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Subject: NOISE ASSESSMENT GUIDELINES FOR NEW HELIPORTS

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FOREWORD

FILE

This circular provides technical guidance for local planners, other government agencies, and operators in calculating the acoustic environment near new heliports. It is intended to provide assistance in preliminary evaluation of the noise compatibility of sites for heliports where none exists. It is not intended for the evaluation of existing heliports or those areas where noise is not an issue.

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Director of Environment and Energy

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SECTION 1. INTRODUCTION

1. PURPOSE. This circular provides technical guidance for local planners, other government agencies, and operators in calculating the acoustic environment near new heliports. It is intended to provide assistance in preliminary evaluation of the noise compatibility of sites for heliports where none exists. It is not intended for the evaluation of existing heliports or those areas where noise is not an issue (e.g., offshore oil rigs). Further, more detailed environmental analysis may be required under Orders 1050.1D and 5050.4 where there is an FAA action in approving the establishment of the heliport.

2. BACKGROUND. FAA Orders 1050.1D and 5050.4 provide detailed procedures for the environmental assessment of all FAA actions under the National Environmental Policy Act (P.L. 91-190, 42 USC 4321) and a number of other statutes, regulations and orders. However, the private sector and local authorities need standardized methods for preliminary evaluation of potential sites for new heliports. This advisory circular is intended to fill the need and to give "quick-look" capability without the detailed (often computer-based) computations necessary to a full NEPA assessment.

3. OVERVIEW. A two-phase process is suggested to ensure that heliport planning includes effective means for evaluating and minimizing noise impacts.

- The first phase uses estimated noise levels and distances to determine relatively simply whether a proposed facility would meet recommended noise criteria. This analysis can be made using the simplified method (paragraph 16) and the data of Table 1 without the need for detailed measurements.

- The second phase can be used if, based on the earlier estimate, the proposed facility would not clearly meet the recommended noise criteria. Detailed noise readings should then be taken to determine whether the heliport would meet the criteria. This analysis can be accomplished using Table I and either the detailed (paragraph 17) or simplified method, as appropriate.

The applicant should be allowed to participate in the analysis and to modify his proposal as appropriate to meet the criteria. Alternatives for modifying a heliport plan are listed in paragraph 21. After thorough study of these alternatives by all parties involved, reanalyses can be performed based on either estimates or measured data.

SECTION 2. PLANNING FACTORS

4. GENERAL. The helicopter is typically operated at low altitudes and, as a result, it frequently comes within the audible range of people. Further, helicopters are becoming more widely used in both urban and suburban areas. Therefore, the sound is generated in close proximity to where people live and work. This closeness accentuates the concern associated with the external sound of the helicopter and its acceptability to the communities in which it operates. It is an underlying philosophy of the procedures and recommendations of this guide that each heliport siting is a unique situation. Thus the application of any procedure may not necessarily result in a satisfactory solution for every community and operator. In these regards, individual consideration should be given to such factors as ambient noise, the specific nature of the noise sensitive areas which may be impacted by heliport operations, and seasonal variations in operation.

5. AMBIENT NOISE. People's concerns about aircraft noise are often reflections of the degree to which the aircraft intrudes on existing ambient noise exposure patterns. Ambient noise at a specific location is a composite of sounds from many sources including automobile, truck and bus traffic, motorcycles, construction noise, aircraft, etc. The ambient noise level in an area continually varies with time as the result of varying levels of activity. This activity, and hence the resultant ambient noise, changes with time of day, day of the week and the seasons.

6. SOUND OF HELICOPTERS. The noise footprint of a helicopter during approach, landing, takeoff, and departure is considerably smaller than that of many airplanes. The sound of a helicopter is comparable in level to other sounds that are acceptable to the community. That acceptance is often due to familiarity. Heavy trucks and city buses are examples of sounds which are equivalent in sound level to helicopters. The sound generated by a helicopter, however, is different in character from other forms of transportation. Each mode of flight, takeoff, landing and flyover, can produce different combinations of sound. Often the sound is new to an area. For these reasons, the helicopter is readily identified and may be singled out for complaint.

7. ROUTE PLANNING CONSIDERATIONS. The flight path to and from a proposed heliport should take advantage of low noise sensitivity corridors, i.e., over freeways, and railways, bodies of water, etc. Routes should be selected to avoid noise sensitive facilities such as schools, churches, rest homes, large open-air gatherings of people, etc. Rapid turns as well as other transient maneuvers can give rise to changes in the character and level of the sound. These maneuvers should be avoided whenever practical, particularly near residential areas. The flyover altitude should also be chosen, within reason, to be the highest practicable since doubling the flyover height will decrease the peak sound level heard on the ground by more than 6 decibels. Thus, routes at 1000 to 2000 ft. altitude are preferable to 500 ft. (Advisory Circular 91-36B recommends 2000 ft. minimum altitude over populated areas.) In the past, there has been a tendency for helicopters to operate at low

altitudes even when there has been no necessity due to safety or Air Traffic Control requirements. The FAA is currently working with a number of cities to designate VFR corridors specifically for helicopters, in order to reduce public impacts. The FAA also supports the helicopter industry's "Fly Neighborly" program to reduce noise effects.

8. ACOUSTICAL CONSIDERATIONS IN SITE SELECTION. The FAA's Heliport Design Guide (AC 150/5390-1B) should be consulted in selecting and developing a heliport site. Where noise impacts are a consideration, it may also be desirable to consider sites in or near high activity areas such as near thoroughfares, freeways, busy streets, railways, etc., since the noise generated by such facilities will tend to mask the sounds generated by the helicopter. Of course, heliports are also compatible in open areas. Except for emergency use, heliports should not be located adjacent to such facilities as schools, churches, and rest homes. Elevated heliports should be considered separately from ground level sites. (See paragraph 19.) Clear zones and helistops on rooftops should be encouraged in recognition of the helicopter's demonstrated rescue and evacuation potential in emergency situations, such as fires.

SECTION 3. CRITERIA SELECTION

9. GENERAL. Outside noise levels have generally proven to be reliable indicators of community response to sound exposure, and most standards use them exclusively. For this reason, the environmental criteria for heliports are based on external sound only. However, in some cases, particularly for sites near schools and hospitals, it may be more appropriate to consider indoor sound levels. In these cases it is not possible to generalize, and each case must be treated on an individual basis.

10. SOUND LEVEL UNITS.

a. Single Event Measure. The Aviation Safety and Noise Abatement Act of 1979 (P.L. 96-193, 49 USC 2101) required that the FAA establish a single system for measuring and evaluating noise impacts. That system, as incorporated in FAR Part 150 and Order 1050.1D, is the family of units based on the "A" weighted sound level. For heliports, the FAA chose the Sound Exposure Level (SEL), which is a single-event measure combining both the events maximum intensity and its duration. A mathematical explanation of this unit is given in FAR Part 150, Appendix A. Values of SEL for various helicopters may be obtained from:

(1) Measurements using an integrating sound level meter, or

(2) Listings of sound exposure levels provided by the FAA or helicopter manufacturers.

In either case, the individual values of SEL for each helicopter takeoff, landing and flyover are combined by the methods contained in this Advisory Circular and compared against the community noise levels.

b. Community Noise Level. So that the relative contributions of the heliport and other sound sources in the community can be compared the FAA recommends the use of a cumulative noise measure, the 24 hour equivalent sound level (EQL). This unit is similar to the day-night average sound level (DNL) specified in FAR Part 150 for evaluating the community noise levels around airports for fixed-wing aircraft. The only difference between EQL and DNL is that DNL adds a 10 dB penalty to night flights between 10:00 p.m. and 7:00 a.m. Helicopter EQL values are obtained by adding logarithmically the single-event SEL values over a 24 hour period.

11. NORMALLY COMPATIBLE SOUND LEVELS.

a. Criteria. Public Law 96-193 (cited above) also directs the FAA to identify land uses which are "normally compatible" with various levels of noise from aircraft operations. Because of the size and complexity of many major hub airports and their operations, FAR Part 150 identifies a large number of land uses and their associated noise levels. However, since the operations of most heliports tend to be much simpler and the impacts more restricted in area, Part 150 does not apply to heliports off the airport property. Instead, for individual heliports the FAA recommends the simpler criteria contained in Table 1. These recommended levels were chosen on the basis of the criteria typically found to be acceptable in areas by type. The community is divided into three basic area categories: "residential", "commercial", and "industrial", with energy equivalent (EQL) noise levels as shown in Table 1.

b. Compatibility. The maximum recommended cumulative sound level (EQL) due to the proposed operations of helicopters at a new site should not exceed the ambient noise level already present in the community at the site of the proposed heliport. This means, the average equivalent helicopter noise level should not exceed the values recommended in Table 1, or the locally measured ambient noise level.

c. Ambients. In cases where it is felt that ambient noise levels significantly differ from those given in the table it is recommended that measurements be made. If the observed ambient for the area around the site exceeds that listed in Table 1, the maximum recommended EQL noise levels should be increased accordingly. See paragraph 20 for suggestions on measurement techniques.

d. Applications. As outlined in paragraphs 7 and 8, the heliport site and related ingress/egress routes should be selected for minimal community noise impact. Examples of this type of route include highways, rail lines, bodies of water, etc. However, it is inevitable that there will be some areas or facilities near the heliport that may be affected by the helicopter operations. These may include single family residences, apartment complexes, condominiums, schools, churches, and rest homes. One or more of these areas or facilities can be identified from maps and plots for use in determining the noise compatibility of the proposed heliport site. Facilities associated with the operation of the proposed heliport itself should not be considered noise sensitive.

12. NUMBER OF HELICOPTER EVENTS. Using the normally compatible sound level criteria defined above, it is possible to compute the maximum permitted number of helicopter events (takeoffs, landings, and flyovers). The resultant number of events will depend on the magnitude of the sound exposure levels from the individual events, as well as the ambient noise level in the general area. The procedures for determining this number are described in Section 4 below.

13. TECHNICAL ASSISTANCE. Assistance in the use of these procedures may be obtained from the Office of Environment and Energy, AEE-110, telephone (202) 755-9027. Noise data from fifteen helicopter types are provided in "Helicopter Noise Exposure Curves for Use in Environmental Impact Assessment," Report FAA-EE-82-16, AEE-120. Data on additional types of helicopters in a format compatible with the noise calculation procedure (Section 4) may be available from AEE-120, telephone (202) 426-3396, or from the manufacturer. In choosing the data to be employed in any of these analyses, caution should be taken to assure that they are representative of the weights, conditions and operational procedures that may actually be flown at the proposed heliport. Assistance in this area is obtainable from the FAA Region or from the Helicopter Association International (HAI), which has extensive resources and file information on successful heliport operations. This information may be obtained by contacting HAI at 1110 Vermont Avenue, N.W., Washington, D.C. 20005, Attention: Heliport Director. The HAI telephone is (202) 466-2420.

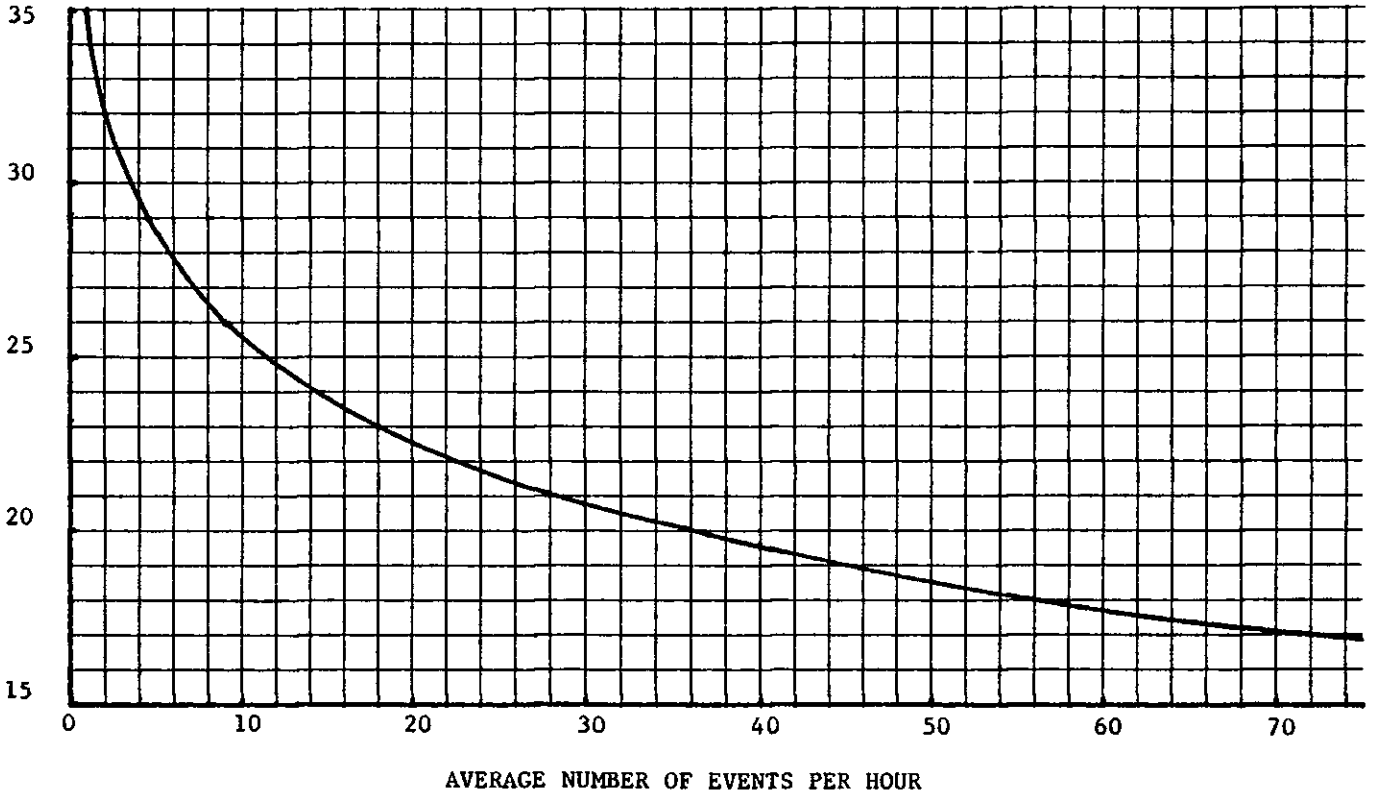


Figure 1. Recommended Maximum Number of Events

TABLE 1

Normally Compatible Community Sound Levels

TYPE OF AREA	24-HOUR AVERAGE EQUIVALENT NOISE LEVEL (EQL) (A-weighted decibels)
RESIDENTIAL	
SUBURBAN	57
URBAN	67
CITY CENTER	72
COMMERCIAL	72
INDUSTRIAL	77

SECTION 4. NOISE CALCULATION PROCEDURES

14. GENERAL. The maximum recommended 24-hour average equivalent helicopter noise level is one that equals, but does not exceed, the 24-hour average equivalent ambient sound levels for the community into which the proposed heliport would be introduced. Two procedures are provided for such assessments. The first of these involves a simple analysis which, in most cases, will provide sufficient information, particularly for heliports with relatively few operations. The second, more detailed procedure is intended for those heliports where the first analysis indicates marginal acceptability.

15. SITE/OPERATIONAL INFORMATION. There may be many routes into a heliport site and all of the potential alternatives should be known in advance of the application, and reported. Flight profiles, each of which may be composed of several FAA approved alternatives, should also be described. The heliport evaluation should consider the mix of routes and flight profiles which constitute the normal planned operations. If it is known in advance that noise abatement profiles may be needed for particular routes, they should be included in the application. All proposed routes should be detailed on a land use map of the heliport area. Generally, the following information is required:

- Location of possible noise sensitive facilities or areas near the heliport site.
- Routes and flight trajectories to and from the heliport.
- Helicopter sound level versus distance data from Report FAA-EE-82-16 or the manufacturer.

Designation of noise sensitive areas and facilities is made by municipal officials from a land use survey of the area surrounding the heliport site. If there are several noise sensitive facilities or areas near the same route, each should be evaluated. Facilities directly associated with the heliport are excluded.

16. SIMPLIFIED METHOD.

a. As mentioned in paragraphs 9 and 10, both the helicopter and community ambient sound levels are evaluated using an energy equivalent (averaging) noise metric, EQL. This unit includes the effects of both level and duration of each noise event and the number of events. The simplified method allows a tradeoff between the Sound Exposure Level and the number of events.

b. Single Helicopter Type and/or Route. Using criteria described above, a recommended maximum number of helicopter events per hour has been developed. It is shown in Figure 1 and listed in Table 2. In determining the hourly average, the daily total number of events is divided by 24. The procedure is as follows:

(1) Determine the closest point of approach of the helicopter for the nearest flight path (takeoff or approach) to the designated noise sensitive area or facility.

(2) Determine the single-event helicopter sound exposure level (SEL) by referring to Report FAA-EE-82-16 or to manufacturers' data (furnished by the applicant) for the slant range of the closest point of approach and the appropriate flight condition. If a relationship between noise and slant range is not included in the furnished data, it may be assumed that sound exposure level decreases as ten times the logarithm of the distance ratio ($10 \log_{10} R/R_0$) which is three dB per doubling of distance.

(3) Subtract the average community equivalent sound level (EQL) value (Table 1) from the sound exposure level (SEL) determined above. Use this value to enter either Figure 1 or Table 2 to find the recommended maximum number of helicopter events. If the proposed number of events is less than or equal to the acceptable number of events and no other type of operation is planned, the heliport meets the recommended noise criteria.

(4) If the analysis indicates marginal acceptability, use of the more detailed method (paragraph 17) may be necessary. A proposal may be considered marginal if the proposed number of events is within ten percent of the recommended maximum.

c. Multiple Routes and/or Helicopters. If there are several routes and/or a mix of helicopters, the sum of the operations can be evaluated for each noise sensitive location as follows:

(1) Using the single route, single helicopter procedure above, determine the recommended maximum number of events affecting each noise sensitive location for each route, direction, and type of helicopter.

(2) For each combination in Step 1, divide the number of proposed events by the recommended maximum number of events. This gives the acceptability ratio for each combination.

(3) Sum the acceptability ratios for all the combinations to obtain the noise loading (L). If the value of L is equal to or less than 1.0, the heliport meets the recommended criteria.

Note: This method is adopted from the current Occupational Safety and Health Administration rule. (Department of Labor Occupational Noise Standard, Code of Federal Regulations, Title 29, Chapter XVII, Part 1910, Subpart G, 36 FR 10466, May 29, 1971.) The determination of sound loading (L) is for one noise sensitive location only. It is to be computed for each location considered noise sensitive. The computed sound loading at each location is independent of the others; they can not be added.

TABLE 2

RECOMMENDED MAXIMUM NUMBER OF EVENTS

DIFFERENCE BETWEEN HELICOPTER SOUND EXPOSURE LEVEL (1) AND COMMUNITY SOUND LEVEL (EQL)	AVERAGE NUMBER OF EVENTS PER HOUR	AVERAGE NUMBER OF EVENTS PER DAY
17	72	
20	36	
23	18	
26	9	
29	4.5	
31		64
34		32
37		16
40		8
43		4
46		2

(1) When measured data are used, this value is the arithmetic average of approximately 6 events.

17. DETAILED PROCEDURE.

a. Background. The mathematical formula for the 24-hour average equivalent sound level (EQL) takes several forms, depending upon the sources which are to be energy averaged:

(1) Identical events, such as a single helicopter flown several times a day over the same route -

$$L_{eq} = 10 \log \frac{N \times 10^{L_{AE}/10}}{86,400} \qquad (1)$$

where

Leq = average equivalent sound level

N = number of daily helicopter events

L_{AE} = sound exposure level of each helicopter event in decibels A-weighted

86,400 = number of seconds in 24 hours.

(2) Dissimilar events, such as different helicopter types flown over one or more routes or the same helicopter using several procedures or routes -

$$L_{eq} = 10 \log \frac{1}{86,400} (10^{L_{AE_1}/10} + 10^{L_{AE_2}/10} + \ldots)) \qquad (2)$$

where L_{AE1}, L_{AE2}, etc. are the individual single-event sound exposure levels in decibels.

(3) Combinations of the above, such as several events of different helicopter types or different procedures -

$$L_{eq} = 10 \log \frac{1}{86,400} (N_1 \times 10^{L_{AE_1}/10} + N_2 \times 10^{L_{AE_2}/10} + \ldots)) \qquad (3)$$

where N_1, N_2 etc. are the number of single events at sound exposure levels L_{AE_1}, L_{AE_2}, etc.

b. Methodology. A process similar to that used in the simplified method is used here, except that the appropriate formula from 17(a) is used to compute the average equivalent sound level (EQL). This value of EQL is then compared against the normally compatible sound levels in Table 1. Again, it is recommended that the helicopter average equivalent sound level not exceed the community EQL. An example calculation using the detailed method is shown in Appendix 1.

18. COMPARISON OF SIMPLIFIED AND DETAILED METHODS. The simplified method uses the normally compatible community sound level from Table 1 or from measurements to determine a recommended maximum for the average number of events per hour. The detailed method computes the helicopter EQL for comparison to the existing community EQL. Both methods use single-event sound exposure level data from Report FAA-EE-82-16 or from measurements.

19. ELEVATED HELIPORTS. In general, elevated heliports, such as those on top of buildings, are evaluated by either method in the same way as grade level heliports. However, care should be taken to use the correct single-event sound exposure levels. The slant range is the direct line-of-sight distance from the noise sensitive location to the heliport atop the building, not the horizontal distance along the ground.

20. SOUND MEASUREMENTS. While an acoustic measurement program can be undertaken to provide all or part of the data used in the assessment procedures of this advisory circular, such programs are often difficult, expensive and time consuming. Therefore, they should be undertaken only after all practical analytical assessments have been made. These assessments should have taken into account the many variables affecting the sound level of the helicopter and the peculiarities of the heliport application. If measurements are still deemed necessary, they should be made in the designated noise sensitive areas using the proposed helicopter route(s), flight profile(s), and model(s). The option of measuring community ambient, energy-averaged, sound levels (EQL) requires 24-hour monitoring over long periods to account for daily, weekly and seasonal variations. This usually requires specialized equipment and often specially-trained personnel. In evaluating helicopter sound levels attributable only to the helicopter, extraneous noise must not influence the data. Guidelines for the measurements are as follows:

a. The integrating sound level meter used for measurements must be calibrated and set to read sound exposure level. The sound level meter used must meet or exceed American National Standards Institute (ANSI) specifications for sound level meters, Standard S1.4-1983 or the most recent revision thereto.

b. Personnel performing the measurements must have been trained in use of the equipment and in techniques required to obtain valid sound levels. It is important that the methods of data acquisition are consistent and accurate so that all cases are evaluated on the same basis.

c. Care should be taken to ensure that the helicopter sound data are not contaminated with sound from other sources and that the sound exposure level (SEL) is a true indication of the sound generated by the helicopter alone.

d. Wind speed at the microphone should not exceed 15 knots during the measurement. A windscreen should be used for all outdoor measurements and any sound level corrections necessary to account for windscreen attenuation should be made.

e. The microphone of the sound level meter should be about 4 feet above the ground and at least 25 feet from the nearest building or structure.

f. The helicopters should use the landing and/or takeoff techniques proposed for use at the heliport.

g. At least six repeat flights are recommended. The data are to be arithmetically averaged to give a mean sound exposure level. (Note: In the case where the pilot has no experience using the proposed heliport site, practice landings and takeoffs should be allowed.)

SECTION 5. REMEDIAL ACTIONS

21. ALTERNATIVES. If analyses or measurements indicate the environmental criteria are not met, the heliport applicant may choose to modify the proposal in order to meet them. Such modification may include one or more of the following alternatives:

a. Selection of different ingress/egress routes.

b. Adoption of specific noise abatement piloting techniques.

c. Relocation of the heliport/helipad on the property further away from a noise sensitive facility or area.

d. Construction of a second heliport/helipad on the site to distribute noise loading between noise sensitive facilities or areas.

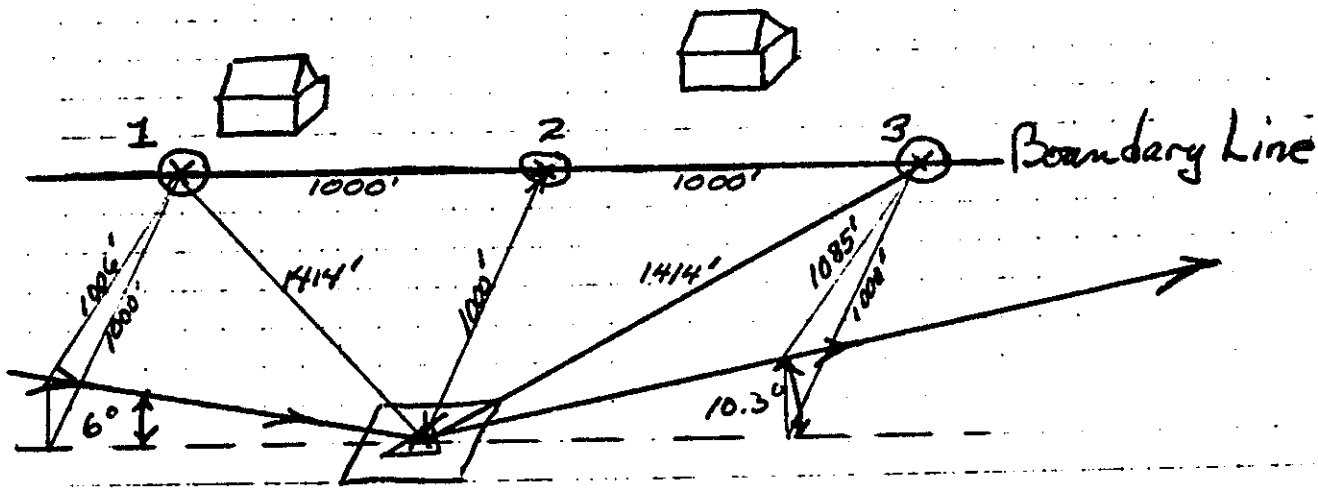
e. Erection of barriers to reduce sound propagated into neighboring areas.

f. Using existing buildings to shield noise from sensitive areas by relocating the heliport/helipad.

Other modifications to the heliport plan may be possible depending on the particular site, terrain and local conditions. These should be thoroughly studied by all parties involved to arrive at a mutually satisfactory heliport plan. Analyses or measurements should then be repeated with the agreed modifications.

This aspect is of particular importance in the case where noise measurements are made during an initial trial demonstration at the proposed site, since the normal operating techniques used may not take full advantage of the helicopter's operational flexibility to further reduce sound levels.

APPENDIX 1. EXAMPLE OF DETAILED HELICOPTER L_{eq} CALCULATION



EXAMPLE CALCULATION OF HELIPORT NOISE EXPOSURE LEVEL:

Assume a proposed heliport located 1,000 feet from the boundary of a suburban residential area, as shown above. It is proposed that 12 flights per day, during daytime hours, be permitted by Sikorsky S-76 helicopters, following the flight paths shown. Available noise data are taken from Report FAA-EE-82-16.

At Point #1:

L (approach) @ 1,006'	85.8 decibels
L (takeoff) @ 1,414'	81.4 decibels

$$L_{eq}(\text{helicopters}) = 10 \log \left(\frac{12}{86{,}400}(10^{8.58} + 10^{8.14})\right)$$

$$= 48.7 \text{ decibels}$$

At Point #2:

L (approach) @ 1,000'	85.8 decibels
L (takeoff) @ 1,000'	83.8 decibels

L_{eq}(helicopters) = 49.3 decibels

At Point #3:

L (approach) @ 1,414'	84.3 decibels
L (takeoff) @ 1085'	85.2 decibels

L_{eq}(helicopters) = 50.0 decibels

From Table 1, the normally compatible sound level (EQL) for a suburban area is 57 decibels. Since the computed helicopter EQL is 50 decibels or less along the boundary, the proposed heliport would meet the recommended guideline.

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