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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The Noise Control Act of 1972 established the national policy "to promote an environment for all Americans free from noise that jeopardizes their public health and welfare." The Act provides for a division of power between the Federal and State and local Governments: The primary Federal responsibility is for noise source emission control; states and other political sub-divisions retain the rights and authority to control the use of noise sources and the levels of noise permitted in their environment. Although an individual's workplace is a vital component of the overall human environment, the EPA, →		

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← charged with the execution of the Noise Control Act, does not have jurisdiction over most occupational health and safety matters. They have been traditionally the responsibility of the Departments of Labor and Health, Education and Welfare. The Occupational Safety and Health Act of 1972 gives the Secretary of Labor the responsibility to set standards which adequately assure, to the extent feasible, that no employee will suffer material impairment of health or functional capacity in their working environment. The practical consequences of these legislations, their differences with respect to noise protection standards and their combined overall effectiveness in combating noise-induced health effects will be discussed. ↗

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Legislation against industrial and ambient noise in the US

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Introduction

That noise can be a nuisance and annoyance has been well recorded over the centuries and many legal systems, states and their subdivisions have been trying to control unwanted sound through general nuisance provisions of the law directed at preventing something offensive or annoying to individuals or the community, to the prejudice of their legal rights¹. In determining whether a particular noise is a nuisance, history, customs, traditions, industry and working habits, geography and climate might have to be taken into consideration. As a consequence, until recently (1970), in the United States the position had been taken consistently that noise abatement is primarily a matter of local, at the most, State level concern with the exception of certain specific considerations (aviation noise and to a lesser extent highway transportation noise). Anti-noise ordinances were therefore enacted in many American cities dating back at least to the middle of the 19th century, all based on the nuisance/annoyance concept.

The health effects of noise were first recognized in connection with occupational loss of hearing of workers in noisy occupations. Although State workmen's compensation laws covering occupational hearing loss were enacted in the various states in the 1950's and 1960's, it was not until 1969 that enforceable controls over noise in some work places were promulgated by the Federal Government, which were given broader coverage when they were incorporated into the Occupational Safety and Health Act (OSHA) passed by the Congress in 1970. The implementation of this Act and the extent of protection to be provided in virtually all industrial establishments of the United States is presently still in progress

and the subject of extensive scientific, economic, legal and public debate.

Noise did not become a matter of concern affecting large segments of the United States population until the mid twentieth century, when aviation noise and to a lesser degree traffic noise resulted in public awareness of the problem and the demand for increased initiative by the Federal Government and for new legislation. The term environmental noise characterizing the noise from all sources at all places where people live and work (i.e., occupational and non-occupational exposure) evolved and the constantly increasing noise levels were considered a public health problem. Public health and welfare considerations and not nuisance or annoyance by noise were therefore the basis for Title IV of the Clean Air Act of 1970 and for the most comprehensive Noise Control Act of 1972.

In the following a brief review of local ordinances to control noise nuisance and of legislation to control occupational noise exposures is presented. Thereafter the Noise Control Act of 1972 is discussed in more detail because of its novel, comprehensive and far reaching content.

Municipal ordinances

In the United States the regulation and abatement of nuisances is one of the functions of the police power, which can be and is normally delegated by the state legislatures to the municipal corporations. Therefore municipal noise ordinances date back to 1850 (Boston) and by 1930, 20 American cities had noise ordinances². Starting in the 1930's this avenue of noise control obtained new impetus with different technical approaches and attempts at enforce-

ment introduced by various cities. Cities such as Memphis, Tennessee, New York City and Chicago pioneered with respect to publications and public education concerning city noises and with the introduction of ordinances (Motor Vehicle Control Ordinance by Memphis, Tennessee in 1938; the noise sections of the Administrative Code of the City of New York, 1948; the Performance Zoning Ordinance in Chicago, 1955). The National Institute of Municipal Law Officers (NIMLO) proposed a model ordinance in 1948 (revised in 1970), which became the basis for most ordinances in use. It prohibits "any loud, unnecessary or unusual noises" within the limits of the city and defines qualitatively such noises with respect to horns, radios, phonographs, yelling, animals, steam whistles, exhausts, defects in vehicle load, construction, hammers, pile drivers, etc., but did not, until the 1970 revision set limits with respect to sound emission except for restricting evening and nighttime operating hours².

As of 1974, 440 municipalities had adopted noise regulations representing a combined population of 62 million; 152 of these municipalities adopted the regulation in the preceding year³. One of the most publicized new noise ordinances was the one of the City of Chicago in 1972, which established quantitative noise limits, for example, for automobiles and trucks, which were scheduled to become lower as time progresses. The trend in the USA is definitively toward quantitative acoustical criteria to be incorporated into the noise ordinances, although their legality and enforcement are areas of considerable debate. At the end of 1974 approximately 200 cities had limit levels incorporated into their codes³. Attempts by the municipalities to control noise from aircraft operations through their ordinances have generally been found invalid by the courts which established a national Federal pre-emption of state and local authority over aviation noise.

The U.S. Environmental Protection Agency is presently preparing a Model Noise Ordinance which is soon to be published and will probably be adopted widely.

Noise ordinances have generally been considered to be effective when coupled with educational campaigns and public awareness of the nuisance of noise. The cost of enforcement is considerable and

enforcement of noise ordinances is frequently not among the highest priority duties of city police forces. In spite of this it is amazing to read that in the 1950's a typical number of noise violations per year reported by the New York police is approximately 300,000. Token fines were not found to be effective; that's why in 1954 New York City, for example, increased sharply the punishment for violations, particularly for repetition of offenses.

Noise ordinances might be effective in suppressing unnecessary noises. They cannot generally deal with the increase in environmental levels due to noisier industrial products or due to greater population density. These problems must be attacked by effective zoning laws and building codes at the local level and effective source emission control and promotion of noise control technology at the national and international level.

Legislation to control occupational noise exposure

The first Federally enforceable controls over noise in work places was promulgated in 1969 as an amendment to the Walsh-Healey Public Contracts Act of 1935⁴. The Act covered employees of all companies with Federal contracts of \$10,000 or more. The proposed rule was published in 1968 and required reduction of continuous noise levels to 92 dBA until 1971, at which time reduction to 85 dBA would be required. Audiometric testing was required for employees exposed to more than 85 dBA. The rule was effective for only a few days.

In May 1969 an advisory committee was appointed, which recommended a new set of rules, including a time-weighted exposure of 90 dBA and a requirement for an effective hearing conservation program although there were no special provisions for audiometric testing.

Briefly, the rule required that the time-weighted 8-hr. noise exposure limit should not exceed 90 dBA. The time-intensity trading ratio was 5 dB with a maximum duration for continuous noise at 15 minutes of 115 dBA. Exposure to impulsive or impact noise should not exceed 140 dB, peak sound pressure level. In all cases where noise exposure exceeded these limits an ef-

fective hearing conservation program should be administered.

In 1970 the Occupational Safety and Health Act (OSHA)⁵ was passed and it incorporated a number of safety and health standards, such as the Walsh-Healey standard. It provided for the development of regulations on toxic substances and harmful physical agents. Criteria for these regulations were to be developed by the National Institute for Occupational Safety and Health (NIOSH), and then sent to the Department of Labor for the formation of regulations under OSHA.

Criteria for occupational noise exposure and a recommended standard were published by NIOSH in 1972⁶. NIOSH recommended an 85 dBA time-weighted exposure level as soon as information on feasibility became available. The existing 5 dB trading ratio and the peak level of 140 dB for impulses were retained, and audiometric testing provisions were included.

OSHA appointed a Standards Advisory Committee on Noise early in 1973. The Committee had a legally mandated composition: 4 members from industry, 4 from labor, 3 from the public (professionals), 2 from Federal government and 2 from state government. The Committee met over a period of 8 months and made its recommendation to the Secretary of Labor in December 1973. The recommended exposure level was changed back to 90 dBA and other major provisions were similar to the NIOSH recommendation.

A proposed standard was published in October 1974⁷ which generally followed the recommendations of the Advisory Committee except that limits were proposed for numbers of impulses; i.e., 100 at 140 dB, 1000 at 130 dB and 10,000 at 120 dB.

Public hearings are scheduled for June 23rd of this year which will probably last two to three weeks. Also an Environmental Impact Statement will be issued early in June, which describes the health and the economic impact of the proposed standard. It is too early to predict whether the final standard will be in line with the proposed OSHA rule or whether the objections raised and documented by EPA, other Government departments, industry and the public will carry enough weight to modify the rules. Some of the main points under discussion are:

a. Should the occupational noise exposure limit for the 8-hour day stay at 90 dBA, or should it be reduced to 85 dBA or lower as proposed by EPA and others to reduce the risk of hearing loss?

b. Should a future date be set at which the permissible level will be further reduced so that the economic impact of required noise control is reduced by giving industry enough time and a clear time schedule for the phase-in of new equipment that emits less noise?

c. Should the permissible exposure level be increased by 5 dB per halving of daily exposure time (as under present OSHA rule and proposal) or should the 3 dB rule, as proposed by EPA, be adopted?

d. Should the provisions of the current standard be maintained that feasible engineering and administrative controls shall be used to reduce noise exposure to within permissible levels or should personal protective equipment be more widely permitted to achieve exposures permissible according to the proposed or a more stringent standard?

e. What is the total national cost of reducing all occupational exposures to 90, 85 or 80 dBA?

It is the answer to this last point, which is most difficult to obtain and which might require more detailed further study. This answer and not any scientific data on hearing loss will also decide in all probability if the permissible level will remain at 90 dBA or if it will be lowered to 85 dBA or lower now or with a specified time schedule which might have to be revised as economic experience indicates.

Environmental noise control

Prior to passage of the Noise Control Act of 1972, by far the most regulated area of environmental noise at the Federal level has been aviation noise. The growth of civil aviation after World War II, and its adoption of high performance jet engine powered aircraft resulted in recognition of a need for consideration on a voluntary basis of noise as a problem which "threatened to undermine aviation progress". The Federal Aviation Act of 1958 was amended in 1968 to specifically provide authority to the

Federal Aviation Administration to prescribe rules and regulations for the control of sonic boom and aircraft noise. This authority, taken with the provisions of the Noise Control Act of 1972, has been finally interpreted by the United States Supreme Court, after years of lengthy litigation and debate, as establishing a pervasive national Federal pre-emption of state and local authority over aviation noise.

Other Federal legislation relating to controlling effects of noise include the Airport and Airway Development Act of 1970, and the Federal Aid Highway Act of 1970, both of which require that consideration be given to environmental noise as a requirement in determining approval for Federally funded projects authorized under these Acts. The National Environmental Policy Act requires general consideration of noise, like any other environmental concern, in all environmental impact statements required for Federal agency actions. Passage of Title IV of the Amendments to the Clean Air Act in 1970⁸ for the first time, however, focused attention on the importance of noise as a problem requiring a central focus of concern at the Federal level. Enactment of that legislation established within the United States Environmental Protection Agency an Office of Noise Abatement and Control, and required that an extensive study on noise as a national environmental problem be completed with a report thereon to the President and Congress by January of 1971. The legislation was based on recognition both in the Congress and the Executive Branch that noise was indeed a problem in the United States which if not regulated at the Federal level to some degree, would become a major national environmental problem.

The United States Environmental Protection Agency, in undertaking the responsibilities assigned to it by Congress, held a series of public hearings on noise at eight major population centers in the U.S. It also undertook a massive coordinated effort to obtain the data for the "Report on Noise" submitted to the President and Congress in January, 1971. In the course of that effort, involving broad public, industry and state and local government participation, as well as that of the professions concerned with noise effects and noise control, there

also evolved a comprehensive basis for establishment of positions regarding the various legislative proposals for a national noise control law, which was ultimately enacted as the Noise Control Act of 1972.

That Act represents a compromise between the differing views and value systems. An appreciation of those different views is essential to an understanding of the actions called for in implementing the Act, to be described shortly. In summary, the major problems and differences which the Congress had to resolve in enacting the noise control legislation were:

1. How to deal with the various responsibilities of the several Federal agencies relating to noise control, especially in the aviation noise area.

2. What should be the proper role of the Federal Government vis-a-vis the states and their political subdivisions, especially in view of the fact that much of the concern for noise relates to nuisance and annoyance, traditionally and constitutionally a function of the states².

3. The views of many industries that it was impossible to cope with a multitude of different laws relating to the noise emission characteristics of a particular product, and that some form of national control was needed.

4. As a correlation of 2 and 3, should the Federal Government establish some sort of national ambient or national cumulative noise exposure standard².

5. How to effectively mobilize the resources needed to deal with the recognized need for more and better information as to the effects of noise, so as to more adequately specify abatement requirements.

The essential elements of the enacted legislation established a sound basis for a United States National Noise Abatement Program.

The essence of the law is that the Federal powers should be applied to regulate noise emission of products which are widely used and distributed in commerce, so as to require uniformity of treatment. These powers should also be applied to the control of noise from transportation sources, which by nature of their movement and numbers constitute a continuum of noise impact more

pervasive than would be inferred from the noise emissions of the individual sources alone.

Authority to determine the levels of noise to be permitted in a particular locale, and as to the use of sources of noise for which there are no Federal regulations is under local control until such time as a specific Federal regulation becomes operative. The major provisions of the Act are as follows:

a. *Coordination of Federal Programs*

The administrator of the Environmental Protection Agency is directed to coordinate all Federal noise research and control programs. The Act recognizes that a number of agencies have responsibilities for noise control assigned by other laws. The Environmental Protection Agency is required to review, prior to issue, any regulations proposed by any other agency that involve noise control and to make recommendations thereon, with special provisions established with regard to aviation.

The Act also establishes procedures whereby the Administrator of EPA may require another agency to examine the adequacy of regulations published by that agency, where the EPA feels that the regulations do not adequately protect public health and welfare from noise.

b. *Aviation Noise*

The authority of the Federal Aviation Administration under the Federal Aviation Act was maintained to issue noise control regulations affecting aircraft. The Noise Control Act amended the Federal Aviation Act to require that health and welfare be the basic consideration for noise control rather than the balance previously called for between technology and economics. A complicated mechanism for noise control relating to aviation based on that amendment and the new provisions in the Noise Control Act are established.

The Environmental Protection Agency was required, within nine months of enactment of the Law (not later than July 1973) to complete a comprehensive study of the aviation noise problem. The study was to include an examination of the adequacy of existing Federal Aviation Administration regulations for aviation noise control; the

questions of retrofit of existing aircraft as compared with their replacement with less noisy aircraft; the possibility of use of operational controls for noise abatement; and an assessment of what, if anything, state and local authorities might do to abate aircraft and airport noise.

After completion of the above study, the Administrator of EPA was required to submit recommendations to the Federal Aviation Administration regarding any needed changes in existing regulations or new regulations to abate aviation noise. Procedures are established whereby the Federal Aviation Administration must acknowledge in the *Federal Register* receipt of the proposals and indicate action they plan to take, including the holding of public hearings.

If disputes between the two agencies result, there are provisions for resolution under other authorities of law such as resolution by the Council on Environmental Quality. The Act provides for review, by EPA, of any regulations for aviation noise proposed by the Federal Aviation Administration, in a manner similar to that provided for all other Federal agencies' actions.

In July 1973, the Environmental Protection Agency submitted the required report¹⁰ to Congress. As a result of this study a number of regulations concerning aviation noise are under consideration:

1. Establishment of an airport noise control system
2. Retrofit of existing aircraft engines
3. Takeoff and landing procedures
4. Minimum altitudes
5. Amendments to FAR Part 36 for future aircraft
6. Control of supersonic aircraft
7. Short haul aircraft

c. *Publication of Criteria and Levels with Respect to the Health Effects of Noise*

The Environmental Protection Agency is called upon to publish "criteria" for noise. These criteria are to "reflect scientific knowledge most useful in indicating the kind and extent of all identifiable effects of noise on the public health and welfare which may be expected from different quantities and qualities of noise". In connection with this requirement, it should be

noted that the terms "criteria" and "standards" are used interchangeably in the scientific communities concerned internationally with noise control. This interchangeable semantic had led to considerable confusion because in an environmental sense, it is the intent of the United States Congress that "criteria" for environmental pollution are descriptive appraisals of the available knowledge relating to health and welfare effects of pollution. They do not make judgments as to the economics and technology involved or do they specify desired levels of control. "Standards", on the other hand, in this context, are statements of conditions not to be exceeded. They take into account health and welfare needs, technology, economics, and other related concerns. In order to meet the requirement for criteria development, the Environmental Protection Agency sponsored an international conference on public health problems associated with noise in Yugoslavia in May 1973 and subsequently published the noise "Criteria Document" on 27 July 1973¹¹.

In order to assist state and local governments in the discharge of their responsibilities and to provide a basis for uniform Federal agency approaches to environmental noise control, the Act requires that EPA issue information on levels of noise requisite to protect the public health and welfare, with an adequate margin of safety. This "information" is not to be construed as the setting of a national ambient noise standard. Rather, the purpose is to provide information to be used by those with the responsibility of setting standards or regulations. Based on the best available data, it represents the best judgment as to the levels of noise which should not be exceeded, without reference to such considerations as available technology or cost, if the ultimate in protection of health and welfare is to be achieved.

The EPA document "Information of Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety", meeting these requirements, was published in March, 1974¹².

d. Control of Noise Emissions

The Environmental Protection Agency is required to identify major sources of noise (without reference to whether or not these

affect health and welfare). The first such identifications were to be accomplished not later than 18 months after the enactment of the law (April 1974). Having identified major sources of noise, the Administrator is then required to determine whether there is technology available to control such sources. If, in his judgment, such technology is available, he must then propose a regulation which will include a standard for the control of such noise, such standards to become effective six months after proposal. The standard for control of noise emission from the products so identified must take into account the available technology, the cost of control and requirements for protecting public health and welfare. The law provides for public participation in the rulemaking process. Provisions are included for identification of major sources of noise on a continuing basis. Sources to be considered include transportation equipment, construction equipment, other engine driven equipment, and electronic products. It also contains authority for the Administrator to propose and promulgate regulations to control noise emissions from other types of products which are determined to be capable of producing noise affecting the public health and welfare.

After these regulations become effective no state or political subdivision may enact or enforce a regulation on noise emissions different from the Federal regulation. However, the division of powers between the Federal Government, states, and lesser political subdivisions is maintained in that states and their subdivisions may enact regulations affecting the *use or operations* of such products regardless of whether they meet the Federal source emission control requirements. They may regulate sources for which the Federal Government has not yet issued regulations.

e. Labeling of Noisy Products

The Act requires regulations for the labeling of products that emit noise capable of adversely affecting the public health and welfare, or which are sold wholly or in part on the basis of their protection against noise. There is a relation between the standard setting requirement described above and this provision. If a product is identified as a

source of noise and it is determined by EPA that a regulation is not possible (because of technological inadequacies for control, etc.), then if the product constitutes a hazard to health and welfare, a label describing the hazard must be issued. Likewise, a product which is a major source of noise for which technology is available, and for which a standard is prescribed still may require labeling: this would be the case where technology is not able to reduce noise so as to meet health and welfare requirements.

Labeling of products sold wholly or in part for the control of noise is obviously a consumer and worker protection measure. Close relationship between the responsibilities of the Environmental Protection Agency and the Departments of Labor and Health, Education and Welfare with regard to occupational safety and health arises from these provisions.

In addition to providing information on noise attenuation characteristics of such protective devices as ear defenders, these provisions also can be applied to engine mufflers, and similar components.

f. *Assistance to State and Local Governments and Provision of Information to the Public*

The Agency is called upon to provide assistance to states and local governments by providing information on the effects of noise, means of control, and other aspects of noise control and abatement. Federal assistance to states and local governments with regard to enforcement of noise control measures, and in the development of model laws and ordinances relating to state and local responsibilities and authorities, is also authorized to provide to the public information on the wide range of aspects of the noise control problem.

g. *Research*

The Act authorizes EPA to undertake such research as needed to complement any research that has been done or is being done, or as is needed, to support its own abatement activities. The Congress specifically in-

tended that there be joint utilization of national laboratories and the bringing together of national capabilities that deal with common interest areas of the noise problem.

h. *The Control of Noise from Surface Interstate Carriers*

The need for uniform treatment of sources of noise involved in interstate commerce is met by a requirement that the Environmental Protection Agency establish standards of noise emission for interstate rail and motor carriers. These standards preempt any state or local regulations aimed at control of noise from interstate rail and motor transportation. These regulations are in addition to any of the new product regulations aimed at major sources of noise such as trucks or locomotives.

Whereas those regulations previously discussed apply only to items manufactured after they become effective, the interstate carrier regulations are retroactive and apply to all carriers in operation. They, thus, require a retrofit of existing vehicles.

i. *Special Features of the Noise Control Act*

There are several special elements of the Noise Control Act that require highlighting. These include the following:

Imports.—Products produced outside the United States and imported therein must conform to the requirements of any new product or labeling regulations issued under the Noise Control Act. Products which might be used in interstate transportation would also have to meet those requirements. Conversely, products produced in the United States and intended exclusively for export need not comply with such regulations, provided they comply with the requirements of the nation for which they are intended for use.

Penalties.—Violations of the regulations result in criminal rather than civil penalties.

Citizens Suits.—Citizens suits are authorized against the Administrator of EPA and the Administrator of the Federal Aviation

Administration for failure to perform any of the mandated actions called for by the Act. Such suits can only be commenced after filing with the Administrator concerned a letter of intent 60 days in advance of such action.

A major question of concern to the Congress in considering the various proposals leading to the Noise Control Act of 1972 was the relative roles of the Federal Government and of the states and their political subdivisions in controlling noise. The Congress decided "that while primary responsibility for control of noise rests with state and local governments, Federal action is essential to deal with major noise sources in commerce, control of which requires national uniformity of treatment". That philosophy underlies all of its provisions. However, the literal language of the Act does not answer a number of questions with regard to just what state and local governments may do to control noise. The extent of Federal, state and local cooperation and interaction requires some elaboration for a full understanding of the respective responsibilities and authorities involved.

It is important to understand the distinction between noise emission regulations (a Federal role) and those limiting environmental noise in a community (a function of State or local government). The former deals with each individual noise source, the latter with the noise experience by people, which is a mixture of sounds from many sources impacting the area in question. Mere source standards alone cannot solve the question of how much noise ought to be allowed to exist in an area. While states are authorized to act in this regard, the cities and counties are generally more concerned with such considerations.

Typical of the types of action which state and local governments can take are such measures as:

1. Operational limits on noise from vehicles in use. A truck meeting Federal emission standards could still be required to operate at low enough speed to meet specified noise levels in residential or other designated areas. Vehicles or other equipment subject to Federal emission regulations can

be prevented from operation at specified times (such as night hours), or in designated zones (such as near hospitals or schools).

2. Quantitative noise level limits where special or designated zones can be established.

3. Nuisance laws are still effective. For example, a state or local code can provide that "it shall be unlawful for any person to willfully make or continue to make or cause to be made any loud, unnecessary or unusual noise which disturbs the peace and quiet, or causes annoyance to persons of normal sensibilities". Even though a noise producing device meets Federal emission standard, its use can be prohibited or subject to penalty if it violates such a code.

4. Noise limitations at designated property zone borders can be established. A state or city can establish either octave band, or dBA values, which shall not be exceeded at the border of the zone by sources of noise within the designated area. Even though all of several items of construction equipment meet the Federal emission standard, if when operating simultaneously the established limit at the property line is exceeded, the local political authority can act to abate the noise.

5. There is no restriction on establishment of source emission standards for those products which the Federal government has not identified and promulgated regulations. If there is no Federal product regulation, then the states and cities are free to act.

The Act recognizes that the Federal Government has an obligation to assist the states and their subdivision in developing an adequate and scientifically suitable basis for determining what levels of noise they consider acceptable, recognizing that the ultimate decision must take into account economics, technology, and local aspirations and desires. Accordingly, the "criteria" and "noise levels" documents discussed above are intended as much for use by the states and local governments as within the Federal Government. This information is intended to establish a local basis for local action, and experience to date has already indicated that it can indeed serve that purpose.

Economic and international implications of the Noise Control Act

Underlying the regulatory authorities and requirements of the Noise Control Act is a fundamental appreciation of the need to achieve a balance among health, welfare and social benefits, available technology to provide such needs, and the costs of its application and insuring its use. There is available abundant technology for the control of noise from the principal sources covered in the Noise Control Act.

In the absence of laws or regulations, generally speaking, the costs of noise control measures are controlled by the attitude toward noise on the part of those providing the funds for the particular project involved. In effect, a noise criterion is established by the sponsor of a building project, such as an apartment house; the manufacturer of a noisy product, based on his judgment of what the consumer will accept; and in turn by the tenants of the apartment, who also may be purchasers of the quiet or noisy products.

The level of control in such circumstances results, in effect, in an externalization of the cost of noise. This arises because the cost of the noise is externalized, the burden of doing something about it being placed upon those exposed to it, the user of the noisy product and/or those who are unwilling neighbors to its locale. What in effect occurs is that the level of noise abatement selected, in most cases, largely depends upon the cost involved in providing it, balanced against the value the particular proprietor places on "quiet", rather than on socially desirable objectives and needs. Those exposed to the resulting acoustic environment must either accept it (such as noise from aircraft), or take some action on their part to reduce the impact (such as sealing windows and purchasing air conditioning units which may or may not be noisy to shut out the intrusion).

Once statutory requirements for noise control are placed into effect, as is being done under the Noise Control Act of 1972, the foregoing situation is changed markedly. Instead of "market place decisions" as to "costs" to be borne for some level of "bene-

fits", the level of abatement and the associated costs to provide it are established by a governmentally imposed "noise control standard". Under the Noise Control Act, however, such standards or regulations must be practical, reasonable, and effective. The Act requires that the standards or regulations be based on available technology, consider cost of compliance, and provide for health and welfare requirements, keeping all of these considerations in balance.

As is the case with a number of environmental problems, there are a considerable number of difficulties to be faced when attempting to assess the economic implications of noise control. Because of the subjective nature of many of the effects of noise, the problem is rendered more difficult than in the case of those pollutants where cause and effect relationships in terms of disease causation or similar specifics can be fairly well defined. Even with air and water this is not always easy. In summary, the principal problems are:

1. The lack of sufficient data as to the magnitude and worth of the benefits derived from noise abatement. This is so with regard to damages from noise to the individual and public health, estimates as to litigation for damage to property and/or its use, and in terms of positive gains achieved. There do not appear to be acceptable measures of merits as to the "value of quiet".

2. There is a major degree of uncertainty regarding the actual costs involved in applying noise control technology. This is especially so with regard to control methodology which, while technically feasible, has not been applied to mass production items.

3. As a result of the above two situations, traditional cost benefit analyses cannot be made, nor can cost effectiveness determinations be achieved with a high degree of precision or refinement.

In spite of these problems, the need for consideration of economic implications in formulating the regulations exists as it also does in assessing their impact and effectiveness. There are several possible indicators by which one can estimate the possible benefits of noise control or the "value of quiet". Prominent among these are estimates

TABLE 1.—Estimated public daily exposures including operators, passengers, and onlookers - Non occupational.

Source	Sound level		Approximate No. of people exposed (millions)
	Average	Maximum	
1. Snowmobiles	108	112	1.5
2. Motor boats (over 45 Hp)	95	105	8.8
3. Motorcycles	95	110	3.0
4. Internal combustion lawn care equip.	87	95	23
5. Chain saws	100	110	2.5
6. City & school buses	82	90	11.0
7. Home shop tools	85	98	13.0
8. Trucks (personal use)	85	100	5.0
9. Commercial propeller aircraft	88	100	5.0
10. Automobiles	68	90	100
11. Subways	80	93	2.15
12. Construction sites (onlookers)	90	—	137
13. Commercial jet aircraft	82	95	33.2
14. General aviation aircraft	90	103	0.3
15. Highway buses	82	90	2.0
16. Light utility helicopters	94	100	0.05

of costs which might be avoided by controlling noise. Included among these are such values as the cost of land easements for noise along highways, cost of flyover easements at airports, the cost of litigation associated with aircraft noise, and costs of sound accommodation treatment in commercial and residential applications, such as double glazing all of the windows in a typical suburban residence, and providing acoustical treatment for the roof.

Unfortunately, from the viewpoint of the affected urban dweller, these estimates only represent sub-optimal components of the total possible impact of noise. An individual may be exposed to noise in many varying

situations in his lifestyle, and the cumulative effect of reducing or eliminating these exposures is virtually impossible to estimate at the present time.

Given the foregoing, another approach can be taken and is the one which is currently being used by EPA. It takes into account the total number of persons exposed to various noise sources in the United States (see Table 1 for current estimates of the United States residential noise environment).

An indication of the magnitude of improvement for a particular noise regulation can be determined and the costs of applying alternative technology for those reductions assessed. A discussion of the judgmental process and the theory underlying such approximations is beyond the scope of this discussion. In essence, the assumption is that the worth or benefit from the costs is indeed the value of the "quieting". Cost estimates for the various transportation sources and products to be regulated by the Federal government during the first five years of the Noise Control Act are listed in Table 2.

TABLE 2.—Economic profile (1970 statistics) of manufacturers directly* affected by the setting of noise emission standards on major sources as called for in section 6 of The Noise Control Act.

Equipment class to be regulated	Annual value of products manufactured and delivered (\$ billion)	%GNP	Employment (people)
Transportation equipment manufacturers (including recreational vehicles - Exclude aviation)	71.5	7.4	1,686,000
Construction equipment manufacturers	9.4	1.0	281,000
Other internal combustion engine powered equipment and machinery manufacturers	39.0	4.0	1,384,000
Applicable electrical and electronic equipment	40.4	4.1	1,427,000
<i>Total</i>	160.3	16.5	4,778,000

*Does not include indirectly affected industries (e.g., road builders).

Source: Statistical Abstracts of the United States, U.S. Government Printing Office, Wash., D.C.

Also listed are estimated numbers of the population who would benefit from such regulations.

There are several major international aspects of the Noise Control Act. These include the requirements that all new products for which standards have been set that are manufactured outside the United States and imported by the United States must meet the same noise control requirements as those manufactured in the United States. These requirements are enforced by the Secretary of the Treasury, through the Bureau of Customs. Likewise, any labeling requirements for products made in the United States must also be met by the manufacturers in other countries. In the absence of an explicit law, it would be assumed that similar requirements would have to be followed by United States manufacturers exporting products to countries with noise laws. The Noise Control Act makes this an explicit requirement. Thus, if a nation has different requirements than those of the United States, the product specifically manufactured for export to that nation must meet its regulations. These provisions also apply for labeling of products including products whose purpose is the control of noise, such as hearing defenders, mufflers, and so on.

These provisions should lend considerable emphasis toward the development of internationally agreed upon standards. More important, perhaps, they should serve to foster international cooperation and agreement on such fundamental concerns as measurement methodology, instrumentation, community noise evaluation and health effects research.

Another major area of international concern relates to aviation noise. Considerable activity on aviation noise has been undertaken over the last two decades within the International Congress of Aeronautical Organizations (ICAO). In the main, these efforts have been oriented toward technology and state-of-the-art activities rather than to health and welfare. In the absence of national laws requiring otherwise, the trend appears to have been to do the best possible, considering the needs of air transportation, the costs of control, and general state of knowledge regarding public acceptance of noise.

Various national states have recognized

the impact of aviation noise on community health and welfare and enacted a variety of restrictions on aircraft and airport operations to provide for community protection and abatement. The Noise Control Act will serve as a further stimulus for the Environmental Protection Agency, the Department of Transportation, and the Federal Aviation Administration to work for improving international agreements regarding aviation noise.

Outlook and summary

The Noise Control Act of 1972 is the most comprehensive noise legislation in the United States. Its main purpose is to institute and carry out, in a timely fashion, the necessary measures to arrest present trends in noise pollution, to improve the environmental quality with respect to noise and to protect public health and welfare against the harmful effects of noise. It is designed to supplement and support: a. existing legislation (Occupational Safety and Health Act of 1970) protecting employees against the effects of noise on health or functional capacity in their working environment and b. state and local government efforts to control the noise environments of municipalities according to local requirements and desires. The Noise Control Act specifically addresses problems such as emission standards, product labeling and research which must clearly be attacked at the national level to result in effective and economical results.

It must be admitted that any estimations as to the economic costs or benefits of the Federal noise control regulations are tenuous and uncertain at best. Nonetheless, some tentative, gross first order of magnitude approximations indicate that for an expenditure of *between \$1.9 and \$5.5 billion dollars over the first five years* after the regulations now being proposed are promulgated, 50 to 60 million persons would have an improvement in the noise environment to which they are exposed. These estimates are presented in Table 3.

In viewing the information presented in Table 3, several cautions and observations need to be kept in mind. First, and most obvious, the numbers of those exposed to

TABLE 3.—Cost effectiveness first phase federal regulations on noise.

Regulations	Estimated five year costs	Estimated population "benefited" *
Interstate carrier		
Aircraft	\$1-\$5 billion	16 million
Airport	\$100 million	16 million
Motor	\$42 million	5-10 million
Rail	\$50-\$80 million	500 thousand
New products		
Trucks	\$150-\$250 million	40-50 million
Air compressor	\$140-\$190 million	30-40 million
Total	\$1.9-\$5.6 billion	50 million

*Population figures are not cumulative.

the various sources are not cumulative because of multiple exposures of single individuals. Further, the relief or benefit resulting from the alleviation to some degree of the various principal sources of urban annoyance may be greater than would be predicted on an additive basis. EPA has recognized that there is a pressing need for more investigations and long term research on these socio-economic attributes.

The success of the legislation over the long term will depend on how effective it has been with regard to:

1. Reducing hearing loss and other direct effects of noise on health caused by the combined exposure to occupational as well as environmental noises.

2. Achieving environmental levels of noise which allow for good communication; and

3. Providing an environment free from noise pollution at times and places where relaxation and sleep are needed.

All of the various Federal regulatory actions and other measures authorized in the Act will not in and of themselves achieve those ends. The Act recognized that in the main, noise is essentially a local problem which requires the vigorous application of

the powers and authorities reserved to the states and their subdivisions. There is a requirement for the Federal Government to determine if there is adequate progress being made toward the above goals. At this writing EPA is in the process of formulating the necessary procedures to make such assessments on a long term basis. The periodic reports to the Congress called for in the Act should serve as a mechanism whereby these evaluations are brought into public view, so as to serve as a basis for whatever modifications and improvements are needed.

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