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.

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_{ZF} + 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. <u>IMPLEMENTATION</u>

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