility. In order to utilize landing runways associated with a runway use program, the reported visibility shall not be less than one statute mile (runway visual range [RVR] 5000).

c. Runway Braking Effectiveness. There should be no snow, slush, ice or standing water present or reported (other than isolated patches which do not impact braking effectiveness) on that width of the applicable runway or stopway (overrun) to be used. Braking effectiveness must be "good" (e.g., not "fair," "poor," or "nil") and no reports of hydroplaning or unusual slippery runway surfaces (e.g., as may occur on ungrooved new pavement or contaminated surfaces).

d. Winds.

(1) Clear and Dry Runways.

(a) Unless a greater crosswind component is approved by the applicable Flight Standards office considering local weather factors, facilities and characteristics of aircraft normally using the facility, the crosswind component for the selected runway (including gust values) must not be greater than 20 knots (Appendix 1, Table 1).

(b) Except for (c) below, the tailwind component must not be greater than 5 knots (Appendix 1, Table 4).

(c) Where anemometers are installed near the touchdown zone of the candidate runway for landings, or near the departure end for takeoffs, any tailwind component must not be greater than 7 knots (Appendix 1, Table 3).

(2) Runways Not Clear or Not Dry.

(a) The crosswind component (including gust values) must not exceed 15 knots (Appendix 1, Table 2), and

(b) No tailwind component may be present except the nominal range of winds reported as calm (0-3 knots) may be considered to have no tailwind component.

(c) Unless otherwise approved by the applicable FAA Flight Standards office based on runway available and field lengths required for aircraft normally using the runway, the runway must be grooved or have a porous friction course surface.

e. Other Safety Factors. Factors peculiar to a specific airport must also be considered to the extent that they have been identified. These factors may include: runway length, runway gradient, aircraft type and performance characteristics, approach aids, etc.

8. WAIVERS. When necessary to accommodate unique site-specific situations, requests for waivers to the criteria contained in this order shall be submitted with justification, a safety analysis, and supporting data to AAT-1 who shall coordinate with AFO-1 for concurrence before granting final approval.

9. APPLICABILITY.

a. This order applies to FAA personnel who may be called upon to advise, evaluate, or coordinate on specific noise abatement plans for runway use programs for particular airports.

b. This order does not require development or use of a runway use program where such a program has not been used or is not needed.

J. Lynn Helms
Administrator

APPENDIX 1. TABLE OF MAXIMUM WIND VALUES

The following table illustrates the maximum components for wind directions in 10-degree increments relative to a runway. No headwind component limitation is stated because strong headwinds would dictate use of a runway aligned into the wind due to the crosswind limitation. Velocity values are rounded down to the nearest whole number.

CROSSWIND COMPONENT TABLE 1
(DRY RUNWAY)

Wind Angle (Degrees) From Runway Heading	Wind Velocity (Knots)
10	114
20	58
30	40
40	31
45	28
50	26
60	23
70	21
80	20
90	20

CROSSWIND COMPONENT TABLE 2
(RUNWAY NOT DRY)

Wind Angle (Degrees) From Runway Heading	Wind Velocity (Knots)
10	86
20	44
30	30
40	23
45	21
50	19
60	17
70	16
80	15
90	15

TAILWIND COMPONENT TABLE 3
(WITH ANEMOMETERS)
DRY RUNWAY

Wind Angle (Degrees) From Runway Heading	Wind Velocity (Knots)
100	20
110	20
120	14
130	10
135	9
140	9
150	8
160	7
170	7
180	7

TAILWIND COMPONENT TABLE 4
(WITHOUT ANEMOMETERS)
DRY RUNWAY

Wind Angle (Degrees) From Runway Heading	Wind Velocity (Knots)
100	20
110	14
120	10
130	7
135	7
140	6
150	5
160	5
170	5
180	5

APPENDIX 2. EVALUATION OF REQUESTS FOR WAIVERS

When reviewing waiver requests in accordance with paragraph 8 of the order, Flight Standards personnel must consider the operational impact of the following factors when providing a safety analysis to support alternate criteria:

a. Are there significant occurrences of wind shear or thunderstorms?

b. Is a low level wind shear alert system (LLWSAS) installed?

c. Do runways significantly exceed critical field length for aircraft commonly using the airport?

d. Are runways grooved or do they have a porous friction course surface?

e. Are precision approach aids available to these runways?

f. Is a VASI present if these runways require a nonprecision approach?

g. Are 2 transmissometers installed?

h. Is runway slope a factor? If so, does it impact aircraft performance?

i. Is Maximum Brake Energy V_{MBE} a factor? If so, does it impact aircraft performance?

APPENDIX 8-C

PART 91 SUBPART E

one pilot station. The authorization contains any conditions that the Administrator finds necessary for safe operation.

(c) No person may designate a pilot to serve as second in command nor may any pilot serve as second in command of an airplane required under this section to have two pilots, unless that pilot meets the qualifications for second in command prescribed in § 61.56 of this chapter.

§ 91.215 Flight attendant requirements.

(a) No person may operate an airplane unless at least the following number of flight attendants are on board the airplane:

(1) For airplanes having more than 19 but less than 51 passengers on board—one flight attendant.

(2) For airplanes having more than 50 but less than 101 passengers on board—two flight attendants.

(3) For airplanes having more than 100 passengers on board—two flight attendants plus one additional flight attendant for each unit (or part of a unit) of 50 passengers above 100.

(b) No person may serve as a flight attendant on an airplane when required by paragraph (a) of this section, unless that person has demonstrated to the pilot in command that he is familiar with the necessary functions to be performed in an emergency or a situation requiring emergency evacuation and is capable of using the emergency equipment installed on that airplane for the performance of those functions.

[§ 91.217 [Reserved.]]

[§ 91.219 [Reserved.]]

Subpart E—Operating Noise Limits

§ 91.301 Applicability; relation to Part 36.

(a) This subpart prescribes operating noise limits and related requirements that apply, as follows, to the operation of civil aircraft in the United States:

(1) Sections 91.302, 91.303, 91.305, 91.306, and 91.307 apply to civil subsonic turbojet airplanes with maximum weights of more than 75,000 pounds and—

(i) If U.S. registered, that have standard airworthiness certificates; or

(ii) If foreign registered, that would be required by this chapter to have a U.S. standard airworthiness certificate in order to conduct the operations intended for the airplane were it registered in the United States.

Those sections apply to operations to or from airports in the United States under this Part and Parts 121, 123, 125, 129, and 135 of this chapter.

(2) Section 91.308 applies to U.S. operators of civil subsonic turbojet airplanes covered by this subpart. That section applies to operators operating to or from airports in the United States under this Part and Parts 121, 123, 125, and 135 but not to those operating under Part 129 of this chapter.

(3) Sections 91.302, 91.309 and 91.311 apply to U.S. registered civil supersonic airplanes having standard airworthiness certificates, and to foreign registered civil supersonic airplanes that, if registered in the United States, would be required by this chapter to have a U.S. standard airworthiness certificate in order to conduct the operations intended for the airplane. Those sections apply to operations under this Part and under Parts 121, 123, 125, 129, and 135 of this chapter.

(b) Unless otherwise specified, as used in this subpart "Part 36" refers to 14 CFR Part 36, including the noise levels under Appendix C of that Part, notwithstanding the provisions of that Part excepting certain airplanes from the specified noise requirements. For purposes of this subpart, the various stages of noise levels, the terms used to describe airplanes with respect to those levels, and the terms "subsonic airplane" and "supersonic airplane" have the meanings specified under Part 36 of this chapter. For purposes of this subpart, for subsonic airplanes operated in foreign air commerce in the United States, the Administrator may accept compliance with the noise requirements under Annex 16 of the International Civil Aviation Organization when those requirements have been shown to be substantially compatible with, and achieve results equivalent

to those achievable under, Part 36 for that airplane. Determinations made under these provisions are subject to the limitations of § 36.5 of this chapter as if those noise levels were Part 36 noise levels.

(c) [Reserved]

§ 91.302 Part 125 operators: designation of applicable regulations.

For airplanes covered by this subpart and operated under Part 125, the following regulations apply as specified:

(a) For each airplane operation to which requirements prescribed under this subpart applied before November 29, 1980, those requirements of this subpart continue to apply.

(b) For each subsonic airplane operation to which requirements prescribed under this subpart did not apply before November 29, 1980, because the airplane was not operated in the United States under this Part or Part 121, 123, 129, or 135, the requirements prescribed under §§ 91.303, 91.306, 91.307, and 91.308 of this subpart apply.

(c) For each supersonic airplane operation to which requirements prescribed under this subpart did not apply before November 29, 1980, because the airplane was not operated in the United States under this Part or Part 121, 123, 129, or 135, the requirements of §§ 91.309 and 91.311 of this subpart apply.

(d) For each airplane required to operate under Part 125 for which a deviation under that Part is approved to operate, in whole or in part, under this Part or Parts 121, 123, 129, or 135, notwithstanding the approval, the requirements prescribed under paragraphs (a), (b), and (c) of this section continue to apply.

§ 91.303 Final compliance: subsonic airplanes.

Except as provided in §§ 91.306 and 91.307, on and after January 1, 1985, no person may operate to or from an airport in the United States any subsonic airplane covered by this subpart, unless that airplane has been shown to comply with Stage 2 or Stage 3 noise levels under Part 36 of this chapter.

§ 91.305 Phased compliance under Parts 121, 125, and 135: subsonic airplanes.

(a) *General.* Each person operating airplanes under Parts 121 or 135 of this chapter, or under Part 125 of this chapter, as prescribed under § 91.302 of this subpart regardless of the State of registry of the airplane, shall comply with this section with respect to subsonic airplanes covered by this subpart.

(b) *Compliance schedule.* Except for airplanes shown to be operated in foreign air commerce under paragraph (c) of this section or covered by an exemption (including those issued under § 91.307), airplanes operated by U.S. operators in air commerce in the United States must be shown to comply with Stage 2 or Stage 3 noise levels under Part 36, in accordance with the following schedule, or they may not be operated to or from airports in the United States:

(1) By January 1, 1981:

(i) At least one quarter of the airplanes that have four engines with no bypass ratio or with a bypass ratio less than two.

(ii) At least half of the airplanes powered by engines with any other bypass ratio or by another number of engines.

(2) By January 1, 1983:

(i) At least one half of the airplanes that have four engines with no bypass ratio or with bypass ratio less than two.

(ii) All airplanes powered by engines with any other bypass ratio or by another number of engines.

(c) *Apportionment of airplanes.* For purposes of paragraph (b) of this section, a person operating airplanes engaged in domestic and foreign air commerce in the United States may elect not to comply with the phased schedule with respect to that portion of the airplanes operated by that person shown, under an approved method of apportionment, to be engaged in foreign air commerce in the United States.

§ 91.306 Replacement airplanes.

A Stage 1 airplane may be operated after the otherwise applicable compliance dates prescribed under §§ 91.303 and 91.305 if, under an approved plan, a replacement airplane has been ordered by the operator under a binding contract as follows:

(a) For replacement of an airplane powered by two engines, until January 1, 1986, but not after the date specified in the plan, if the contract is entered into by January 1, 1983, and specifies delivery before January 1, 1986, of a replacement airplane which has been shown to comply with Stage 3 noise levels under Part 36 of this chapter.

(b) For replacement of an airplane powered by three engines, until January 1, 1985, but not after the date specified in the plan, if the contract is entered into by January 1, 1983, and specifies delivery before January 1, 1985, of a replacement airplane which has been shown to comply with Stage 3 noise levels under Part 36 of this chapter.

(c) For replacement of any other airplane, until January 1, 1985, but not after the date specified in the plan, if the contract specifies delivery before January 1, 1985, of a replacement airplane which—

(1) Has been shown to comply with Stage 2 or Stage 3 noise levels under Part 36 of this chapter prior to issuance of an original standard airworthiness certificate; or

(2) Has been shown to comply with Stage 3 noise levels under Part 36 of this chapter prior to issuance of a standard airworthiness certificate other than original issue.

(d) Each operator of a Stage 1 airplane for which approval of a replacement plan is requested under this section shall submit to the FAA Director of the Office of Environement and Energy an application constituting the proposed replacement plan (or revised plan) that contains the information specified under this paragraph and which is certified (under penalty of 18 U.S.C. § 1001) as true and correct. Each application for approval must provide information corresponding to that specified in the contract, upon which the FAA may rely in considering its approval, as follows:

(1) Name and address of the applicant.

(2) Aircraft type and model and registration number for each airplane to be replaced under the plan.

(3) Aircraft type and model of each replacement airplane.

(4) Scheduled dates of delivery and introduction into service of each replacement airplane.

(5) Name and address of the parties to the contract and any other persons who may effectively cancel the contract or otherwise control the performance of any party.

(6) Information specifying the anticipated disposition of the airplanes to be replaced.

(7) A statement that the contract represents a legally enforceable, mutual agreement for delivery of an eligible replacement airplane.

(8) Any other information or documentation requested by the Director, Office of Environment and Energy reasonably necessary to determine whether the plan should be approved.

§ 91.307 Service to small communities exemption: two-engine, subsonic airplanes.

(a) A Stage 1 airplane powered by two engines may be operated after the compliance dates prescribed under §§ 91.303, 91.305, and 91.306, when, with respect to that airplane, the Administrator issues an exemption to the operator from the noise level requirements under this subpart. Each exemption issued under this section terminates on the earlier of the following dates—

(1) For an exempted airplane sold, or otherwise disposed of, to another person on or after January 1, 1983—on the date of delivery to that person;

(2) For an exempted airplane with a seating configuration of 100 passenger seats or less—on January 1, 1988; or

(3) For an exempted airplane with a seating configuration of more than 100 passenger seats—on January 1, 1985.

(b) For purposes of this section, the seating configuration of an airplane is governed by that shown to exist on December 1, 1979, or an earlier date established for that airplane by the Administrator.

§ 91.308 Compliance plans and status: U.S. operators of subsonic airplanes.

(a) Each U.S. operator of a civil subsonic airplane covered by this subpart (regardless of the State of registry) shall submit to the FAA, Director of the Office of Environment and Energy, in accordance with this section, the operator's current compliance status and plan for achieving and maintaining compliance with the applicable noise level requirements of this subpart. If appropriate, an operator may substitute for the required plan a notice, certified as true (under penalty of 18 U.S.C. § 1001) by that operator, that no change in the plan or status of any airplane affected by the

plan has occurred since the date of the plan most recently submitted under this section.

(b) Each compliance plan, including any revised plans, must contain the information specified under paragraph (c) of this section for each airplane covered by this section that is operated by the operator. Unless otherwise approved by the Administrator, compliance plans must provide the required plan and status information as it exists on the date 30 days before the date specified for submission of the plan. Plans must be certified by the operator as true and complete (under penalty of 18 U.S.C. § 1001) and be submitted for each airplane covered by this section on or before the following dates—

(1) May 1, 1980 or 90 days after initially commencing operation of airplanes covered by this section, whichever is later, and thereafter—

(2) Thirty days after any change in the operator's fleet or compliance planning decisions that has a separate or cumulative effect on 10 percent or more of the airplanes in either class of airplanes covered by § 91.305(b); and

(3) Thirty days after each compliance date applicable to that airplane type under this subpart and annually thereafter through 1985 or until any later compliance date for that airplane prescribed under this subpart, on the anniversary of that submission date, to show continuous compliance with this subpart.

(c) Each compliance plan submitted under this section must identify the operator and include information regarding the compliance plan and status for each airplane covered by the plan as follows:

(1) Name and address of the airplane operator.

(2) Name and telephone number of the person designated by the operator to be responsible for the preparation of the compliance plan and its submission.

(3) The total number of airplanes covered by this section and in each of the following classes and subclasses:

(i) Airplanes engaged in domestic air commerce.

(A) Airplanes powered by four turbojet engines with no bypass ratio or with a bypass ratio less than two.

(B) Airplanes powered by engines with any other bypass ratio or by another number of engines.

(C) Airplanes covered by an exemption issued under § 91.307 of this subpart.

(ii) Airplanes engaged in foreign air commerce under an approved apportionment plan.

(A) Airplanes powered by four turbojet engines with no bypass ratio or with a bypass ratio less than two.

(B) Airplanes powered by engines with any other bypass ratio or by another number of engines.

(C) Airplanes covered by an exemption issued under § 91.307 of this subpart.

(4) For each airplane covered by this section—

(i) Aircraft type and model;

(ii) Aircraft registration number;

(iii) Aircraft manufacturer serial number;

(iv) Aircraft power plant make and model;

(v) Aircraft year of manufacture;

(vi) Whether Part 36 noise level compliance has been shown: Yes/No;

(vii) [Reserved];

(viii) The appropriate code prescribed under paragraph (c)(5) of this section which indicates the acoustical technology installed, or to be installed, on the airplane;

(ix) For airplanes on which acoustical technology has been or will be applied, following the appropriate code entry, the actual or scheduled month and year of installation on the airplane;

(x) For DC-8 and B-707 airplanes operated in domestic U.S. air commerce which have been or will be retired from service in the United States without replacement between January 24, 1977, and January 1, 1985, the appropriate code prescribed under paragraph (c)(5) of this section followed by the actual or scheduled month and year of retirement of the airplane from service:

(xi) For DC-8 and B-707 airplanes operated in foreign air commerce in the United States, which have been or will be retired from service in the United States without replacement between April 14, 1980, and January 1, 1985, the appropriate code prescribed under paragraph (c)(5) of this section followed by the actual or scheduled month and year of retirement of the airplane from service;

(xii) For airplanes covered by an approved replacement plan under § 91.305(c) of this subpart, the appropriate code prescribed under paragraph (c)(5) of this section followed by the scheduled month and year for replacement of the airplane;

(xiii) For airplanes designated as "engaged in foreign commerce" in accordance with an approved method of apportionment under § 91.305(c) of this subpart, the appropriate code prescribed under paragraph (c)(5) of this section;

(xiv) For airplanes covered by an exemption issued to the operator granting relief from noise level requirements of this subpart, the appropriate code prescribed under paragraph (c)(5) of this section followed by the actual or scheduled month and year of expiration of the exemption and the appropriate code and applicable dates which indicate the compliance strategy planned or implemented for the airplane.

(xv) For all airplanes covered by this section, the number of spare shipsets of acoustical components need for continuous compliance and the number available on demand to the operator in support of those airplanes; and

(xvi) For airplanes for which none of the other codes prescribed under paragraph (c)(5) of this section describes either the technology applied, or to be applied to the airplane in accordance with the certification requirements under Parts 21 and 36 of this chapter, or the compliance strategy or methodology, following the code "OTH" enter the date of any certificate action and attach an addendum to the plan explaining the nature and extent of the certificated technology, strategy, or methodology employed, with reference to the type certificate documentation.

(5) TABLE OF ACOUSTICAL TECHNOLOGY/STRATEGY CODES

Code	*Airplane Type/ Model*	*Certificated Technology*
A	B-707-120B B-707-320B/C B-720B	Quiet Nacelles + 1-Ring
B	B-727-100	Double Wall Fan Duct Treatment
C	B-727-200	Double Wall Fan Duct Treatment (Pre-January 1977 Installations and Amended Type Certificate)
D	B-727-200 B-737-100 B-737-200	Quiet Nacelles + Double Wall Fan Duct Treatment
E	B-747-100 (pre-December 1971) B-747-200 (pre-December 1971)	Fixed Lip Inlets + Sound Absorbing Material Treatment
F	DC-8	New Extended Inlet and Bullet with Treatment + Fan Duct Treatment Areas
G	DC-9	P-38 Sound Absorbing Material Treatment Kit
H	BAC-111-200	Silencer Kit (BAC Acoustic Report 522)
I	BAC-111-400	(To be identified later if certificated)
J	B-707 DC-8	Reengined with High Bypass Ratio Turbojet Engines + Quiet Nacelles (if certificated under Stage 3 noise level requirements)

REP—For airplanes covered by an approved replacement under § 91.305(c) of this subpart.

EFC—For airplanes designated as "engaged in foreign commerce" in accordance with an approved method of apportionment under § 91.307 of this subpart.

RET—For DC-8 and B-707 airplanes operated in domestic U.S. air commerce and retired from service in the United States without replacement between January 24, 1977, and January 1, 1985.

RFC—For DC-8 and B-707 airplanes operated by U.S. operators in foreign air commerce in the United States and retired from service in the United States without replacement between April 14, 1980, and January 1, 1985.

EXD—For airplanes exempted from showing compliance with the noise level requirements of this subpart.

OTH—For airplanes for which no other prescribed code describes either the certificated technology applied, or to be applied to the airplane, or the compliance strategy or methodology. (An addendum must explain the nature and extent of technology, strategy or methodology and reference the type certificate documentation.

§ 91.309 Civil supersonic airplanes that do not comply with Part 36.

(a) *Applicability.* This section applies to civil supersonic airplanes that have not been shown to comply with the Stage 2 noise limits of Part 36 in effect on October 13, 1977, using

applicable tradeoff provisions, and that are operated in the United States after July 31, 1978.

(b) *Airport use.* Except in an emergency, the following apply to each person who operates a civil supersonic airplane to or from an airport in the United States:

(1) Regardless of whether a type design change approval is applied for under Part 21 of this chapter, no person may land or take off an airplane, covered by this section, for which the type design is changed, after July 31, 1978, in a manner constituting an "acoustical change" under § 21.93, unless the acoustical change requirements of Part 36 are complied with.

(2) No flight may be scheduled, or otherwise planned, for takeoff or landing after 10 p.m. and before 7 a.m. local time.

§ 91.311 Civil supersonic airplanes: noise limits.

Except for Concorde airplanes having flight time before January 1, 1980, no person may, after July 31, 1978, operate, in the United States, a civil supersonic airplane that does not comply with the Stage 2 noise limits of Part 36 in effect on October 13, 1977, using applicable trade-off provisions.

APPENDIX 8-D

AC 91.53
NOISE ABATEMENT DEPARTURE PROFILE

ZK-FHRO4-041 AC 91-53

DATE 10/17/79

ADVISORY CIRCULAR

DEPARTMENT OF TRANSPORTATION
Federal Aviation Administration
Washington, D.C.

Subject: NOISE ABATEMENT DEPARTURE PROFILE

1. PURPOSE. This advisory circular provides a technical analysis and description of a generally effective standardized noise abatement departure profile that is consistent with the Federal Aviation Administration's safety responsibilities. It describes safe standard noise abatement departure profiles for turbojet-powered airplanes with a maximum certificated takeoff weight over 75,000 pounds, consistent with Federal Aviation Regulation (FAR) Section 91.87; and Aviation Noise Abatement Policy, dated November 18, 1976. The profiles contained in this circular should be considered for inclusion in all air carrier training and flight operations manuals as well as in airport noise abatement plans.

2. BACKGROUND.

a. On October 30, 1967, the Federal Aviation Administration (FAA) adopted Amendment 91-46 to FAR Part 91 (32 FR 15422; November 4, 1967). It amended, among other provisions, paragraph 91.87(f) regarding departures at airports with operating air traffic control towers. Under this amendment, all turbine-powered airplanes were added to the class of aircraft to which the safety/noise abatement departure rule applies.

b. For several years, the FAA has been actively involved in continuing efforts to develop and provide safe and effective control and abatement of aircraft noise. As part of that commitment, the FAA has worked with airport and aircraft operators, pilots, and other federal, state, and local agencies in numerous developmental and operational flight test programs for measuring and evaluating noise levels in the airport environment, including consideration of various departure flight tracks and profiles. Regulatory and nonregulatory techniques for enhancing the safety, noise, and energy benefits have been reviewed and, when appropriate, implemented.

Initiated by: AFS-220

c. From an environmental standpoint, whenever possible, the avoidance of departures over or near noise sensitive areas by the use of preferential noise abatement runways and flight tracks is an effective noise control technique. The FAA believes that use of a noise abatement departure profile for turbojet-powered airplanes with a maximum certificated takeoff weight over 75,000 pounds, which incorporates a thrust reduction and airplane configuration management, provides additional general benefits to the airport community. This noise abatement departure profile may be used in conjunction with preferential runway and flight path techniques and other noise abatement measures. This AC addresses turbojet-powered airplanes with a maximum certificated takeoff weight over 75,000 pounds because they present one of the most significant noise impacts on the airport community and because their operating characteristics are different from other airplane groups.

d. FAA review of current air carrier departure profiles indicates that they result in varying degrees of noise control and abatement at different points along the departure flight tracks. Different airplane types using the same profile also produce different results in terms of noise abatement and fuel efficiency. Accordingly, assessments of which departure profile is preferable from environmental standpoints, including noise abatement and energy conservation, require consideration of airplane type and various airport factors. Relevant airport factors include the location of affected noise sensitive areas. Based on its experience with aircraft noise matters and its review of existing operating procedures, the FAA recommends the use of a standardized noise abatement departure profile. The standard profile is intended to be applied consistent with the responsibility of the airport proprietor, local government bodies, and local residents to assess the noise impact of operations at particular airports and for airport proprietors to fulfill their "local option" obligations in a comprehensive aircraft noise abatement program under the Aviation Noise Abatement Policy.

3. NOISE ABATEMENT DEPARTURE PROFILES.

a. Take off and climb at an airspeed of V_2 + 10 to 20 knots until attaining an altitude of 1000 feet above airport elevation (AAE).

b. Upon attaining 1000 feet AAE, accelerate to the zero flap minimum safe maneuvering speed (V_{ZF}) while retracting flaps on schedule and reduce thrust. Thrust should not be reduced below the minimum thrust at which compliance has been shown with the required final takeoff climb performance gradient with one engine inoperative under § 25.121(c) of Part 25 ("final takeoff engine out climb gradient"). Thrust should be reduced consistent with the following:

(1) Thrust for airplanes with high bypass ratio engines should be reduced to normal climb thrust.

(2) Thrust for airplanes with low bypass ratio engines should be reduced below normal climb thrust but in no case lower than that necessary to maintain the final takeoff engine-out climb gradient.

(3) Thrust for airplanes with slow flap retraction rates should be reduced at an intermediate flap setting.

c. Continue climb at an airspeed not greater than V_{2S} + 10 knots at the reduced thrust to an altitude of not less than 3000 feet AAE whereupon the pilot should smoothly initiate a normal climb profile (Figure 1). However, the reapplication of power can be delayed if that event would occur over a noise sensitive area.

d. Notwithstanding paragraph b. above, airplanes not using wing flaps for takeoff should reduce thrust before attaining 1000 feet AAE but not before 500 feet AAE.

4. DISCUSSION.

a. The FAA, in conjunction with other Federal agencies and the aviation industry, has evaluated numerous flight test programs and the operational experience of turbojet-powered airplane operations prior to selecting a standard noise abatement departure profile. These profiles include flying the airplane to 1000 feet at V_2 + 10 to 20 knots followed by flap retraction and thrust reduction. This achieves climbing the airplane to a safe altitude as quickly as practical where the pilot then reduces thrust to reduce the airplane's noise. This combination of altitude and reduced thrust setting will have a direct effect on the level of noise that is perceived on the ground near the airport. These profiles were developed with five major considerations in mind: safety, noise abatement, standardization, fuel conservation, and operational flexibility.

b. These standard noise abatement profiles are safe. A review of airports served by the affected airplane types has shown that a standard profile containing a thrust reduction below 1000 feet could compromise safety due to obstacle clearance and airplane performance considerations. Further, a thrust reduction below that which is required to maintain the FAR Part 25 final takeoff engine-out climb gradient would not provide enough thrust to maintain an adequate climb rate should an engine fail during departure. Due to these factors, the standard noise abatement profile contains a minimum altitude for thrust reduction of 1000 feet, and a limitation on the amount of thrust reduction based on the performance characteristics of the airplane and its takeoff weight.

c. Use of the standard noise abatement profiles described in this advisory circular will provide noise abatement. A review of airport noise problems shows that there are several noise abatement techniques which are effective depending on the location of the noise sensitive area. Typical airports can be divided into three categories: those with far-neighbor noise sensitive areas which lie beyond 10 miles from the airport; those with near-neighbor noise sensitive areas which lie within 10 miles of the airport; and those with both near-neighbor and far-neighbor noise sensitive areas.

(1) Airports which have only far-neighbor noise problems can generally achieve noise abatement by developing and using a preferential

runway use program and by, in cooperation with FAA, establishing departure tracks to avoid the noise sensitive areas. The FAA believes that these are effective techniques to provide noise abatement to far-neighbor communities.

(2) Airports which have near-neighbor noise problems can achieve noise abatement through developing and using a preferential runway use program in combination with the use of noise abatement departure profiles. Reviews of various noise abatement departure profiles have shown that they are most effective within 10 miles of an airport. Further, people who live within 10 miles of an air carrier airport on the departure flight track are most likely to be exposed to the highest levels of departure noise for the longest time periods. Therefore, the standard noise abatement departure profiles contained in this circular primarily addresses near-neighbor noise problems.

(3) Airports which have both near-neighbor and far-neighbor noise abatement problems, such as airports located in large metropolitan areas, may find it helpful to use a combination of departure profile, preferential runway, and flight track techniques as part of their total noise abatement program.

d. These noise abatement profiles have basic standardization. This standardization has three major benefits. It improves safety by reducing flightcrew workload during a critical phase of flight; it improves the ability of the airport proprietor, local bodies, and local residents to assess the noise impact of operations at a particular airport; and it improves the ability of the airport proprietor and the FAA to monitor flightcrew adherence to the profile. Many departure noise complaints involve nonstandard departure profiles. Investigations into these complaints frequently have shown that the airplanes involved may not have flown the profile, may not have been flown satisfactorily, or that the profile was not designed for noise abatement. A standardized departure profile could greatly lessen these problems since pilots would be trained in and would be more familiar with a standard noise abatement profile.

e. The standard noise abatement profile will encourage fuel conservation. Airplane data show that an airplane burns less fuel on departure when its flaps are retracted than when they are extended. Therefore, the standard noise abatement departure profile permits flap retraction as soon as safety and noise abatement considerations permit. Industry data on actual flights have shown a significant fuel savings in a mixed fleet of 105 aircraft, including B-727's, DC-10's, and B-747's, using a departure profile similar to the standard rather than a maximum takeoff climb profile. If these data are representative of the entire U.S. fleet, the potential savings, in both energy and cost, would be significant.

f. Operational flexibility in the profile is essential in order to operate each airplane type most efficiently in terms of both noise abatement and fuel conservation. Each airplane type, depending largely on the engines it has installed and its takeoff weight, has different noise and fuel burn

characteristics. Since the capability for thrust reduction and rate of climb diminishes as an airplane's gross weight approaches its maximum, some differences in noise levels perceived on the ground for the same airplane type is expected. Application of the standard noise abatement profiles should, however, provide a significant reduction in overall airplane noise levels as compared to a maximum thrust departure profile. An evaluation of these different characteristics has resulted in the following recommendations in applying the standard noise abatement profile to specific airplane types.

(1) Thrust for airplanes with high bypass ratio engines (e.g., DC-10, B-747, L-1011, A-300) should not be reduced below normal climb thrust on departure. This is because the noise generated by these engines is not significantly affected by reducing thrust below normal climb thrust, but the climb performance is significantly reduced. A reduced thrust climb would result in more noise on the ground since the airplane would remain at lower altitudes longer.

(2) Thrust for airplanes with low bypass ratio engines (e.g., B-707/727/737, DC-8/9) should be reduced below normal climb thrust but in no case lower than that necessary to maintain the final takeoff engine-out climb gradient. Review of airplane data has shown that reducing thrust below normal climb thrust on these engines can provide significant noise benefits.

(3) Thrust for airplanes with slow flap retraction rates (e.g., B-747), should be reduced at an intermediate flap setting rather than waiting until the flaps are fully retracted. Otherwise, because of their flap retraction rate, these airplanes could be at takeoff thrust significantly longer than other airplanes. This longer time at takeoff thrust could result in a greater noise impact than if they had climbed out at reduced thrust beginning at an intermediate flap setting.

5. IMPLEMENTATION

a. Each operator of a turbojet-powered airplane with a maximum certificated takeoff weight over 75,000 pounds should amend its operating procedures and training programs to incorporate the standard noise abatement departure profiles.

b. The standard noise abatement profile would not apply when --

(1) Otherwise authorized or directed by air traffic control;

(2) Otherwise required under applicable provisions of the FARs; or

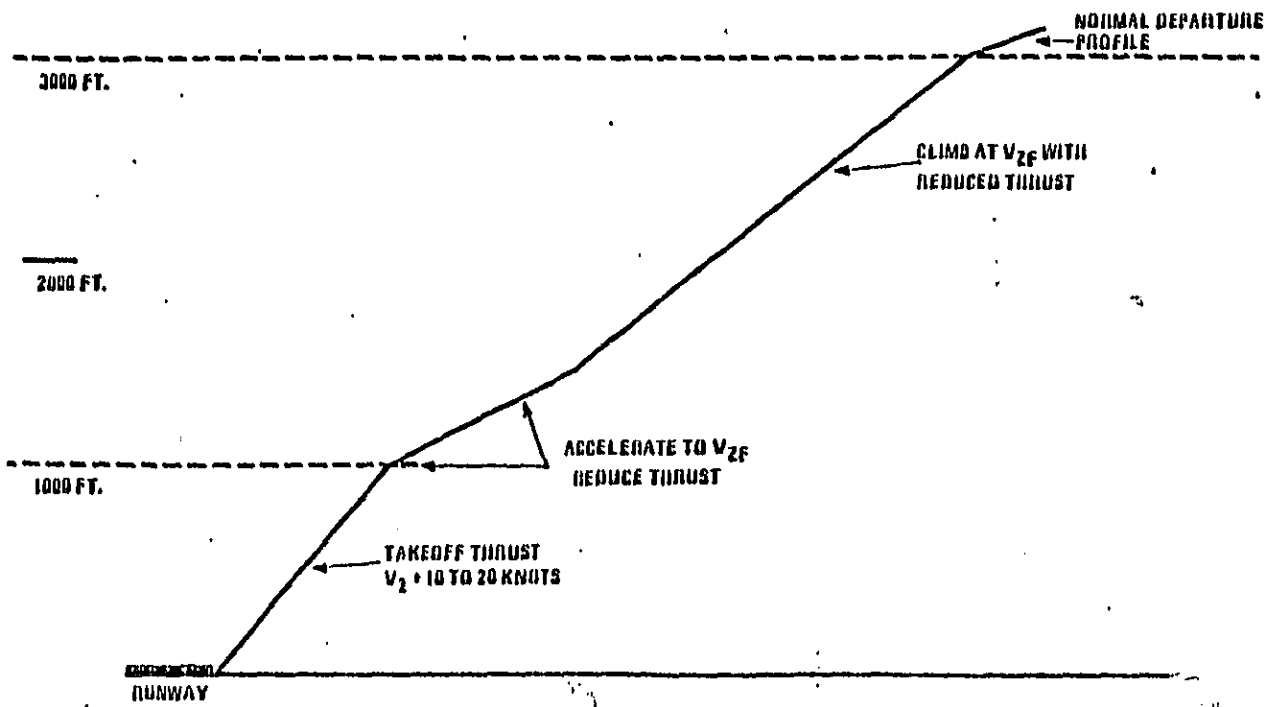
(3) An alternate profile is approved by the Director, Flight Standards Service.

c. This advisory circular, including the publication of a standard noise abatement profile, should not be construed to affect the responsibilities and authority of the pilot in command for the safe operation of the airplane under FAR § 91.3 or other regulations.

d. The aviation noise abatement policy states that, after consultation with the local community and airport users, an airport proprietor may propose to the FAA, for implementation at a specific airport as an operational noise procedure, "flight operational procedures such as thrust reduction or maximum climb on takeoff."

Langhorne Bond
Administrator

FIGURE 1. STANDARD NOISE ABATEMENT DEPARTURE PROFILE



APPENDIX 8-E

AC 150/5020.1

US Department of Transportation
Federal Aviation Administration

Advisory Circular

Subject:	Date: 8/5/83	AC No: 150/5020-1
NOISE CONTROL AND COMPATIBILITY PLANNING FOR AIRPORTS	Initiated by:	Change:

1. PURPOSE. This advisory circular provides guidance for Noise Control and Compatibility Planning for airports under Federal Aviation Regulation (FAR) Part 150 and the Aviation Safety and Noise Abatement Act of 1979 (ASNA) (P.L. 96-193). It is intended for use by airport operators, state/local planners and other officials, and interested citizens who may engage in noise control planning. Airport noise compatibility planning has the goals of reducing existing noncompatible land uses around airports and of preventing the introduction of additional noncompatible land uses through the cooperative efforts of all those involved. The Part 150 program is voluntary and airport operators are encouraged to participate.

2. BACKGROUND. FAR Part 150 implements portions of Title I of the Aviation Safety and Noise Abatement Act of 1979. It establishes a single system for the measurement of airport (and background) noise, a single system for determining the exposure of individuals to airport noise, and a standardized airport noise compatibility planning program. The planning program includes (1) provision for the development and submission to the FAA of Noise Exposure Maps and Noise Compatibility Programs by airport operators; (2) standard noise units, methods and analytical techniques for use in airport assessments; (3) identification of land uses which are normally considered compatible (or noncompatible) with various levels of noise around airports; and (4) procedures and criteria for FAA approval or disapproval of noise compatibility programs by the Administrator. The program includes consideration of alternative noise control that might be employed as well as appropriate land use

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planning strategies. The goal of the overall program is for the airport proprietor, in consultation with state/local planners, local aviation groups and interested citizens, to develop a balanced and cost-effective program to minimize and/or mitigate the airport's noise impact on local communities.

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CHAPTER 1. GENERAL

SECTION 1. INTRODUCTION

1. PURPOSE. This advisory circular provides guidance for Noise Control and Compatibility Planning for airports under Federal Aviation Regulation (FAR). Part 150 and the Aviation Safety and Noise Abatement Act of 1979 (ASNA)as amended. It is intended for use by airport operators, state/local planners and other officials, and interested citizens who may engage in noise control planning. Airport noise compatibility planning has the goals of reducing existing noncompatible land uses around airports and of preventing the introduction of additional noncompatible land uses through the cooperative efforts of all those involved. The Part 150 program is voluntary and airport operators are encouraged to participate.

2. BACKGROUND. There are existing airport noise/land use compatibility problems at many airports in the United States. In addition, there is a potential for exacerbation of these noise problems and the possibility of problems arising at other airports as urban areas and use of air travel continue to grow. Through cooperative efforts on both the local and national levels, much has already been accomplished in limiting the growth and spread of noise compatibility problems. Actions have included limits upon noise emissions by new aircraft, provisions for the retirement or retrofit with quieter engines of the noisiest transport aircraft, and an environmental review process for airport development projects. Some of the major remaining obstacles for implementing successful noise compatibility programs around airports have been the need for a single system for measuring airport noise, a single system for determining the exposure of individuals to airport noise, the identification of land uses that are normally compatible with the various levels of noise around airports, and a process for safety and economic evaluations of proposed actions. These remaining major obstacles have been addressed by recent regulatory actions detailed below.

a. Federal Aviation Regulation (FAR) Part 150 implements portions of Title I of the Aviation Safety and Noise Abatement Act. It specifically establishes a single system for the measurement of airport (and background) noise, a single system for determining the exposure of individuals to airport noise, and a standardized airport noise compatibility planning program. The planning program includes (1) provision for the development and submission to the FAA of Noise Exposure Maps and Noise Compatibility Programs by airport operators; (2) standard noise units, methods and analytical techniques for use in airport assessments; (3) identification of land uses that are normally compatible (or noncompatible) with various levels of noise around airports; and (4) procedures and criteria for FAA approval or disapproval of noise compatibility programs by the Administrator.

b. The Airport Noise Compatibility Planning Program includes land use planning and implementation programs necessary to carry out the ASNA Act. The Act does not in any way, however, interfere with established prerogatives of State and local governments concerning land use and related noise compatibility actions and responsibilities. Accordingly, approvals and disapprovals of programs submitted to the FAA under Part 150 do not constitute a Federal determination that the use of land covered by the program is acceptable or unacceptable under Federal, State, or local law. The responsibility for determining the acceptable and permissible land uses remains with the local authorities.

3. BENEFITS OF NOISE COMPATIBILITY PLANNING - PROGRAMMING UNDER PART 150.

a. Noise is one of the greatest threats to aviation today. Projected growth in demand for air travel means that we will have larger aircraft and more operations in the future. The increase in air carrier traffic at large airports will generate more air carrier traffic at feeder airports and more traffic by sophisticated general aviation aircraft at these and many general aviation airports.

b. The costs of most forms of noise mitigation are rapidly increasing. These include soundproofing, land purchases, relocations, land use changes, by-passing of impacted land, and construction of alternative aviation facilities. People's perceptions of what is an acceptable level of urban noise is becoming more critical while their opportunity to voluntarily move away from such noise is becoming more limited. All of these are resulting in strong pressures upon airport operators to impose operational constraints, curfews, growth limitations, and other severe constraints upon their airports as easy, "one-shot" solutions to the noise problem.

c. Relief of these pressures on the airport operators and the preservation of a national system of airports requires that aviation become as compatible as possible with its neighbors. This requires that the airport operators work much more closely with local jurisdictions than has been generally feasible in the past, since they control most of the viable non aviation-constraining noise mitigation measures.

d. The Part 150 Airport Noise Compatibility Planning Program offers an ideal vehicle for noise planning and implementation in this contemporary context. It includes:

(1) A balanced approach producing realistic and practical solutions fair to both aviation and non aviation interests.

(2) Positive FAA technical guidance through regional and airports district offices.

(3) Federally identified land uses which are normally compatible with various exposures of individuals to noise.

(4) Consultations and interactions between the airport operator, airport users, airport neighbors, local land use control jurisdictions, and the FAA designed to achieve broad-based confidence in and acceptance of the program and the support essential for its implementation over the long term.

(5) Recognition of factors beyond the control of the airport operator which strongly influence local land use decisions.

(6) A viable framework for conducting efficient and constructive compatibility programs which achieve large benefits in noise reduction for the costs in aviation.

(7) Community and airport operator decisions that are made from a fully informed position in order to weigh the full costs and benefits of the alternatives.

(8) Federal financial assistance available to the airport operator under the Airport Improvement Program for noise compatibility planning and for implementation of that planning.

(9) Federal financial assistance also available to units of local government in the area surrounding the airport to carry out projects in accordance with FAA approved noise compatibility programs.

(10) Certain sanctions are available under Section 107 of the ASNA Act to protect the airport operator from land owner noise suits.

e. No two airport situations are alike, and each will likely require a unique combination of mitigation measures to achieve an acceptable solution. At a given airport, a full range of possible solutions is explored, then the best composition of solutions is chosen and carefully weighed before settling upon a final plan. The objective being to reduce the noise by the most efficient way and then balance this against the possible non-aviation solutions. A balance is sought between realistic environmental goals and the costs to the aviation system. When the proposed aviation constraints are significant, then the local needs and benefits are weighed and balanced against the needs and concerns of the rest of the nation.

4. FAA INFORMATION SOURCES. Users of this circular are strongly encouraged to contact their FAA Airports District Office or the Airports Division of their FAA regional office for additional information, guidance, and consultation prior to starting an Airport Noise Exposure Map or Airport Noise Compatibility Program. These offices are also prime sources for reference materials, such as other advisory circulars and citizen participation manuals.

5. DEFINITIONS. All terms used in this circular which are also used in Part 150 have the same meaning in this circular as they do in that Part.

a. A-Weighted Sound Level (L_A). The A-Weighted Sound Level is sound pressure level which has been filtered or weighted to reduce the influence of the low and high frequency noise (formerly dBA). It was designed to approximate the response of the human ear to sound. (See paragraph 203)

b. Average Day-Night Sound Level (L_{dn}). See Yearly Day-Night Average Sound Level.

c. Land Use. The present or planned utilization of a given parcel of land. Such land uses are normally indicated or delineated on a land use map. Land use maps may indicate usages for any given time period past, present, or future, and such period should always be indicated. (See paragraph 237)

d. Zoning. An exercise of the police powers of the State, as delegated to local governments, designating the uses permitted on each parcel of land within the zoning jurisdiction. (See paragraph 331)

e. Standard Land Use Coding Manual (SLUCM). A Standard System for identifying and coding land use activities. Published jointly in 1965 by Urban Renewal Administration, Housing and Home Finance Agency (both now Parts of HUD) and the Bureau of Public Roads (now the Federal Highway Administration). (See paragraph 237)

f. Noise Level Reduction (NLR). The amount of noise level reduction achieved through incorporation of noise attenuation (between outdoor and indoor levels) in the design and construction of a structure. (See paragraph 237)

g. Noise Exposure Map. A scaled, geographic, depiction of an airport, its noise contours, and surrounding area developed in accordance with Section A150.101 of Appendix A of FAR Part 150, including the accompanying documentation setting forth the required descriptions of projected aircraft operations at that airport during 1985 and if submitted after 1982, during the fifth calendar year beginning after submission of the map, together with the ways, if any those operations for each of those years will affect the map (including noise contours and the forecast land uses). See FAR Part 150 for legal definition.

h. Noise Contour. A continuous line on a map of the airport vicinity connecting all points of the same noise exposure level; for the purposes of this program usually the L_{dn} 65, 70, and 75 levels.

i. Airport Noise Compatibility Program. That program reflected in documents (and revised documents) developed in accordance with Appendix B of Part 150, including the measures proposed or taken by the airport operator to reduce existing noncompatible land uses and to prevent the introduction of additional noncompatible land uses within the area. See FAA Part 150 for legal definition.

j. NEPA. Acronym for the National Environmental Policy Act of 1969. (See paragraph 26)

k. Curfew. A restriction placed upon all or certain classes of aircraft by time of day for the purposes of reducing or controlling airport noise. (See paragraph 326)

l. Easement. The legal right of one party to use a portion of the total rights in real estate owned by another party. This may include the right of passage over, on, or below the property; certain air rights above the property, including view rights; and the rights to any specified form of development or activity, as well as any other legal rights in the property that may be specified in the easement document. (See paragraph 332)

m. Office of Management and Budget Circular No. A-95. A regulation requiring coordination of Federal and federally assisted programs and projects with each other and with State, areawide, and local plans and programs, utilizing a series of state and regional clearinghouses. (See paragraph 25)

n. Federal Aviation Regulation (FAR) Part 36. A regulation establishing noise certification standards for aircraft. (See paragraph 24)

o. Aviation Noise Abatement Policy (ANAP). Policy adopted jointly by the Secretary of Transportation and the FAA, on November 18, 1976, delineating the responsibilities of FAA, air carriers, airport operators, and local communities in achieving reductions in airport noise.

p. Airport Noise Control and Land Use Compatibility (ANCLUC) Program. A pilot program for airport noise compatibility planning established by the ANAP and funded under Section 13 of the Airport and Airway Development Act of 1970 as amended. It was a voluntary planning process initiated and led by airport proprietors with Federal funding and technical assistance. (See paragraph 21)

q. Yearly Day-Night Average Sound Levels (L_{dn}) or (DNL). The 24-hour average sound level, in decibels, for the period from midnight to midnight, obtained after the addition of ten decibels to sound levels for the periods between midnight and 7 a.m. and between 10 p.m. and midnight, local time, as averaged over a span of one year. It is the FAA standard metric for determining the cumulative exposure of individuals to noise. (See paragraph 221)

r. Equivalent Sound Level (L_{eq}). L_{eq} is the steady A-weighted sound level over any specified period (not necessarily 24 hours) that has the same acoustic energy as the fluctuating noise during that period (with no consideration of a nighttime weighting.) It is a measure of cumulative acoustical energy. Because the time interval may vary, it should always be specified by a subscript (such as L_{eq} 8) for an 8-hr exposure to workplace noise) or be clearly understood.

6.-19. RESERVED.

SECTION 2. RELATIONSHIP TO OTHER AIRPORT AND NOISE PLANNING ACTIONS

20. AIRPORT MASTER PLANS. An Airport Noise Exposure Map or an Airport Noise Compatibility Program for an airport supplements but does not replace the Airport Master Plan (AMP) developed for that airport. The AMP may provide the base data for the noise exposure map. However, operational data for use in the Integrated Noise Model (INM) (or an FAA approved equivalent) and the land use and jurisdictional data for the map should be certifiable by the airport operator as current data. Similarly, the AMP may offer inputs to development of the noise compatibility program. Again, all of the alternatives, analyses, consultations, and public involvement required by Part 150 for the program should be certifiable by the airport operator as up-to-date and based upon current data. See also, Section A150.101(f) of Part 150.

21. AIRPORT NOISE CONTROL AND LAND USE COMPATIBILITY (ANCLUC) PLANNING STUDIES. A number of ANCLUC planning studies have been undertaken and/or completed. Although this was an interim program, much valuable noise and land use information was produced and much viable compatibility planning accomplished. Where these studies meet the requirements of Part 150, or an FAA approved equivalent under Part 150, and are otherwise appropriate, airport operators are encouraged to incorporate that work into Noise Compatibility Programs; see Section A150.101(f) of Part 150.

22. AIR INSTALLATION COMPATIBLE USE ZONES. Complimentary to ANCLUC, the U.S. Department of Defense developed the Air Installation Compatible Use Zones (AICUZ) Program for achieving noise/land use compatibility at military air installations. AICUZ studies have also been prepared for a number of joint civil-military use airports where there are a significant number of military operations. As in the case of ANCLUC's, information developed for an AICUZ study which is appropriate and certifiable as current by the airport operator may be used in developing an Airport Noise Exposure Map or Airport Noise Compatibility Program.

23. ENVIRONMENTAL ASSESSMENTS. Environmental Assessments (EA) are prepared for many types of airport development projects and/or airport operational changes under the requirements of the National Environmental Policy Act (NEPA), Regulations of the Council on Environmental Quality (CEQ), Department of Transportation Order 5610.1C (Procedures for Considering Environmental Impacts), FAA Order 1050.1C (Policies and Procedures for Considering Environmental Impacts), and FAA Order 5050.4 (Airport Environmental Handbook). Many EA's contain analyses of airport noise, compatible land use, social impacts, and induced socioeconomic impacts. An Airport Noise Compatibility Program may supplement, but is not intended to replace an EA in meeting required environmental analyses. Similarly, an EA may contain information that, provided it is current, can be valuable inputs to developing airport noise exposure maps and airport noise compatibility programs. To the extent the information in the EA is appropriate, such use of existing sources is encouraged. See also, paragraph 26 for applicability of NEPA to Part 150.

24. FEDERAL AVIATION REGULATIONS, PART 36. Federal Aviation Regulations, Part 36 contains noise certification standards for most airplane types, generally requiring newly designed and manufactured aircraft to be significantly quieter than older aircraft. However, as a certification standard, Part 36 has no provisions to control either the operations or numbers of operations at an airport in order to stabilize or reduce noise impacts. Part 150 works as a compliment to Part 36 by integrating the gains in reduced aircraft noise emissions into an overall noise compatibility program with controls on both aviation noise and land uses to assure full implementation and long term protection to both the airport and its environs.

25. OMB A-95 NOTIFICATION AND REVIEW. Office of Management and Budget (OMB) Circular No. A-95 established a process whereby state and local clearinghouses are notified of proposed Federal Grant-in-Aid projects and other assistance actions. Interested parties are provided the opportunity to review and evaluate the proposals in advance in terms of their potential impact on or conflict with statewide or areawide comprehensive planning or upon the plans and programs of local governments. The A-95 process (or its Federal or state successor) must (or should) be used to give notification and opportunity for comment when Federal assistance is involved. It does not, however, substitute for the consultative process as required by the ASNA Act. Note also that A-95 will be revised or replaced upon implementation of Executive Order 12372. See paragraphs 350-359 for guidance on Consultations.

26. NATIONAL ENVIRONMENTAL POLICY ACT. FAA compliance with the NEPA is controlled by FAA Order 1050.1C, Policies and Procedures for Considering Environmental Impacts. The FAA has determined that approval or disapproval of airport noise compatibility programs are "categorical exclusions" to the requirements for environmental assessment under Order 1050.1C. The ASNA Act requires an airport noise compatibility program to be either approved or disapproved within 180 days of receipt or it will be automatically approved. Development of a noise exposure map or noise compatibility program does not replace an environmental assessment but can be used in the preparation of such an assessment. Environmental assessment leading to a finding of no significant impact or to an environmental impact statement must still be conducted, where required by applicable procedures, prior to taking any Federal implementing action such as grant approvals or covered air traffic actions. Although the 180 day time constraint does not permit the normal federal Environmental Impact Assessment process, consideration of the potential impacts remains an integral part of the planning process. Airport operators should fully consider environmental as well as noise and land use consequences in developing an airport noise compatibility program.

27.-29. RESERVED.

SECTION 3. OVERVIEW

30. NOISE - ITS MEASUREMENT AND ASSESSMENT. It is assumed that users of this circular have a general technical background, but are not proficient in noise measurement, particularly aviation noise. Chapter 2 is devoted to a basic discussion of aviation noise and its measurement and assessment. Care has been taken to avoid technical language and the emphasis has been placed upon practical understanding. This should enable the typical user to understand what is involved; to estimate the size of the effort required; how to gather data for the Integrated Noise Model (or an FAA approved equivalent); how to interpret the noise contours; how to validate noise contours using noise measurements; and how to prepare an airport noise exposure map. FAA personnel are available to assist as necessary.

31. SENSITIVITY OF LAND USES TO NOISE. Different uses of land by people exhibit different sensitivities to noise. Schools, residences, churches, public health facilities, and concert halls often appear quite sensitive to noise. By contrast, factories, warehouses, storage yards, and open farmland are relatively insensitive to noise. Other uses, such as offices, shopping centers, recreation areas, or hotels, have intermediate levels of noise sensitivity. In order to assist the users in assessing noise compatibility/noncompatibility in the vicinity of their airports, a table of land uses and their compatibility/noncompatibility with various levels of noise is provided in Appendix 1. However, the designations in this table do not constitute a Federal determination that any use of land covered by this program is acceptable or unacceptable under Federal, state, or local law. The responsibility for determining the acceptable and permissible land uses remains with the local authorities. FAA determinations under Part 150 are not intended to substitute federally determined land uses for those determined to be appropriate by local authorities in response to locally determined needs and values in achieving noise compatible land uses.

32. NOISE EXPOSURE MAPS. FAR Part 150, in accordance with the ASNA Act, provides an opportunity for airport proprietors to submit Noise Exposure Maps to the FAA. Each such map is a scaled geographic depiction of an airport, its noise contours, and surrounding areas. Specifically, Part 150 requires that each noise exposure map shall depict continuous L_{dn} contours for levels of 65, 70, and 75. Within the 65 L_{dn} contour, the airport proprietor is required to identify land uses and to determine land use compatibility in accordance with the standards and procedures of Appendix A of FAR Part 150. Sections 150.21 and A150.101 contain other specific requirements on the form and contents of such maps.

33. NOISE COMPATIBILITY PROGRAMS. FAR Part 150 provides for the preparation and submission of Noise Compatibility Programs in addition to Noise Exposure Maps. The purpose of such a program is to seek optimal accommodation of both airport operations and community activities within acceptable safety, economic and environmental parameters. That may be accomplished by reducing existing noncompatible land uses in the vicinity of the airport and preventing the introduction of new noncompatible land uses in the future. To that end, the airport proprietor and other responsible officials should consider a wide range of feasible alternatives of noise control actions and land use patterns. A checklist for preparing Noise Compatibility Programs is contained in Appendix 2.

34. SUBMISSION TO THE FAA. Completed Airport Noise Exposure Maps and Airport Noise Compatibility Programs are submitted by the airport operator to the appropriate FAA Regional Director. They will be given Preliminary Review for acceptance for evaluation and then be given a full evaluation. Details of this procedure and of airport operator obligations following any change in the operation of the airport which might create any substantial incompatible land uses are described in Sections 150.23 through 150.35 of FAR Part 150.

35. WITHDRAWAL OR REVISION. At any time before approval or disapproval of a program, it may be withdrawn or revised. Such a termination stops the 180-day approval period. A new evaluation is begun upon receipt of a revised program and, unless the FAA finds that the revisions can be integrated without exceeding the original approval period, a new 180-day approval period is begun.

36. PERIODIC REVIEW AND UPDATING. Growth and transition in urban locations create pressures for changes to zoning and other controls established to achieve and protect compatibility. These stimuli are also likely to generate greater aviation activity and airport requirements with consequent changes in airport noise impacts. For these reasons, Part 150 requires the inclusion of a schedule for periodic review and updating of airport noise compatibility programs. Updating is also necessary to reflect increased operations and, with the map, continue the sanctions under Section 107 of the ASNA Act.

a. After the plan is adopted there is a need for the airport operator and the local planning agencies to continually evaluate its effectiveness and to identify those aspects of the plan which may need improvement. This includes evaluation to determine if proposed implementing actions are being carried out as scheduled. For instance, it should include review of land acquisition or soundproofing projects and ascertain whether they are effective, on schedule, or whether modifications are necessary. Also, operational procedures adopted as part of the noise control plan must be monitored to assure that they are being adhered to. The responsible organization, either the airport operator, the local planning authority, or both, should monitor all requests for changes in zoning, variances, or subdivision actions within the study area.

b. Periodic or formal reviews, at intervals of three to five years or when the noise exposure map or airport master plan is updated, should be scheduled and budgeted by the airport operator as an integral part of the program. Included within the formalized review should be consideration of those problems or deficiencies identified during the monitoring process and most notably those pertaining to the performance of the plan. The review will normally not be as extensive as the original effort but should establish whether the plan remains viable or what actions are necessary to correct existing or forecast deficiencies. The types of activities included in the review should be:

(1) A comparison of the current compatibility of the airport and its environs to that outlined in the program's goals and objectives.

(2) Appraisal of the rate of growth of both the community and airport to determine the current and future adequacy of the compatibility plan.

(3) Review of the airport noise exposure map in light of both current and forecast operations and the noise performance levels of aircraft.

(4) Review of the adequacy of current operational controls in maintaining aircraft noise within the designated noise impact areas.

(5) Review of the adequacy of the adopted development controls in protecting the designated noise impact areas from encroachment by noise sensitive uses.

(6) Review of the effectiveness of the corrective actions employed in resolving existing unprotected noise sensitive uses within the noise impact areas.

c. Revised Programs. Revised programs should be submitted to the Regional Director in the same manner as the original submission.

37.-199. RESERVED.

CHAPTER 2. NOISE MEASUREMENT AND ASSESSMENT

SECTION 1. NOISE FUNDAMENTALS

200. SOUND. This section provides a conceptual description of the acoustical metrics which comprise the FAA approved "system" for aircraft noise measurement. The sound experienced in our everyday lives is the result of objects or bodies being set into vibration. This vibration causes a motion in the surrounding air resulting in a minute variation in atmospheric pressure called "sound pressure." This sound pressure forms the basis to measure sound and is usually expressed as a sound pressure level in decibels which are dimensionless units expressing logarithmically the ratio of two values (i.e., a measured quantity and a referenced value). Another important characteristic of sound is its "frequency." The human ear is sensitive to frequencies ranging from 20 to 20,000 hertz (cycles per second). The simplest of all sounds are those composed of a single frequency. These sounds are called pure tones. However, the sounds to which people are usually exposed are much more complex, since they are composed of many frequencies, each occurring simultaneously at its own sound pressure level.

201. DECIBELS. Sound pressure level is a measure of the amplitude of the sound, while frequency relates to the sound's pitch. The range of sound pressures of interest is represented on the low end by the threshold of hearing of normal young people and on the upper end by the noise of gunfire at close range. Stated in physical terms, this sound pressure range is approximately from 0.00002 to 2,000 pascals. It is clear that this is a tremendous range of sound pressures. An analogous problem would be that of measuring lengths ranging from one inch to 1575 miles. Because acoustics deals with the effects of small changes near the threshold of hearing as well as the effects of small changes near the upper end of the scale, a proportional scale is more appropriate than a linear scale to handle this wide variation in sound pressure. The simplest mathematical scale available for this purpose is the logarithmic or decibel scale. A decibel (dB) is defined as ten times the logarithm (to the base 10) of a power or intensity ratio.

202. SOUND PRESSURE LEVELS. Sound pressure level is expressed as 10 log (P^2/Po^2), where P_o is the reference pressure and P is the differential pressure of a sound over that of ambient pressure. This is equivalent to twenty times the logarithm of the ratio of the pressures. It is also important to note that the reference pressure has been internationally standardized as 0.00002 pascals, which is approximately the threshold of human hearing. Because of the logarithmic nature of the decibel scale, a sound pressure level of 60 dB corresponds to a pressure, not 60 times the reference pressure, but 1000 times the reference pressure. Thus, 20 log (1000) = 20(3) = 60.

203. A-WEIGHTED SOUND PRESSURE LEVELS (L_A). Sound is a physical phenomenon that affects many things besides people. However, when sound is measured in order to relate to the reactions of people, it is necessary to use a measure which relates to the way human beings hear sound. It has been found that people are more sensitive to higher frequencies (treble) than lower frequencies (bass). That is, the human ear discriminates against lower frequencies. Naturally if we want to measure sound in a way which corresponds to the way people hear sound we want to duplicate the ear's discrimination. This is accomplished electrically using a device called a "weighting network." Because unweighted sound pressure level did not correlate well with human assessment of the loudness of sounds, weighting networks were added to sound level meters to attenuate low and high frequency noise to approximate the response of the human ear to sound. One of these weighting networks was designated "A" and was originally employed for sounds less than 55 dB in level. Now it is used for all levels. It is measured in decibels which are usually designated L_A (formerly dBA). A-Weighted Sound Level has been found to correlate well with people's subjective judgment. Its simplicity and superiority over unweighted sound pressure level in predicting people's response to noise have made it the most widely used metric for assessing the impact of aircraft noise and for comparing that noise with other community noise sources.

204. MEASUREMENT SYSTEM RESPONSE TIME. While the A-weighted sound level (L_A) is the basic unit for most Federal, State, and local noise standards, variations do exist in its method of measurement. Sound level meters and other noise measuring systems are capable of operating in several characteristic modes, such as "slow," "fast," "impulse," and "peak." Basically, these modes differ in the way in which the output value (indicated sound level reading) follows rapid changes in the input sound level. The higher speed responses are often useful in architectural, industrial and research acoustics. However, for most community and transportation noise sources the "slow" response is preferred since experience has shown that it provides the most repeatable data. Thus, in response to the ASNA Act requirements, the FAA uses a family of related noise units based on the slow response, A-weighted sound level (L_{AS}). FAR Part 150 incorporated by reference International Electrotechnical Commission Publication No. 179, entitled "Precision Sound Level Meters," dated 1973. This document specifies technical standards for both the system response and the A-weighting network.

205.-219. RESERVED.

SECTION 2. NOISE MEASUREMENTS

220. MEASURING SINGLE AIRCRAFT EVENTS. Part 150 specifies use of the slow response A-weighted sound level L_{AS} in decibels for measuring single events. Measurements of aircraft noise made in this unit can be directly related to sound levels of surface transportation noise sources since standards for the measurement of noise from these other sources also use L_{AS}. Many communities throughout the U.S. have local noise ordinances which use this unit. L_{AS} is also the metric used in FAA Advisory Circular 36-3B, Estimated Airplane Noise Levels in A-Weighted Decibels. Most U.S. and foreign airports with noise monitoring systems provide L_{AS} information. There is also a single event integrated A-weighted sound

level (L_{AE}) which is different from the maximum A-weighted sound level (L_{AS}) described in paragraphs 204 and 220. L_{AE} (sometimes also known as the Sound Exposure Level) is the level of an equivalent one-second duration reference signal. This metric quantifies the effect of both duration and magnitude for a single event measured above a specified threshold. The L_{AE} is sometimes best understood as the dose of noise associated with a single event. A survey program at an airport which provides average L_{AE} data for specific aircraft type categories can be used to compute L_{dn} values, one method of validating computer generated noise contours.

221. AIRPORT CUMULATIVE NOISE EXPOSURES. While people certainly respond to the noise of single events (particularly to the loudest single event in a series), the long-range effects of prolonged exposure to noise appear to best correlate with cumulative metrics. Such a unit provides a single number which is equivalent to the total noise exposure over a specified time period. Thus, cumulative noise units are based on both time and level. The day-night average sound level (L_{dn}) specified as the noise metric for cumulative exposure under Part 150 is such a unit. Specifically, the L_{dn} is the yearly average of the A-weighted sound level integrated over a 24-hour period. It also incorporates a 10 dB step function weighting to aircraft events between 10:00 p.m. and 7:00 a.m. to account for the increased annoyance to noise during the night hours.

222. BASIC RECOMMENDED NOISE MEASUREMENT SYSTEM. A recommended basic noise measurement system and suggestions regarding its use and maintenance is included in Appendix 3.

223. VALIDATION OF NOISE CONTOURS. One of the primary objectives of many noise measurement programs is to validate computer generated noise contours. The understanding of a few important concepts (listed below) provides the basis for cumulative noise exposure estimation techniques.

a. Yearly average airport noise exposure contours are estimates of actual average airport noise exposure.

b. Actual airport noise exposure at any point on the ground may be approximated by the energy average (over a year's time) of the daily L_{dn} values for that point.

c. The actual daily L_{dn} value for any given location will vary from day to day. A large set of data acquired at Washington National Airport and Dulles International Airport (24 locations over 500 days) indicates that standard deviations in L_{dn} are generally 2 dB or less.

for long term measurements

d. For daily L_{dn} standard deviations of 2 dB, it can be shown from simple statistical theory that a sample of 10 days (L_{dn}) will provide an estimate of the actual yearly L_{dn} accurate within 1 dB with 90 percent confidence. This "sample of 10" requirement involves the assumption that measurements are conducted on days when no bias exists in the airport operation. In order to assure "average" conditions over the 10 days, it is recommended that data be acquired for each direction of airport operation in proportion to the proper (annual) percent.

e. Thus one way to estimate the yearly L_{dn} value is to conduct 10 random (representative) 24 hour measurement surveys. Measurement equipment is available which, left unattended, can measure three consecutive daily L_{dn} values.

f. In lieu of conducting 24 hour continuous measurements in order to acquire a days L_{dn} data, it is possible to conduct a shorter sample and then estimate the L_{dn}. The method of extrapolation must be carefully documented and must demonstrate that the short sample is "representative" of the average operation during the day. The requirement of 10 representative days remains a requirement for estimating the yearly average L_{dn}. Two "shorter than 24 hour" sampling techniques are available. One involves measuring the noise during a period in which the mix of aircraft and the number of aircraft are representative of daily average values. Calculations are then needed for the nighttime weighting and to account for the present nighttime operations and curfew restrictions (if applicable) to arrive at an estimate of L_{dn} for the day. The second technique involves quantifying average single event L_{AE} values by aircraft type. The average L_{AE} data must reflect yearly average variability for the particular aircraft type. The yearly average L_{dn} is then computed from the mean L_{AE} data along with a knowledge of the airport mix and the daily operations schedule. This technique however, involves certain difficult to answer questions:

(1) How many measurements are needed for each aircraft type?

(2) How many measurements on any one day?

(3) How many total days of sampling?

Because of difficulty in identifying a statistical rationale, one may choose to use the first technique described in this subparagraph.

224. VALIDATION NOISE MEASUREMENTS VERSUS MICRO-SAMPLE SURVEY MEASUREMENTS. In any measurement program there is the tradeoff to be considered between the statistical confidence interval for the measured data and the available manpower and time. In survey work, the usual objective is to achieve a practical level of accuracy at many locations rather than highly accurate data at a few. When conducting a short survey which includes numerous measurement locations and a single measurement system, one implicitly

accepts the medium accuracy confidence level associated with the survey. These survey-measured levels accurately represent the acoustical environment at the time of the measurement. Short samples or surveys remain the most effective means (given limited time or resources) for quantifying the magnitude or environmental noise problems which affect large areas of a metropolis. If survey type measurements are utilized, it is important to identify them as such. In presenting single event survey data one should indicate means, standard deviations, and sample sizes. Care should be taken to avoid assigning statistical confidence limits to estimated daily L_{dn} values based on survey data unless the analytical and computational process is clearly set forth. This presentation is even more important when establishing an estimate of yearly average L_{dn} based on survey data alone.

225. AIRCRAFT NOISE EXPOSURE PREDICTION REFINEMENT PROCEDURE. The flow diagram shown in Figure 1 sets out the process by which FAA approved noise contours can be refined. Detailed modeling requirements are provided in Section 3 along with FAA approved procedures and standards. The key feature of this process is the "feedback loop" provided by L_{dn} data acquired either from continuous airport noise monitoring systems or from limited field measurement programs. This prediction refinement process (Figure 1) allows the contour analyst a chance to reevaluate the input assumptions and seek a reasonable explanation for differences (if any) between measured and predicted values. If suitable justifications can be provided, the analyst reruns the noise prediction model with new or modified inputs. Theoretically, several iterations could be run if justified on the basis of better input assumptions.

226. CONTINUOUS AIRPORT NOISE MONITORING SYSTEMS. There are several optional measures which may be undertaken as part of an airport noise compatibility program and which can enhance its effectiveness. Continuous airport noise monitoring systems fall into this category. Such systems can provide important input to the process of refining airport noise contours. (Contact AEE-120 for specific details). In brief, any FAA approved noise monitoring system would have the following minimum capabilities:

a. Provides continuous measurement of dBA at each site.

b. Provides hourly L_{eq} data.

c. Provides daily L_{dn} data.

d. Provides single event maximum A-weighted sound level data.

Desirable but nonessential capabilities include:

AIRCRAFT NOISE EXPOSURE PREDICTION

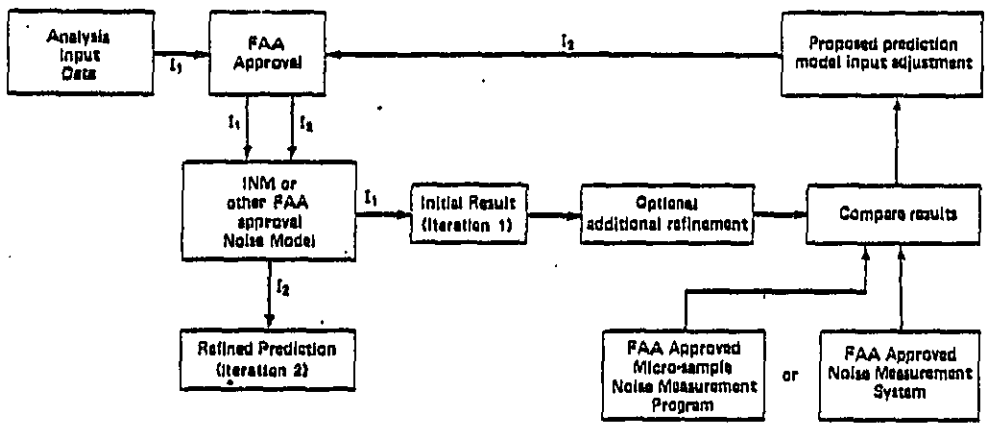

FIGURE 1

(1) Aircraft event discrimination ability.

(2) Single event L_{AE} data for each aircraft event.

(3) Differentiation between ambient and aircraft contributions to hourly Leq and L_{dn}.

(4) Monitoring data can be used to develop a statistical data base of noise levels for each aircraft type category.

227.-229. RESERVED.

SECTION 3. NOISE EXPOSURE PREDICTION

230. PREDICTION ANALYSIS TOOL. Only a computer-based mathematical model is capable of predicting the noise impact associated with the operation of a complex airport and projecting that impact to some future period. FAA approval of a model is conditional on the capability of that model to produce the required output and the public availability of the model to provide interested parties the opportunity to substantiate the results. Accuracy of a noise prediction model is measured by the statistical comparison of the noise exposure calculations derived from the data base and observations of the noise emitted during operations of similar aircraft types. Statistically adequate samples of observations are obtained over periods of a year or more.

231. INTEGRATED NOISE MODEL (INM). The FAA's Integrated Noise Model is the standard prediction analysis tool to which all computer-based airport noise exposure models are compared. The INM calculates the total impact of aircraft noise at or around airports. Although this noise exposure level can be presented in contours of equal noise exposure for any one of the following noise measures; Noise Exposure Forecast (NEF), Equivalent Sound Level (Leq), Day-Night Average Sound Level (L_{dn}), and Community Noise Equivalent Level (CNEL); only the L_{dn} is approved for use with Part 150. In January 1978, the FAA released Version 1 of INM to provide an analytical tool for the preparation of environmental impact studies. In September 1979, the FAA released Version 2, an improvement to the first version, with an expanded data base and additional input options. Version 3 reflects further enhancements in the method of determining noise impacts and in the data base of individual aircraft noise and performance. FAA has shipped magnetic tapes of the INM to government offices, consultants and various foreign countries. Tapes are also already in the possession of several commercial computer time-share vendors, thus offering broad accessibility on national and even international levels. Wider distribution is envisioned for later versions which will be more readily adaptable to a variety of large computers. In addition, the FAA has conducted an INM validation project to determine the accuracy of both the computational methods and data base of the model by comparing the model's noise exposure calculations with measured levels. The first phase of validation was an analysis of air carrier flights over the monitoring system at Washington National and Dulles International Airport. Information on the continuing validation project, availability of INM documents and tapes can be obtained through the Office of Environment and Energy (AEE-120).

232. INPUT REQUIREMENTS. The first step in running an airport case study is to gather the necessary data and organize it in the way which is recognized by the computer program. While the INM and similar models are accompanied with sets of aircraft noise and performance information, information on airport geometry and aircraft movements is also necessary.

The gathering of information is a time consuming process. Care must be taken in defining program input, especially in those situations in which a clearcut choice does not exist among similar items. There is also the problem of conflicting estimates of the airport operations from the airport manager, tower chief, airline operators and others. The following information needs to be obtained for input to INM computer program:

a. A map of the airport and its environs at an adequately detailed scale not less than 1 inch to 8,000 feet. It should indicate runway length, alignments, landing thresholds, takeoff start-of-roll points, and flight tracks out to at least 30,000 feet from the end of each runway. The locations of the nominal flight tracks are important. Exposure to aircraft noise is highest directly underneath the flight profile.

b. Airport activity levels and operational data which will indicate, on an annual average-daily-basis, the number of aircraft, by type, which utilize each flight track, in both the day time (7:00 a.m. to 10:00 p.m.) and nighttime (10 p.m. to 7 a.m.) periods for both landings and takeoffs. The INM offers a wide selection of aircraft types from which to choose. However, the model does not contain every combination of aircraft and engine types. Decisions on equivalent types must be carefully thought out with respect to possible ramifications to the calculation of exposure.

c. Landing glide slopes, glide slope intercept altitudes, and other pertinent information needed to establish approach profiles, along with the engine power setting for each aircraft type to fly that approach profile.

d. Takeoff flight profiles (the relationship of altitude to distance from start-of-roll and associated engine power settings for each aircraft type to fly that takeoff profile); these data must reflect the use of noise abatement departure procedures and, if applicable, the takeoff weight of the aircraft or some proxy for weight such as stage length. The INM data base contains a set of representative profiles for each aircraft type. The INM profiles conform to a widely used procedure. However, local conditions may preclude the use of these profiles in favor of a local standard procedure.

e. Any topographical or airspace restrictions which preclude the use of alternative flight tracks.

f. Government furnished data depicting aircraft noise characteristics. The standard data can be refined with on-site measurements by the procedure described in Section 234.

g. Airport elevation, wind conditions and average temperature.

233. ACCURACY. As is the case with any computer program or with any prediction method, the accuracy of the output of the Integrated Noise Model is directly dependent upon the appropriateness, completeness, and accuracy of the input data. Use as input of average flight tracks, flight procedures, aircraft types and mix, and the schedule of operations can

degrade the accuracy of the predicted contours. Further, the effects of local topography, weather, buildings, etc., cause variations from point to point along a contour. Accordingly, the accuracy of the INM computer noise prediction model in estimating the yearly average L_{dn} value at any specific geographical point has been estimated to be L_{dn} 75 contours $\pm$ 3 dB and L_{dn} 65 contours $\pm$ 5 dB with the average error over all points along the contour tending towards zero.

234. USE OF MEASUREMENTS IN REFINING/VALIDATING PREDICTIONS. On completion of a noise exposure map, one may find that the noise contours vary somewhat from measured conditions due to external influences that are not accounted for in the INM. This problem is not unexpected for a sophisticated model such as INM, since it is very difficult to compensate and model for all the variables that influence the noise environment. If a permanent and continuous noise monitoring system is in place, the airport operator may be able to calibrate the model specifically for that airport. The data acquisition will assist the airport operator in identifying specific problem areas based upon on-site measurements. A noise monitoring system may also allow the operator to fine tune or calibrate the output of the INM for specific conditions that cannot otherwise be accounted for. Thus the operator may be able to improve the noise compatibility program and the noise exposure map.

235. NOISE COMPATIBILITY PREDICTION. Different uses of the land have different sensitivities to noise. Individuals may each have different perceptions of what is an acceptable or an intruding level of noise. The background or residual noise against which a specific noise is perceived varies both by location and by time of day. Even the specific situation of the receiver, such as outdoor, indoor with windows open or closed, as well as one's activity of the moment affect the perception of a noise as intruding or not intruding. Regardless of the human activity, however, the associated noise sensitivity must be translated into a land use category for planning and regulatory purposes. The ASNA Act requires the FAA to identify land uses that are "normally compatible" or "noncompatible" with various levels of noise exposure by individuals. This was done in Part 150 and is used in developing and reviewing airport noise exposure maps and airport noise compatibility programs. It is important to recognize, however, that land use guidelines (even those adopted by regulation) are a planning tool and as such provide general indications as to whether particular land uses are appropriate for certain measured or calculated noise exposure levels.

236. BASIS FOR NOISE COMPATIBILITY. The adverse effects of noise exposure on people can be grouped into three general categories: degradation of health, attitudinal reactions, and activity interference. The first category, which includes hearing loss, is not normally encountered from aircraft sources at any point outside the airport boundary. However, the noise levels defining the thresholds of interference with noise-sensitive human activities, such as sleep and speech thresholds, are lower and airport noise can affect compatibility or noncompatibility.

a. Interference with human activity. These may generally be grouped as sleep interference; speech interference; interference with study, concentration, or critical tasks; interference with the performing arts; interference with outdoor activities; and interference with warning sounds.

(1) Sleep Interference. Interference with sleep activity is critical in hospitals, nursing homes, and certain other health facilities, and is important in individual homes. The zero interference threshold inside such health facilities is 40 dBA (Report No. DOT-FAA-AEQ-77-9, Study of Soundproofing Public Buildings Near Airports, April 1977). Tests have shown that about 10 percent of people sleeping in a laboratory environment who were exposed to a noise level of 50 dBA were awakened. Most residences have ambient noise levels that are higher than might be expected in a laboratory. Due to this higher background noise level, fewer than 10 percent of those exposed to 50-55 dBA of interior noise from aircraft would be expected to be awakened (Metropolitan Washington Airport Policy, Supplement to the August 1980 Environmental Impact Statement, Final, September 1981).

(2) Speech Interference. Interference with speech is most critical in learning environments such as classrooms. It has been determined to be somewhat less critical in other activities where speech communications are important. At sound levels greater than 45 dBA speech interference can begin to occur (at distances of about 25 to 30 feet) in a classroom. (Study of Soundproofing Public Buildings, et. al).

(3) Study, Concentration, and Critical Tasks. These thresholds are more difficult to identify than are those for sleep or speech interference and are even more subjective. To a considerable degree, these thresholds are dependent upon the individual recipient, the task at hand, the background noise through which the specific noise intrudes, and the impulse characteristics of the noise. The absence of recognized standards should not, however, prevent adequate consideration being given to these sensitive tasks whenever it is appropriate.

b. Relationship to Self-Generated Noise. Part 150 directs that no use or activity should be considered to be noncompatible as a result of airport noise if its own self-generated noise equals or exceeds the airport noise.

c. Relationship to Background Noise. Steady state background (ambient) noise which equals or exceeds the maximum noise resulting from individual aircraft events effectively masks uses in the immediate locale from aircraft noise impact. Hence, Part 150 directs that no uses in such an area should be considered to be incompatible. However, such cases can be determined only by analyzing the average 24 hour pattern of ambient noise and comparing it with the time of day distribution of aircraft events.

d. Noise Attenuation. Attenuation of noise, or outdoor to indoor Noise Level Reduction (NLR) through blocking of noise paths or soundproofing measures can reduce the intrusive impacts of noise. Where appropriate, NLR may be taken into account in determining the compatibility of indoor uses or activities. Inasmuch as this implies that windows and doors must be closed and that air conditioning or artificial ventilation must be used, due consideration should be given to the living environment and quality of life before using NLR to place individual residences or schools into a "compatible" designation. Consideration should also be given to the possible impacts upon outdoor and indoor-outdoor living and activities.

237. LAND USE COMPATIBILITY TABLE. FAR Part 150 contains a table, Land Use Compatibility With Yearly Day-night Average Sound Levels, identifying land uses that are "normally compatible" or "noncompatible" with various levels of noise exposure. Appendix 1 contains that table, but expands the list of uses under most categories in order to be more useful. The expanded land use descriptions are based upon the Standard Land Use Coding Manual (SLUCM) published by the Federal Highway Administration and the Department of Housing and Urban Development in 1965. The levels of noise exposure, in yearly day-night average sound levels (L_{dn}) correspond to the contours required to be shown on Airport Noise Exposure Maps. The table indicates compatibility of the land uses with the outdoor noise environment. By comparing the predicted or measured yearly L_{dn} level at a particular site with the values given in the table the range of compatible uses may be determined. In using the land use compatibility table, the following cautions should be observed:

a. L_{dn} contours indicate the boundaries lines between areas of acceptable or unacceptable noise exposures for the various land uses in Appendix I. The contours do indicate the trend in relative noise levels. However, vegetation, land contours, and the position of buildings or walls may often affect the impact of noise on the human users at a specific site.

b. L_{dn} levels may vary somewhat above or below the predicted levels for a particular location, depending upon local topography and vegetation, and upon final aircraft loadings and operations.

c. Although all land uses may be considered as normally compatible with noise levels less than 65 L_{dn}, local needs and values may dictate further delineation based on specific local requirements or determinations as well as low ambient levels.

d. When appropriate, noise level reduction may be achieved through incorporation of sound attenuation into the design and construction of a structure to achieve compatibility. However, more specific noise measurement and analysis is generally advisable prior to incurring the expense of such sound treatment. The cautions mentioned in paragraph 236d should be observed when applying Noise Level Reduction (NLR) to residential uses or other uses where indoor-outdoor activities are important.

e. Other local noise sources may often contribute as much as or more than aircraft to the total noise exposure at a specific location.

f. Compatibility designations in the table generally refer to the major use of the site. If other uses with greater sensitivity to noise are permitted at a site, the compatibility determination is based upon the use which is most adversely affected by noise.

g. Designations contained in the table do not constitute a Federal determination that any use of land covered by the program is acceptable or unacceptable under Federal, State, or local law. The responsibility for determining the acceptability and permissible land uses remains with the local authorities.

h. Although Table 2 of FAR Part 150 defines the compatibility or noncompatibility of various land uses for the purposes of Federal aid, programs, or sanctions under the ASNA Act, adjustments or modifications of the descriptions of the land use categories may be desirable after consideration of specific local conditions.

238. INTERPRETATION OF NOISE EXPOSURE MAPS. Note that it is possible that the process of plotting noise contours onto locally generated land use maps may introduce a degree of charting imprecision, especially relative to property lines on the land use map. For the purpose of Section 107 of the ASNA Act, as amended, questions may arise concerning the precise relationship of specific properties to noise exposure contours depicted on a noise exposure map submitted under Section 103 of that Act. The FAA is not involved in any way in determining the relative locations of specific properties with regard to the depicted noise contours, or in interpreting the noise exposure map to resolve questions concerning which properties should be covered by the provisions of Section 107. These functions are inseparable from the ultimate land use control and planning responsibilities of local government. Therefore, the responsibility for the detailed overlaying of noise exposure contours onto the map of subjacent properties on the surface rests exclusively with the airport operator which submitted those maps, and/or with those public agencies and planning agencies with which consultation is required under Section 103 of the Act. In its decisions to accept noise exposure maps, the FAA relies on the certifications, by the airport operator that this statutorily required consultation has been accomplished.

239.-299. RESERVED.

CHAPTER 3. AIRPORT NOISE COMPATIBILITY PLANNING

SECTION 1. ELEMENTS OF AIRPORT NOISE PLANNING

300. GENERAL. This chapter discusses the airport noise compatibility planning process and forms the primary background for preparing airport noise compatibility programs under FAR Part 150. In addition, noise control and noise impact abatement actions available to both airport operator and neighboring communities are discussed. Equal emphasis is placed upon urban planning and airport operational solutions. Throughout the chapter, emphasis will be placed upon reduction of airport noise (present and future) to the practical minimum; long-term protection of the agreed-upon noise impact areas from development with noncompatible uses; and actions to reduce the noncompatibilities remaining within those noise impact areas to acceptable levels.

301. NOISE COMPATIBILITY PLANNING. Airport Noise Compatibility Planning is a joint planning effort which examines and weighs both aviation and urban planning strategies in seeking long-term solutions to existing and or future noise conflicts around an airport. Local consultation and citizen participation are key elements of the process. This includes the participation of airport users, affected local governments and airport neighbors, as well as the airport's operator. Section 103 of the ASNA Act requires that noise exposure maps be prepared in consultation with public agencies and planning agencies in areas surrounding the airport. FAR Part 150 requires consultation with the users and the agencies with land use control jurisdiction or planning responsibilities lying within the airport's 65 L_{dn} contour. Citizen participation in the planning and decisionmaking processes which affect their lives and property is now recognized as a cornerstone of planning and should be integrated into that process. See FAA Advisory Circular 150/5050-4, Citizen Participation in Airport Planning, and Report No. FAA-EE-79-06, Community Involvement Manual, for more detail on this subject.

302. SCOPE OF THE PLANNING EFFORT. The scope of the planning effort will, of course, vary considerably, depending upon the extent and complexity of the noise problems at a given airport. However, the planning effort should be sufficient to identify the most viable alternative of those which might be proposed, to demonstrate that it is equitable to those affected, and that is fully implementable. This planning should be integrated into the existing or ongoing comprehensive planning for the region involved and should be realistic in its regard for monetary costs and its ability to generate the local planning and land use control actions necessary for its implementation and longevity. FAA does not regulate or direct the consultative process of local governments, but will rely on the certification by the airport operator, under Section 150.21 of Part 150, concerning such consultation.

303. THE CONTEXT OF AIRPORT NOISE PLANS. The Airport Noise Compatibility Planning Program should be viewed as a more detailed segment of the overall comprehensive planning for the area. It should first determine the extent of existing problems (if any) and the effects of airport and air traffic growth trends, and then determine the needs and values of both the airport users and those impacted by the airport. The planning program must explore with equal vigor both aviation and urban planning solutions to the problems. Each viable solution or combination of solutions is then tested against the realities of the social, economic, and environmental needs of the community(s) served and of the State and the Nation. It should also be recalled that aviation growth is not only a function of community growth but also the per capita usage of aviation.

304. THE OBJECTIVES OF PART 150 PLANNING. The objective of the planning effort is to find reasonable solutions to the noise problems and to present solutions that can be implemented. Although FAA environmental assessment of the compatibility program is not required prior to FAA approval or disapproval within the 180 day review period, each element or combination of elements going into the program should be capable of passing such a test prior to implementation. Failure to do so may seriously delay FAA funding of projects to carry out approved programs if, through the sponsor's failure to adequately assess those impacts, the FAA is forced to deal with these impacts without adequate environmental data at the funding stage. FAR Part 150 also requires that adequate provision be included for periodic review and updating of the compatibility program to account for changes in airport operations.

305. USE OF LOCAL OR STATE STANDARDS. The land use compatibility chart (Appendix 1) is derived from FAR Part 150 and contains land uses that have been identified as "normally compatible" with various levels of noise. The values for residential uses are based upon studies of noise-induced annoyance. For other land uses, the values are based primarily upon noise-induced interference with speech communication or upon interference with the critical activity associated with the use. However, in applying the table, it should be kept in mind that no two communities are likely to have situations or value systems that are identical. Adjustments to the land-use categories and noise levels may be necessary in considering specific local conditions. These decisions should be made early in the compatibility planning process. Citizen participation in this key element of the planning is advisable.

306. DEVELOPMENT OF ALTERNATIVES AND IMPLEMENTATION STRATEGIES. Development of reasonable alternatives is the nucleus of the compatibility planning process. The objective is to explore a wide range of feasible options and alternative compositions of land use patterns, noise control actions, and noise impact patterns, seeking optimum accommodation of both airport users and airport neighbors within acceptable safety, economic, and environmental parameters. Consideration of alternatives should address both physical planning and the implementation aspects of proposed solutions. It is, however, unlikely that any single option, by itself, will be capable of totally solving the problem(s) without having objectional impacts of its own. Some of the options may have little or no value in the situation,

especially if used alone. Realistic alternatives, then, will normally consist of combinations of the various options in ways which offer more complete solutions with more acceptable impacts or costs. Each alternative considered should: have the potential of resolving the problem(s); be implementable within acceptable economic, environmental, and social costs; and be legally implementable within existing State/Federal legislation and/or regulation. Brief summations or estimates indicating how these criteria are to be met should be prepared for each alternative. A sufficiently wide range of alternatives should be developed to assure that all reasonable routes to the ultimate solution have been explored and that there is a sufficiently broad range of choices available to give credibility to the studies. The matrix of noise control actions shown in Figure 2 on the following page, while not necessarily exhaustive, illustrates an array of options or possible solutions to a cross section of noise compatibility problems.

307.-319. RESERVED.

SECTION 2. AIRPORT PROPRIETOR OPTIONS

320. DENIAL OF USE TO AIRCRAFT NOT MEETING FEDERAL NOISE STANDARDS. This strategy may be implemented by limiting access to the airport to aircraft that conform with certain FAR Part 36 standards. Most turbojets and other large aircraft produced after 1974 already meet those standards; so do most propeller-driven light airplanes. In addition, older turbojets over 75,000 lbs. maximum gross weight must (under FAR Part 91) be either retrofitted with quiet engines or be replaced by certain specific dates. The ASNA Act also directs that certain classes of aircraft be exempt from compliance with FAA noise standards until certain dates. Denial of the use of an airport to such aircraft prior to the Part 91 or ASNA Act prescribed retirement dates might force some owners to retrofit or replace the aircraft to meet Part 36 standards in order to continue to operate at the airport during the interim period. To this extent, such local rules are in conflict with the Federal scheme and should be avoided.

321. CAPACITY LIMITS BASED ON NOISE. Airport use restrictions are sometimes based upon noise limits. However, such restrictions often have uneven economic consequences and should be employed only after careful consideration of other alternatives and after thorough consultation with the affected parties. Some of the forms that such restrictions might take are as follows:

a. Restrictions based on cumulative impact. Under this strategy, a maximum cumulative impact (such as the total area within the L_{dn} 75 contour) is established and then the airport's operations are adjusted or limited so as to not exceed that maximum. This is done through "capacity limitations," e.g., limiting either the aircraft types based upon their noisiness, or the numbers and mix of aircraft so as to respect the established cumulative noise exposure restriction.

FIGURE 2

MATRIX OF NOISE CONTROL ACTIONS

CONSIDER THESE ACTIONS ▼ / IF YOU HAVE THIS PROBLEM ➤			Noise from Taxiing	Departure	Approach	Landing Roll	Training Flights	Maintenance	Ground Equipment
AIRPORT PLAN	Changes in Runway Location, Length or Strength	1	●	●	●	●	●		
	Displaced Thresholds	2			●		●		
	High-Speed Exit Taxiways	3	●			●			
	Relocate Terminal	4	●					●	●
	Isolating Maintenance Runups or Use of Test Stand Noise Suppressors and Barriers	5	●					●	●
AIRPORT AND AIRSPACE USE	Preferential or Restricted Runway Use *	6	●	●	●	●	●		
	Preferential Flight Track Use or Modification to Approach and Departure Procedures *	7		●	●		●		
	Restrictions on Ground Movement of Aircraft *	8	●						
	Restrictions on Engine Runups or Use of Ground Equipment	9						●	●
	Limitations on Number or Types of Operations or Types of Aircraft	10	●	●	●	●	●	●	●
	Use Restrictions Rescheduling Move Flights to Another Airport	11	●	●	●	●	●	●	●
	Raise Glide Slope Angle or Intercept *	12			●		●		
AIRCRAFT OPERATION	Power and Flap Management *	13		●	●		●		
	Limited Use of Reverse Thrust *	14				●			
LAND USE	Land or Easement Acquisition	15	●	●	●	●	●	●	●
	Joint Development of Airport Property	16	●	●	●	●	●	●	●
	Compatible Use Zoning	17	●	●	●	●	●	●	●
	Building Code Provisions and Sound Insulation of Buildings	18	●	●	●	●	●	●	●
	Real Property Noise Notices	19		●	●	●	●	●	●
	Purchase Assurance	20		●	●	●	●	●	●
NOISE PROGRAM MANAGEMENT	Noise-Related Landing Fees	21	●	●	●	●	●		
	Noise Monitoring	22		●	●		●	●	
	Establish Citizen Complaint Mechanism Establish Community Participation Program	22	●	●	●	●	●	●	●

* These are examples of restrictions that involve FAA's responsibility for safe implementation. They should not be accomplished unilaterly by the airport operator.

b. Restrictions based upon certificated noise levels. Most aircraft types in general service today have been certificated for noise by the FAA. Consequently, it possible to devise limitations based upon those certificated data. Such limitations might take the form of threshold noise levels for the airport or different levels for day and night at the airport.

c. Restrictions based upon estimated single event noise levels. Since aircraft noise levels vary widely with changes in operational procedures, it may be possible to set limits on estimated single event noise levels. However, it should be noted that this does not mean that the airport operator or community can set up a microphone and a noise level limit and challenge the pilots to "beat the box." The FAA considers this to be unsafe and has never approved such a scheme. Instead, a target noise level limit or threshold is discussed in advance with the FAA and the aircraft operators and an appropriate level is selected, balancing the needs of aviation and the noise impacts on the community. FAA Advisory Circular 36-3B, Estimated Airplane Noise Levels in A-Weighted Decibels is useful with this option.

322. NOISE ABATEMENT TAKEOFF OR APPROACH PROCEDURES. A basic noise mitigation strategy is the use of noise abatement takeoff and landing procedures. There are a number of alternatives within this strategy, including runway selection, takeoff and landing profiles and power settings, and approach or departure paths. Runway selection has an obvious relationship with wind vectors, runway lengths, aircraft peformance and tolerance for crosswinds, and safety. Within these parameters, however, there is often a significant range of acceptable options. Some of these options may well offer significant relief to the airport's noise impact problems, especially when linked with appropriate landing and takeoff profiles and approach-departure paths. Takeoff and landing profiles and their attendent power and flap settings can be adjusted so as to offer relief to either close-in or more distant noise sensitive areas. These options are covered in more detail in other FAA documents such as Advisory Circular 91-53. Similarly, there are also often a number of viable choices for approach and departure paths. Some of these options may only be available during visual flight reference conditions, while others may be unavailable to certain aircraft. The objective is to achieve the greatest noise relief within the parameters of safety and economics and in coordination with the compatible land use strategies being developed for the airport's noise compatibility programs. Since FAA approval of these procedures is required, there should be discussion with the FAA region early in program development.

323. LANDING FEES BASED ON NOISE. This strategy bases all or a portion of the landing fee upon the noisiness of the individual aircraft, thus apportioning the fees to the relative noise "cost" of the operation to the airport's proprietor. The strategy encourages the use of quieter aircraft while producing additional revenue to offset noise induced expenses. For maximum benefit, noise fees should be used in concert with other noise abatement strategies. A steeply sloped-noise fee curve would offer additional disincentive to continued use of the noisiest aircraft. Noise fees could also be used differentially to help shift noisier aircraft from a close-in, urban impacted airport to an outlying airport with greater noise capacity. To avoid discrimination the noise fee for each aircraft should be based upon standard single event noise ratings for the aircraft, such as those published by the FAA in Advisory Circular 36-3B (subject to the limitations contained in its preamble). The reverse strategy can also be applied. Instead of assessing a fee, an airport operator can reward air carriers who go to extra lengths to reduce noise generated by their aircraft by providing a discount or a reduction in landing fees. This might also act as an incentive for air carriers to use one airport over another in special circumstances.

324. NOISE BARRIERS (SHIELDING). Ground-level noise sources on an airport include run-up and maintenance areas, taxiways and freight warehouse areas. Because the noise is generated on the ground, the impact is usually confined to those areas immediately adjacent to the source. An effective method of mitigating this type of noise impact is through use of sound barriers or berms. "Hush houses" may be appropriate in engine maintenance areas. Strategic placement of new hangar or terminal structures on the airport may also be used. These wil shield adjacent neighborhoods by absorbing and third method is the movement of run-up and maintenance operations to an area of the airport away from the community. One common misconception is that trees or bushes will provide substantial attenuation of sound. This is not true except when bands several hundred feet wide are used and when they are planted thickly with both trees and underbrush.

325. ACQUISITION OF LAND AND INTEREST THEREIN. Purchase of sufficient land area to totally contain the significant noise impacts of an airport is usually impractical. Not only is it very costly, but it removes too much potentially valuable land from local tax rolls. However, certain land areas are often much more critical to achieving or maintaining an airport's noise compatibility than are others. Purchase of full or partial interest in such lands may be the only way the airport can be assured of long-term protection. Acquisition by the airport of development rights for all but noise tolerant development via easement in these critical areas may often be accomplished at much less cost than purchase in fee-simple. Compatible development under such restrictions should enhance the airport as well as the local tax rolls.

326. COMPLETE OR PARTIAL CURFEWS. Curfews are an effective though costly method of controlling noise intrusion into areas adjacent or in proximity to an airport. They should be reserved as a strategy of last resort, however, when all other options have been shown to be clearly inadequate, because of their drastic negative impacts upon both aviation and the community's benefit from aviation. They can take various forms, from restrictions upon some or all flights during certain periods of the day through restrictions based upon noise threshold and certificated aircraft noise levels (see AC 36-3H). Since unwanted noise intrusions are most pronounced in the late evening or early morning hours, curfews are usually implemented to restrict operations that occur during those periods. The period of 2200 hours to 0700 hours is when most people are resting and are most sensitive to noise intrusions. However, it should be pointed out that curfews have economic impacts upon airport users, upon those providing airport-related services, and upon the community as a whole. Other communities may also be impacted through curtailment of service. Thus undue burden on interstate or foreign commerce is a specific concern of the ASNA Act. Therefore, curfews should only be considered after careful consideration of other alternatives and after thorough consultation with the affected parties.

327.-329. RESERVED.

SECTION 3. STATE/LOCAL GOVERNMENT OPTIONS (STRATEGIES TO PREVENT NEW NONCOMPATIBLE DEVELOPMENT)

330. DEVELOPMENT CONTROL. Land use and development controls based upon a well worked out compatible land use plan is among the most potent and affordable of all the compatibility strategies. This is particularly so in still developing areas. The exercise of these land use and development controls is usually within the authority of local or county governments rather than in the airport operator. Even when the airport is operated by the same governmental body which exercises these controls there is often little recognition or action based on the needs in these critical areas. This emphasizes the need for a comprehensive approach to developing an airport noise compatibility program. A number of different controls are normally available to local governments and/or to airport operators to prevent intrusion of noncompatible development. The controls which are generally most useful for mitigating noise intrusions or achieving compatible land use within proximity to the airport are: zoning, easements, transfer of development rights, land purchase (for compatible public use), and capital improvements. In addition, local governments can consider establishing minimum acoustical insulation standards, expressed as Sound Transmission Coefficients (STC) for new residential dwellings within high noise impact contours. Appropriate expertise should be consulted in developing such a code.

331. ZONING. The most common land use control is zoning. Zoning is an exercise of the police powers of a state or local government which enables that government to designate the uses that are permitted for each parcel of land. It normally consists of a zoning ordinance which specifies land development and use constraints. One of the primary advantages of zoning is that it may be used to promote land use compatibility while leaving the land in private ownership, on the tax rolls, and economically productive. Although most cities and larger towns have zoning authority, it should be remembered that rural areas often are not subject to this remedy, since in many states counties have only limited (or no) zoning authority.

a. Use of Zoning. In order for zoning to work effectively it should be based upon a comprehensive plan. This plan must consider the total needs of the community along with the specific needs of the airport. A comprehensive plan defines the goals and objectives of a community and zoning is one of the tools available to the community for implementing that plan. Zoning can and should be used constructively to increase the value and productivity of the affected land. For zoning to be viable, there should be a reasonable present or future need for each designated use. Within its limitations, zoning is a preferred method of controlling land use in noise impacted areas.

b. Limitations of Zoning. Zoning has a number of limitations which must be considered when using it as a compatibility implementation tool:

(1) Zoning is not necessarily permanent. In most jurisdictions, the current legislative body is not bound by prior zoning actions and it may change that zoning. Consequently, zoning which achieves compatibility is subject to continual pressure for change from both urban expansion and those

who might profit from such changes. Also, from time to time the entire zoning ordinance for a jurisdiction will be updated to accommodate increased growth or incorporate new land use concepts.

(2) Cumulative zoning can permit noncompatible development. A number of communities still have "cumulative" type zoning districts which permit all "higher" uses (such as residential) in "lower" use districts (such as commercial or industrial), thus permitting development that may be incompatible. In these instances it would be necessary to prepare and adopt new or additional zoning use districts of the "exclusive" type which clearly specify the uses permitted and exclude all other uses.

(3) Zoning is usually not retroactive. Changing zoning primarily for the purpose of prohibiting a use which is already in existence is normally not possible. In some jurisdictions, any zoning or rezoning that affects current land uses may not pass state constitutional tests. However, if such zoning is permissable and is accomplished, the use may be permitted to remain as a "nonconforming" use until such time as it is changed voluntarily to a conforming use or until the owner has had ample opportunity to recoup his/her investment.

(4) Zoning controls are normally applicable to those areas within the boundaries of the zoning jurisdiction. Noise impacts with airport operation, however, often span more than one such jurisdiction. Therefore, effective zoning requires the coordinated efforts of all the involved jurisdictions. Zoning which implements a land use compatibility plan will often be a composition of existing and new zoning districts within each of the jurisdictions covered by the plan. Often, each jurisdiction will have a different zoning ordinance with districts having different applicability for implementing the compatibility plan.

332. EASEMENTS. An easement is a right held by one person to make use of the land of another for a limited purpose. In the context of airport noise compatibility planning, two general types of easements are possible: positive easements to allow someone to make noise over the land and negative easements to prevent the creation or continuation of unprotected noise sensitive uses on the property. Easements can be an effective strategy for assuring compatible development around airports. A major advantage of easements for controlling land use around airports is that they can be permanent, whereas zoning may be easily changed. Additionally, easements often may be acquired for a fraction of the total value of the land and thus be less expensive than outright purchase. Acquisition of easements does not reduce the noise impacts on people or by and of itself change noncompatible land uses to compatible uses. However, the purchase of price can and should be dedicated to the soundproofing and or use change necessary to achieve compatibility. The most important advantage of easements over full acquisition is that the land is left on the tax rolls and remains free for compatible development by its owner(s).

a. Obtaining Easements. Easements may be obtained in a number of ways including purchase, condemnation, and dedication. For each easement acquired, consideration may be given to including a legal description of the noise that may be created over the property, describing classes of uses which may be established or maintained with and without soundproofing, and, where applicable, granting an avigation easement.

b. Purchase. Easements may be purchased via negotiation with the price based upon the value to the owner of the rights surrendered. Timing can have a significant effect upon the price paid; once the subject land has gotten into the arena of speculation, prices tend to rise quickly.

c. Condemnation. Easements, may also be obtained by condemnation, in a manner similiar to full rights condemnation. The cost, while still likely to be less than that of outright acquisition (fee simple) of the land, is likely to be significantly higher than similar rights obtained via negotiation because of the time and court costs involved. Also, the cost of any ill will generated by a condemnation action, while difficult to measure, can be significant.

d. Dedication. Dedication is another way to obtain easements. Subdivision regulations governing the development of land for industrial or other purposes can include provision for dedicating private land or easements upon private land for public purposes. When easements for airport-environs compatibility are considered necessary and when they are determined to be compatible with the intended use of the land, the need for such easements may be required by local agencies in the approval of subdivision dedications.

333. TRANSFER OF DEVELOPMENT RIGHTS (TDR). TDR involves separate ownership and use of the various "rights" associated with a parcel of real estate. Under the TDR concept, some of the property's development rights are transferred to a remote location where they may be used to intensify allowable development. With TDR, for example, lands within an airport's noise impact area could be kept in open space or agricultural uses and their development rights for residential uses transferred to locations outside the area. Landowners could be compensated for the transferred rights by their sale at the new locations or the rights could be purchased by the airport. Depending upon market conditions and/or legal requirements, the airport could either hold or resell the rights. The TDR approach must be fully coordinated with the community's planning and zoning. It may be necessary for the zoning ordinance to be amended in order to permit TDR's. Also, such transfers must usually be contained within single zoning jurisdictions.

334. PURCHASE. There are often locations or circumstances within the noise impact areas which leave little choice other than direct acquisition of full or partial interest in the impacted land by either the airport sponsor or, perhaps, by state or local levels of government. Purchase of noise impacted land is the most direct (and usually the most expensive) of all forms of land use control. However, when combined with either resale for compatible

purposes can considerably enhance compatibility. Provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (P.L. 91-646) are applicable whenever Federal or federally-assisted programs are involved in such purchases.

335.-339. RESERVED.

SECTION 4. STATE/LOCAL GOVERNMENT OPTIONS (ACTIONS TO REDUCE EXISTING NONCOMPATIBLE USES)

340. REMEDIAL ACTIONS. In cases where there are already existing conflicts between land-use and airport noise, remedial or corrective actions may be appropriate. The degree of remedial action will be dependent upon the degree of urbanization around the airport. Where the noise impacts fall on predominately rural land or, where a new airport is built in an undeveloped area, there may be only a few scattered noncompatible uses to be resolved. In urbanized areas, however, remedial actions are complex and may be difficult to implement. Change to noise compatible usages, soundproofing, and acquisition of full or partial interest in the land are examples of possible actions that can be used to mitigate noise impacts. Changes in the use of noise impacted land or changes in occupancy to uses or occupations less sensitive to noise are obvious and practical strategies for resolving conflicts.

341. ENCOURAGEMENT OF EXISTING FAVORABLE TRENDS. Land use in urban areas is in a continual state of change and transition. Many of these changes tend to favor a turnover in land use from noncompatible to compatible. A typical example would be the transition of older residential areas into retail, commercial, or office uses. Encouragement and promotion of these trends can be through the implementation of public policy and local planning processes.

342. CONSTRUCTIVE USE OF PLANNING AND ZONING. Detailed planning of land within noise impact areas by local authorities and constructive uses of zoning changes can often improve both compatibility and land values. Noise sensitive uses cannot normally be forced to move by simply changing their zoning to a use district that is compatible. The existing uses must be permitted to continue under the new zoning as "Legal Nonconforming Uses" as long as the use is continuous and unchanged or until the owner has had an opportunity to receive a fair value from the use. This strategy then finds productive and compatible uses for the land which will give the present land owner a fair return on his investment in addition to covering his relocation expenses. The land should then be rezoned accordingly.

343. CONSTRUCTIVE USE OF PUBLIC CAPITAL IMPROVEMENT PROJECTS. Locating and programming of public works projects can exert strong influences over land use trends and demands. These include road construction and widenings, transit service, schools, parks or recreation facilities, water and sewer lines, and flood control projects. Exercised judiciously as an implementation tool for promoting compatible land use such capital improvements can be a powerful tool.

344. PURCHASE ASSURANCE PROGRAMS. Purchase guarantees can be applied to residential properties within lightly or short-term noise impacted areas to help assure their saleability. Such sales should then be to individuals not as sensitive to the noise impacts or who have trade off values for residing in these particular areas. Sales agreements should assure that all future purchasers are cognizant of the noise levels and sign appropriate releases or easements. The advantages of this strategy are its relatively low costs and its retention of otherwise viable residential areas.

345. SOUNDPROOFING. Soundproofing consists of increasing the exterior to interior sound transmission losses of a building by identifying those structural elements providing transmission paths and applying appropriate modifications to improve noise attenuation.

a. Metrics. The airport cumulative noise metric (L_{dn}) is useful as an indicator that soundproofing may be required in a particular area. However, when considering any specific building site within a cumulative noise exposure contour (representing significant noise impact) it is recommended that additional analysis via single event maximum sound level and/or sound pressure level versus frequency data be used to determine the necessity (and/or eligibility) for soundproofing. While L_{AS} is utilized to assess eligibility, the sound pressure levels in each of the one-third octave bands are required to design and implement soundproofing measures. The A-weighted sound level is more utilitarian than other single event metrics in establishing the need for soundproofing as many of the sleep, speech and activity interference criteria have been developed using L_{AS} levels.

b. Sealing Existing Leaks. In soundproofing most structures, the first five decibels of additional sound insulation usually can be obtained by sealing existing leaks. A very small gap or imperfect seal in an otherwise massive wall can result in only moderate sound attenuation.

c. Retrofit of Existing Buildings. For rehabilitation of existing buildings, soundproofing modifications include: replacement of existing windows with windows of greater sound transmission coefficient (STC) rating, or adding a second layer of glass; upgrading doors and seals; acoustic baffling of vents; adding insulation to walls and attic spaces; adding another layer of wall material to existing walls, in effect creating a two-panel wall; eliminating windows and filling the space to match exterior walls (only recommended to achieve noise reduction commensurate with the

potential capability of the wall). Some very effective soundproofing techniques, such as staggered studs or fiberboard under paneling are not suitable for retrofit because they would involve virtual demolition of the existing structure and construction of a new wall.

d. New Construction. For new sound-insulated construction, design considerations often include: using brick or concrete masonry walls, using staggered studs, insulation and fiberboard under interior and exterior finish materials; installing attic space insulation; properly baffling vents avoiding single joint roof constructions where interior and exterior materials are attached to the same rafters; avoiding exposed rafter ceilings with any roof material other than thick concrete and with no interior finish ceilings; installation of air conditioning; mortar should be free of pinholes; and all joints should be well sealed.

e. Energy Savings from Soundproofing. The soundproofing of buildings has two direct energy effects - increased energy consumption by air conditioning equipment due to the elimination of natural ventilation and reduction in heat loss due to the sealing of walls, windows and other openings. Energy savings realized by reduction of heat loss, will in the long run outscrip the increased energy consumption of air conditioning. One caution is in order however; a reduction in thermal energy transmission does not always accompany a reduction in sound transmission (e.g., concrete wall).

f. Cost/Benefit of Soundproofing. While soundproofing is both a feasible and practicable means of alleviating the impact of external noise, the analysis should be made on a case by case basis in concert with both acoustical and architectural expertise. The general condition, age and repair of a structure normally dictate the degree of soundproofing application. Also, the building's location and noise exposure levels must be quantified to identify the target "reduction in noise level." Before a soundproofing program is initiated, tradeoffs in costs and benefits should be carefully examined. If some form of cost sharing arrangement between the airport operator or a governmental agency and the property owner should be utilized, suitable agreements or easements for current and future aircraft noise should also be obtained.

346. ACQUISITION OF IMPACTED LAND. In some circumstances, there may be locations or circumstances within the noise impact areas which leave little choice other than direct acquisition of full or partial interest in the impacted land by either the airport sponsor or, perhaps, by state or local levels of government. As described in paragraph 343, constructive use of land purchases for other public purposes can also enhance compatibility.

Land or interest in land (easement) may be acquired by negotiation, through a voluntary program, or via condemnation. In any case, the provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (P.L. 91-646) are applicable whenever Federal or federally assisted programs are involved.

a. Land for Other Public Uses. Noise impacted land can be acquired by a public or semi-public agency either to implement the compatibility plan or in cooperation with the plan while fulfilling another public purpose. Typical uses may include sites for equipment maintenance or storage yards, water or sewer works, and floodways or reservoirs. Other possibilities include selected park, recreation, and open space uses which are noise tolerant (golf courses, skeet ranges, nature areas, etc.). All uses should respect the height and hazard requirements of the airport and be tolerant of future airport growth.

b. Land for Compatible Resale. Occasionally, state or local governments are willing to acquire land which is then resold with covenants or easements retained to assure long-term compatibility. In some cases, it may be feasible to change such land to compatible uses within existing or remodeled buildings. In other cases, it would be desirable to clear and redevelop the land before making it available for sale. In either case, the changes should be in compliance with the land use plan and be supported by appropriate zoning. Appropriate covenants or easements should be retained to assure long-term compatibility. Since this strategy approaches the complexity of urban renewal, appropriate expertise should be consulted.

347.-349. RESERVED.

SECTION 5. CONSULTATIONS

350. CONSULTATIONS UNDER PART 150. In developing a noise exposure map and identifying noncompatible land uses the airport proprietor should identify the geographic areas of jurisdiction of each public agency and planning agency which are either wholly or partially contained within the 65 L_{dn} contour and meet with the appropriate officials to discuss means of reducing the noise impact as required by Part 150. Methods for mitigating and/or reducing the effects of noise that are available to local authorities after consulting with the airport proprietor are discussed in sections 3 and 4 of this chapter. Part 150 requires that consultation must include any air carriers and to the extent practicable, other aircraft operators using the airport. Prior to submission of the noise exposure map or noise compatibility program, the airport operator is required by Part 150 to allow interested persons adequate opportunity to submit their views, data, and comments concerning the correctness and adequacy of the map or program and projection of aircraft operations. FAA will not inject itself into the essentially local responsibility for consultation imposed directly on the airport operator by the ASNA Act, but will rely upon the airport operator's certification under penalty of 18 U.S.C. § 1001, that such consultation has occurred (See § 150.21).

351. RESERVED.

352. CONSULTATION WITH AVIATION GROUPS. Part 150 requires consultation with aviation groups. For air carrier airports, this consultation includes all air carriers and, to the extent practicable, other aircraft operators using the airport. For other than air carrier airports, consultations should include those aircraft operators that do use the airport. Thus, "operators" may include some or all of the following groups: airlines; commuter airlines; air taxi; and commercial; flight training and instruction; based aircraft operators (business, private, public); and fixed; base operators. These consultations should take place as early as possible in the planning process in order that the view and perspectives obtained may be fully integrated into the study effort. Additional consultations, as may be appropriate, should be conducted throughout the progress of the study. If proposed aircraft operational changes are not coordinated with the appropriate parties until the end of the study, there is potential for real problems to develop.

353. PUBLIC AND COMMUNITY INVOLVEMENT.

a. The airport and the community have a number of important influences upon each other, including economic, social, and environmental considerations. The airport acts as an entry point for air traveling vacationers and business persons and freight movement. Since the airport can act as a major focal point for growth, it should be integrated in the comprehensive planning process for the community and region. Therefore, it is essential to receive public response to any new proposed actions for airport development that would influence the public.

b. Community involvement and public participation are often determining factors in successfully assessing the compatibility/noncompatibility of various land uses for individual communities. The goals, values and developmental needs of the communities should always be considered from the early (planning) stages of land use evaluation. See FAA Advisory Circular 150/5050-4, Citizen Participation in Airport Planning, for guidance in developing citizen participation and community involvement programs.

c. When organizing a community involvement program, it is first necessary to identify the issues and to determine:

(1) What information must be communicated to the public;
(2) Which groups must receive this information;
(3) What information must be received from the public;
(4) From which groups this information can be obtained.

d. Specific community involvement techniques can then be evaluated and a sequence of activities developed, including formulation of alternatives, analysis and evaluation of alternatives, and the final decisionmaking process. Additional guidance that may be useful on aviation issues may be found in Federal Aviation Administration's Community Involvement Manual. This may be obtained from the Office of Environment and Energy, Noise Abatement Division, AEE-100, Washington, D.C., 20591.

354. DOCUMENTATION. In accordance with Part 150, the airport operator is to provide documentation summarizing the public procedure and input to the program. In addition, the operator is to provide documentation of consultation with officials of public agencies, planning agencies, FAA required, and other Federal officials which may be affected by the proposed action. This documentation may consist of summaries of communications between the organizations indicating the issues and depth of review or it may consist of a summary of comments and replies to the plan or letters of approval adopting the proposed action.

355.-359. RESERVED.

SECTION 6. ANALYSIS OF COSTS AND BENEFITS AND SELECTION OF AN ALTERNATIVE

360. GENERAL. The costs and benefits of each reasonable alternative should be identified and assessed in order to form a logical basis for decisionmaking. Detailed alternatives most closely approaching an optimum solution to the noise compatibility problems of the particular airport should be identified. Costs may be generally grouped as possible constraints upon interstate or foreign commerce, or as environmental, economic, and social impacts. Obviously, solutions (alternatives) will not only differ in their costs and benefits; costs and benefits may also accrue to different groups, industries, geographical areas, or persons.

361. CONSTRAINTS UPON INTERSTATE AND FOREIGN COMMERCE. A stipulation of the ASNA Act and of FAR Part 150 is that an approved airport noise compatibility program not create an undue burden on interstate or foreign commerce. Such an undue burden is often difficult to identify and is based upon a number of trade-offs, which go beyond the responsibilities of the local airport operator. For example, a restriction upon the operations of aircraft exceeding a given noise level between 10 p.m. and 7 a.m. could create too small a "window" for connection with another airport 2,000 miles away. Full consultation with the FAA, the air carrier users of the airport, and with other users will identify constraints in this area and help generate mutually acceptable compromises.

362. ENVIRONMENTAL COSTS. Each action proposed by an airport noise compatibility program may have environmental costs and/or benefits to be traded off against its economic and social costs and benefits. The environmental impacts may also have to be assessed under Federal or state guidelines prior to implementing the action. The analysis at this preliminary stage should be sufficient to reasonably assure that future implementation will be both possible and within the constraints of economic and social costs. If a particular action is critical to the success of the alternative, then a more thorough analysis may be in order. FAA Orders 1050.1C, Policies and Procedures for Considering Environmental Impacts, and 5050.4, Airport Environmental Handbook, give detailed instructions for conducting environmental analyses when an environmental assessment is required for Federal approval of certain actions. Although FAA acceptance of noise exposure maps and approval of noise compatibility programs are both categorical exclusions, any application for Federal funding of any portion of noise compatibility program may involve the need for an environmental assessment before such funding decisions can be made.

363. ECONOMIC COSTS. The economic costs or benefits of a noise compatibility alternative may be both direct and indirect. It is the total of these costs which should be assessed and considered against social and environmental costs. The direct costs are usually obvious and easily quantifiable. They include such things as construction costs, acquisition costs, the cost of extra fuel used in noise abatement operations, and the costs of aircraft idled by noise curfews. Benefits may include the increase in value of noncompatible uses after the critical noise environment is removed. Indirect costs and benefits can be more difficult to identify and quantify. They can include induced development resulting from airport construction or from the introduction of noise tolerant industrial uses into the area. They may also include lost opportunities for development when there are more acres of noise impacted land than will be needed for noise compatible uses. Also, housing removed from noise impacted areas must be replaced with new housing in another location. Other costs and benefits may be more subtle but just as real as are these.

364. SOCIAL COSTS. Evaluation of the social costs and benefits of the alternatives is of equal importance with those of economics and the environment. Social costs can include such impacts as the disruption of established neighborhoods or school districts through removal of noise impacted housing, altered surface transporation patterns, disruption of orderly planned development, or the creation of appreciable changes in employment. The often improved sense of safety with the diminishment of aircraft noise may also be a significant benefit. If preparation of an environmental assessment becomes necessary prior to approval of Federal funding for a program element, social costs are one of the prime impacts which must be assessed.

365. SELECTION OF AN ALTERNATIVE. The selection of one or a combination of the alternatives explored is the focal point of the whole planning and evaluation process. It is also a common point of failure of the process, either immediately or later, during the implementation stages. Although the final decision must remain with the duly elected or appointed decisionmaker(s), an appropriate degree of involvement by those affected by that ultimate decision during the deliberations and eliminations leading up to a final recommendation is likely to produce more workable and satisfying results. It is suggested that prior to this point in the planning process a logical and fair decisionmaking process be agreed upon and established. Such a process might take the following form:

a. A decision tree indicating the decisions to be made, who is to make them, and their sequence and timing.

b. A matrix which displays the costs and benefits of each alternative and arrays them against the costs and benefits of the other alternatives.

c. An outline of the possible decision combinations (some decisions automatically preclude other decisions or combinations).

d. A draft of a logical and probable scenario of future events based upon each decision combination.

e. Review and discussion of the issues in each of the alternatives by the reviewers and/or decisionmakers, following the sequences and format noted above, to make the evaluations and trade-offs leading to recommendations or decisions. A two-step selection process may be appropriate for multiple or complex alternatives.

366. DEVELOPMENT OF THE SELECTED ALTERNATIVE INTO A DRAFT COMPATIBILITY PROGRAM. Once an alternative has been selected, it should be fully developed into a complete airport noise compatibility program. This consists, essentially, of treating the alternative as an accepted preliminary scheme, then making the more vigorous investigations into its viability and developing the details of the plan and its implementation. The recommended steps include:

a. Stringent investigation of the alternative's assets and liabilities to assure that it will stand the tests of reality.

b. Detailed development of the plan, giving particular attention to fully coordinating it with existing local planning, community growth trends and the local agencies which will be responsible for its implementation.

c. Development of the specific implementation actions necessary to fully implement the plan.

d. Assign to and get written agreement from the agencies (or officials) who will be responsible for each of the implementing actions.

e. Development of the implementation schedules and any documents required for adoption and full implementation. These could include resolutions for adoption as well as new or revised zoning districts designed to be added to existing local zoning ordinances.

367.-399. RESERVED.

APPENDIX 1. TABLE OF LAND USES NORMALLY COMPATIBLE WITH VARIOUS NOISE LEVELS.

1. LAND USE COMPATIBILITY TABLE. FAR Part 150 contains a table, Land Use Compatibility With Yearly Day-night Average Sound Levels, identifying land uses that are "normally compatible" or "noncompatible" with various levels of noise exposure. This appendix contains that table, but expands the list of uses under most categories in order to be more useful. The expanded land use descriptions are based upon the Standard Land Use Coding Manual (SLUCM) published by the Federal Highway Administration and the Department of Housing and Urban Development in 1965. The levels of noise exposure, in yearly day-night average sound levels (L_{dn}) correspond to the contours required to be shown on Airport Noise Exposure Maps. The table indicates compatibility of the land uses with the outdoor noise environment. By comparing the predicted or measured yearly L_{dn} level at a particular site with the values given in the table the range of compatible uses may be determined. In using the land use compatibility table, the following cautions should be observed:

a. L_{dn} contours indicate the boundaries lines between areas of acceptable or unacceptable noise exposures for the various land uses in Appendix I. The contours do indicate the trend in relative noise levels. However, vegetation, land contours, and the position of buildings or walls may often affect the impact of noise on the human users at a specific site.

b. L_{dn} levels may vary somewhat above or below the predicted levels for a particular location, depending upon local topography and vegetation, and upon final aircraft loadings and operations.

c. Although all land uses may be considered as normally compatible with noise levels less than 65 L_{dn}, local needs and values may dictate further delineation based on specific local requirements or determinations as well as low ambient levels.

d. When appropriate, noise level reduction may be achieved through incorporation of sound attenuation into the design and construction of a structure to achieve compatibility. However, more specific noise measurement and analysis is generally advisable prior to incurring the expense of such sound treatment. The cautions mentioned in paragraph 236d should be observed when applying Noise Level Reduction (NLR) to residential uses or other uses where indoor-outdoor activities are important.

e. Other local noise sources may often contribute as much as or more than aircraft to the total noise exposure at a specific location.

f. Compatibility designations in the table generally refer to the major use of the site. If other uses with greater sensitivity to noise are permitted at a site, the compatibility determination is based upon the use which is most adversely affected by noise.

LAND USES NORMALLY COMPATIBLE WITH VARIOUS NOISE LEVELS

Land Uses	Yearly Day-Night average Sound Level (L_{dn}) in Decibels					
	Below 65	65-70	70-75	75-80	80-85	Over 85
RESIDENTIAL						
Residential, other than mobile homes and transient lodgings	Y	Y[1]	N[1]	N	N	N
Mobile home parks (14)	Y	N	N	N	N	N
Transient lodgings (13)	Y	Y[1]	Y[1]	Y[1]	N	N
PUBLIC USE						
Schools, hospitals, and nursing homes	Y	25	30	N	N	N
Churches, auditoriums, and concert halls	Y	25	30	N	N	N
Governmental services (68)	Y	Y	25	30	N	N
Transportation	Y	Y	Y[2]	Y[3]	Y[4]	Y[4]
Parking (66)	Y	Y	Y[2]	Y[3]	Y[4]	N
COMMERCIAL USE						
Offices, business, and professional	Y	Y	25	30	N	N
Wholesale and retail - building materials, hardware and farm equipment	Y	Y	Y[2]	Y[3]	Y[4]	N
Retail Trade - general	Y	Y	25	30	N	N
Utilities (44)	Y	Y	Y[2]	Y[3]	Y[4]	N
Communications (48)	Y	Y	25	30	N	N
MANUFACTURING AND PRODUCTION						
Manufacturing, general	Y	Y	Y[2]	Y[3]	Y[4]	N
Photographic and optical	Y	Y	25	30	N	N
Agriculture (except livestock) and forestry	Y	Y[5]	Y[6]	Y[7]	Y[8]	Y[8]
Livestock farming and breeding (01.1 to 01.2)	Y	Y[5]	Y[6]	N	N	N
Mining and fishing, resource production and extraction	Y	Y	Y	Y	Y	Y
RECREATIONAL						
Outdoor sports arenas and spectator sports (79.2)	Y	Y[9]	Y[9]	N	N	N
Outdoor music shells, amphitheaters (79.11)	Y	N	N	N	N	N
Nature exhibits and zoos (79.2)	Y	Y	N	N	N	N
Amusements, parks, resorts and camps	Y	Y	Y	N	N	N
Golf courses, riding stables and water recreation (76)	Y	Y	25	30	N	N

Numbers in parentheses refer to Standard Land Use Coding Manual (SLUCM)

*The designations contained in this table do not constitute a Federal determination that any use of land covered by the program is acceptable or unacceptable under Federal, State, or local law. The responsibility for determining the acceptable and permissible land uses remains with the local authorities. FAA determinations under Part 150 are not intended to substitute federally determined land uses for those determined to be appropriate by local authorities in response to locally determined needs and values in achieving noise compatible land uses.

KEY TO TABLE

Number in ( )	Standard Land Use Coding Manual (SLUCM).
Y (Yes)	Land Use and related structures compatible without restrictions.
N (No)	Land Use and related structures are not compatible and should be prohibited.
25, 30, or 35	Land use and related structures generally compatible; measures to achieve Noise Level Reduction (NLR), outdoor to indoor, of 25, 30, or 35 must be incorporated into design and construction of structure.

NOTES FOR TABLE

1. Where the community determines that residential uses must be allowed, measures to achieve outdoor to indoor Noise Level Reduction (NLR) of at least 25 dB and 30 dB should be incorporated into building codes and be considered in individual approvals. Normal construction can be expected to provide a NLR of 20 dB, thus, the reduction requirements are often stated as 5, 10 or 15 dB over standard construction and normally assume mechanical ventilation and closed windows year round. However, the use of NLR criteria will not eliminate outdoor noise problems.

2. Compatible where measures to achieve NLR of 25 are incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas or where the normal noise level is low.

3. Compatible where measures to achieve NLR of 30 are incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas or where the normal noise level is low.

4. Compatible where measures to achieve NLR of 35 are incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas or where the normal noise level is low.

5. Land use compatible provided special sound reinforcement systems are installed.

6. Prime use only, any residential buildings require an NLR of 25 to be compatible.

7. Prime use only any residential buildings require an NLR of 30 to be compatible.

8. Prime use only, NLR for residential buildings not normally feasible, and such uses should be prohibited.

g. Designations contained in the table do not constitute a Federal determination that any use of land covered by the program is acceptable or unacceptable under Federal, State, or local law. The responsibility for determining the acceptability and permissible land uses remains with the local authorities.

h. Although Table 2 of FAR Part 150 defines the compatibility or noncompatibility of various land uses for the purposes of Federal aid, programs, or sanctions under the ASNA Act, adjustments or modifications of the descriptions of the land use categories may be desirable after consideration of specific local conditions.

2. INTERPRETATION OF NOISE EXPOSURE MAPS. Note that it is possible that the process of plotting noise contours onto locally generated land use maps may introduce a degree of charting imprecision, especially relative to property lines on the land use map. For the purpose of Section 107 of the ASNA Act, as amended, questions may arise concerning the precise relationship of specific properties to noise exposure contours depicted on a noise exposure map submitted under Section 103 of that Act. The FAA is not involved in any way in determining the relative locations of specific properties with regard to the depicted noise contours, or in interpreting the noise exposure map to resolve questions concerning which properties should be covered by the provisions of Section 107. These functions are inseparable from the ultimate land use control and planning responsibilities of local government. Therefore, the responsibility for the detailed overlaying of noise exposure contours onto the map of subjacent properties on the surface rests exclusively with the airport operator which submitted those maps, and/or with those public agencies and planning agencies with which consultation is required under Section 103 of the Act. In its decisions to accept noise exposure maps, the FAA relies on the certifications, by the airport operator that this statutorily required consultation has been accomplished.

APPENDIX 2. CHECKLISTS FOR NOISE EXPOSURE MAPS AND NOISE COMPATIBILITY PROGRAMS.

The two checklists included in this appendix are intended as an aid to both developing and reviewing noise exposure maps and noise compatibility programs. They should not, however, be considered as definitive or as replacing in any way the requirements of FAR Part 150. Responsibility for compliance with the provisions of Part 150 remains with the preparers and reviewers.

Airport: _____

CHECKLIST FOR NOISE EXPOSURE MAPS

	REFERENCE	YES	NO
1. Base Map developed using INM or approved equivalent.	A150.103(a)	___	___
a. Land uses identified.	A150.101(a)	___	___
b. Scale not less than 1 inch = 8000 feet.	A150.103(b)(1)	___	___
c. Runway Locations and alignments.	A150.101(e) & A150.103(b)(1)	___	___
d. Airport boundaries.	A150.101(a)	___	___
e. Flight tracks.	A150.101(a)	___	___
2. Continuous noise for L_{dn} 65, 70, and 75.	A150.101(a&e)	___	___
a. Estimates of numbers of people residing within each contour.	A150.101(a)	___	___
b. Depicted on land use map of sufficient detail and quality to discern streets and other identifiable geographical features.	A150.101(a)	___	___
3. Depiction and identification of each public and/or planning agency having jurisdiction within the L_{dn} 65 contour.	A150.105(a)	___	___
4. Brief analysis of the types of land use controls available to the identified agencies.	A150.105(b)	___	___
5. Noncompatible land uses identified within the L_{dn} 65 contours using Table 2 of Part 150 and based on self generated noise (ambient)	A150.101(a&b)	___	___
6. Location of noise sensitive public buildings (schools, hospitals, etc.).	A150.101(a)	___	___
7. Locations of any noise monitoring sites.	A150.101(a)	___	___
8. Projected aircraft operations for submission date and for fifth calendar year after submission date.	150.21(a)	___	___
9. Consultations with public, users, and other agencies	150.21(b)	___	___
10. Certified as true and complete	150.21(a)	___	___

Airport_____

CHECKLIST FOR NOISE COMPATIBILITY PROGRAMS

	REFERENCE	YES	NO
1. Current FAA accepted noise exposure map included.	150.23(e)(1)	___	___
2. Consultations with public and/or planning agencies within L_{dn} 65.	150.23(c)	___	___
3. Consultations with air carriers and other airport users.	150.23.(c)	___	___
4. Opportunity afforded public to submit views, data and comments.	150.23(d)	___	___
5. Description (summary) of the consultations conducted.	150.23(a)(1,4,&8)	___	___
6. Alternatives considered and presented according to these categories:			
a. Those within airport operator's implementation authority.	B150.7(a)(1)	___	___
b. Those within authority of another local agency or state/local governing body.	B150.7(a)(2)	___	___
c. Those under Federal authority.	B150.7(a)(3)	___	___
7. At a minimum have these alternatives been considered:			
a. Preferential runway system.	B150.7(b)(3)	___	___
b. Restrictions on use of airport based on noise:	B150.7(b)(5)	___	___
(1) Restrictions on aircraft not meeting FAA noise standard.	B150.7(b)(5)	___	___
(2) Capacity limitations based on relative noisiness.	B150.7(b)(5)	___	___
(3) Required use of noise abatement takeoff/approach procedures.	B150.7(b)(5)	___	___
(4) Landing fees based on noise or on time of arrival.	B150.7(b)(5)	___	___
(5) Other actions recommended for FAA analysis.	B150.7(b)(5)	___	___

		REFERENCE	YES	NO
	c. Noise barriers and/or acoustical shielding.	§150.7(b)(2)	___	___
	d. Soundproofing of public buildings.	§150.7(b)(2)	___	___
	e. Modified flight procedures and/or flight tracks.	§150.7(b)(4)	___	___
	f. Land purchases, air rights, easements and/or development rights.	§150.7(b)(1)	___	___
	g. Other actions or combinations of actions having beneficial impact on noise.	§150.7(b)(6)	___	___
8.	Description of alternatives considered and the reasons why any alternatives were rejected.	150.23(e)(2)	___	___
9.	Specific alternative program measures (actions) proposed and the relative contribution of each to program effectiveness.	150.23(e)(3)	___	___
10.	Statement of the actual or anticipated effect of the program on reducing noise to individuals and noncompatible uses.	150.23(e)(5)	___	___
11.	Documentation of feasibility of each proposed measure, including:			
	a. Essential governmental actions.	150.23(e)(8)	___	___
	b. Anticipated funding sources.	150.23(e)(8)	___	___
12.	Relationship of proposals to existing FAA approved airport layout plan, master plan, and system plan.	150.23(e)(6)	___	___
13.	Summary of the comments and materials received via public comment and disposition.	150.23(e)(7)	___	___
14.	Time period covered by the program.	150.23(e)(8)	___	___
15.	Schedule for implementation of the program.	150.23(e)(8)	___	___
16.	Persons responsible for implementation of each program measure.	150.23(e)(8) & §150.7(c)	___	___
17.	Schedule for periodic review and updating.	150.23(e)(9)	___	___

APPENDIX 3

RECOMMENDED BASIC NOISE MEASUREMENT SYSTEM

Noise monitoring may be utilized by airport operators for data acquisition and data refinement, but is not required by Part 150, for the development of noise exposure maps or airport noise compatibility programs. This Appendix describes a basic noise measurement system. First a few words about the purchase and maintenance of noise measurement equipment. There are at least four or five companies in the U.S. which carry special product lines of noise measurement equipment. The FAA Office of Environment and Energy, Noise Abatement Division, Noise Technology Branch, (AEE-120) will furnish a list of vendors upon request. At the time of purchase, two very important related needs must be considered, (1) periodic maintenance and (2) periodic re-calibration of equipment traceable to the National Bureau of Standards. If possible, try to minimize future difficulties, by assuring that local service is available. One should also seriously consider the advantages of establishing a maintenance service contract. This is especially recommended if long delays and extensive paperwork are required for each individual maintenance purchase order. The following list details the principle components of a mobile noise measurement system. The word "system" is underlined to indicate that much more than a sound level meter is required to be able to conduct an efficient multi-purpose noise measurement survey.

ITEM	COMMENT
Microphone Windscreens	Purchase several for each microphone. Windscreens have a habit of disappearing, blowing away, becoming misplaced etc.
Microphones	Purchase at least 2 per system. Microphones are easily damaged making one spare per system essential.
"Dummy Microphone"	This device simulates the microphone impedance and is used to determine the system electrical noise floor and as an aid in troubleshooting. One "dummy mike" per system is recommended.
Calibrators	At least one calibrator per system is recommended. Multi-frequency calibrators are very useful for checking the "A-weighting" filter characteristic, as well as for demonstrating the variation in human hearing response with frequency.
Calibrator Inserts	It is often advantageous to use a single calibrator type on different types and sizes of microphones. Plastic inserts are recommended as their low thermal conductivity avoids thermally shocking the microphone in cold weather, a problem encountered with metal inserts: One set is needed for each calibrator.
Tripod(s)	One tripod per system is necessary to remove the microphone 50 to 100 feet from the observer and any vertical reflective surface.
Microphone extension cable	Purchase at least one per system. The extension cable permits the microphone to be separated from the meter, as mentioned above. Caution: When ordering extension cable be sure the meter (with built in preamp) has enough power to handle the cable length.

ITEM (Cont'd)	COMMENT
Precision Integrating Sound Level Meter (PISLM)	The PISLM is a highly versitile instrument, part sound level meter-part computer, capable of providing single event metrics L_{AS}, and L_{AE} as well as a cumulative metric. This meter can be used both for assessment of airport use restrictions as well as for noise contour validation. Some PISLMs can also provide octave band analysis capabilities. The PISLM "DC output" can be input to a graphic level recorder providing A-weighted time histories.
Sound Level Meter (SLM)	Most SLMs can provide maximum L_{AS} as well as a continuous readout. The "DC output" of most SLM's can also be input into graphic level recorders providing A-weighted time histories. The typical SLM can be used to assess airport use restrictions but is difficult to use in evaluating airport noise contours. Many SLM's also have the capability of assessing octave band sound pressure levels, useful in analyzing stationary noise source problems.
Graphic Level Recorder (GLR)	The GLR is a highly recommended system component. Many situations arise in which a grpahic time history "pictorial" is more understandable than tabulated decibels. Caution: The GLR must accept a DC signal within a voltage range corresponding to the SLM or PISLM output voltage. An AC signal GLR cannot be used in a manner which will provide an accurate dBA, slow response time history. The power supply of the GLR can be either AC or DC however a DC power option is highly recommended for field operational flexibility.

ITEM (Cont'd)	COMMENT
Portable Aviation Frequency Radio	The portable aviation frequency radio, preferably with rechargable batteries, is a vital system component. Monitoring the Advisory Terminal Information System (ATIS) frequency provides airport wind and barometric pressure readings. Monitoring tower, approach and departure frequencies provides aircraft identification and most importantly warning that an aircraft overflight is imminent.
Walkie-Talkies	Communication between noise measurement teams is often a requirement both for aircraft identification as well as redeploying teams in response to a chage in airport operational runways. Walkie-talkies can also be useful in estimating aircraft speed between two observation points.
Camera	A camera is useful for photo-scaling aircraft altitudes. It is usually not necessary to acquire aircraft altitude data, however, special programs do arise in which altitude is required. The camera is also used to document the test site environs, equipment set ups, and microphone locations to resolve post test questions.
Portable sling psychrometer	The sling psychrometer provides dry-bulb and wet-bulb temperature for computing relative humidity. Sound attenuation varies significantly with temperature and relative humidity and the measurement of those parameters is often necessary.
100 Ft. Tape Measure	Useful in siting microphone position relative to landmarks as well as microphone height.
Four-foot long rope (1.2m)	Convenient way to verify microphone height when a tape measure is not available.

2. RECOMMENDED MEASUREMENT PRACTICES. The following list of recommended measurement practices are key elements in providing a traceable record of a noise monitoring program.

a. Conduct measurement with the microphone(s) at a height of 4 feet (1.2m) above the ground.

b. Orient the microphone properly, according to manufacturer's specifications.

c. Avoid measuring aircraft noise in close proximity to vertical reflective surfaces (at least 25 feet whenever possible).

d. Avoid overhead obstructions in the vicinity of the microphone. Ideally, a cone of free space, with a half angle of 75 degrees from vertical should exist above the microphone.

e. Avoid the use of two-way radios in the immediate vicinity of microphone cables and SLM's while recording data. The transmission of electromagnetic energy often can be picked up through the noise measurement system.

f. Calibrate all instrumentation at least once an hour as well as at the beginning and the end of each measurement period. Take special care with calibrators. If a calibrator is dropped it must be checked against another calibrator known to be accurate. For this reason it is a good idea to keep a "laboratory standard" calibrator in the office.

g. Use a windscreen at all times. Avoid measurements under windy conditions; if unavoidable, document the wind-induced sound level. If maximum sound levels of aircraft or other events exceed the wind noise by more than 10 dB, the sound level measurement error will be less than 0.5 dB.

h. Check battery energy levels at least once every thirty minutes. Instruments, using nickel-cadmium batteries may require more frequent checking.

i. Maintain accurate thorough data logs during a measurement program including: day, data, time(s), calibration levels, noise floor levels, battery checks and the selector and gain settings for every component in the measurement system. Noise event data sheets should also include aircraft type, carrier, elevation anagle above the horizon, time, aircraft operation (takeoff or landing), and a space for comments. All intrusive noise events during data recording should be noted. When the time comes to write a report on the measurement survey, all of the little details noted during the test will prove most valuable.

j. As further documentary record it is always good to draw a schematic diagram of the measurement setup showing equipment, orientation, priximity to obstructions, roadways, etc. Photos of each measurement site are also very useful in going back and addressing questions concerning field procedure or the neighborhood characteristics.

k. During data acquisition for any desired event avoid conversation in the vicinity of the microphone(s). Keep voice levels low at all times. This may seem obvious but is one of the most frequent errors in procedure made by inexperienced persons and observers.

l. The list shown below identifies certain essential items easily overlooked in preparing to go out and measure noise:

(1) properly sized calibration screwdriver(s);

(2) calibrated watch, clock, or other "time-piece";

(3) extra graphic level recorder pens and paper;

(4) spare batteries;

(5) maps;

(6) data sheets, and clipboard.

m. Two of the "easiest errors to make" in sound level measurement are:

(1) Meter Response Time set incorrectly on fast rather than SLOW.

(2) Meter weighting network on some other setting than A.

n. The single biggest category of problems encountered with noise measurement equipment involves connections and cables. Time spent in checking and caring for these items will minimize the chance of wasting a day in the field. Avoid pulling cords anywhere but at the connector, avoid kinks in wiring (especially in cold weather) and frequently test cables for continuity. If a cable becomes crimped or damaged in any way, remove it from service until repaired.

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APPENDIX 8-F

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