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THE ECONOMICS OF NOISE POLLUTION

by

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for the

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THE ECONOMICS OF NOISE POLLUTION

It is important to understand why pollution - air, water, noise - arises in our, or any, society and why it is allowed to persist. Such understanding is necessary if rational decision making is to prevail in the "pollution field."

In consuming many goods and services an individual, in the terminology of J. S. Mill, is involved in a "self regarding act," or in the terminology of the economist, is creating no externalities; all the benefits accrue to the consumer with no positive or negative spill-overs. For certain commodities, however, individuals other than the consumer are affected by his act of consumption. The attractively painted house, the well-kept yard, the growing of trees and flowers, can all yield satisfaction or utility to neighbors who did not contribute to the costs of such commodities; indeed, one can imagine a situation in which neighbors would be willing to pay you money not to cut down trees in your own property. At the opposite end of the spectrum certain acts create negative externalities; the riding of a noisy motorcycle in a residential area yield benefits to the rider or consumer but at the same time imposes costs (or yields negative benefits) to residents. The rider is performing an "other regarding act." Recognizing this distinction between "self regarding" and "other regarding" acts or activities which do not and those which do create externalities, many people argue that societal laws should be concerned only with the latter category. Others argue for sumptuary law and existing legislation penalizes acts of homosexuality, marijuana smoking, suicide, the wearing of motor-cycle crash helmets in California,

and so on. Economics being a positive, not a normative science, has nothing at all to say in the field. With activities causing external effects, however, economic analysis is essential for rational decision making by society.

In the "wonderful world" of perfect competition with no externalities economic efficiency is achieved when the last dollar's worth of resources used in industry A results in the same level of satisfaction or utility as the last dolar's worth of resources used in industry B. If this equivalency condition did not hold society could increase its well-being by switching resources until equality were attained. Competition between buyers and competition between sellers operating through the market mechanism ensures economic efficiency; the consumer is sovereign. Resources flow according to his wishes reflected in dollar votes and the impersonal market ensure that goods and services are produced at least cost. Whether such a system is just or equitable, whether or not individuals should be rewarded according to their contribution to the production of goods and services, whether or not any initial distribution of wealth is good or bad are normative issues not subject to economic analysis. However, it is the ownership of wealth, especially property, or rather the laws governing property ownership, which are at the heart of the externalities problem.

For example, if we return to our noisy motorcycle example, it is obvious that if an individual owned sufficient property he could ensure no disutility from motorcycle noise in his residence by barring all motorcycles from his private property. If all property, including roads, were privately owned and if vehicles were allowed

on private roads only if certain noise pollution standards were met, a noisy motorcycle would be restricted to its owner's property. It is precisely because many of our resources are not and cannot be privately owned that pollution - water, air, and noise - emerges as a problem. To help clarify the issues involved consider the following example. Imagine that a firm producing chemical is located on the banks of a river which the firm also owns. If the firm dumps water into the river a large number of salmon die. (Assume no other benefits, e.g., scenic, are derived from the river.) In making the rational decision as to whether or not chemical wastes should be dumped in the river the firm will decide if the resulting decrease in value of the river as a fishery would be greater or less than the costs of other methods of chemical waste disposal. If on the other hand the river is publicly owned and the chemical firm will ignore the costs of dumping waste in the river and use the river as <u>its</u>, not necessarily society's, cheapest method of waste disposal. The price of chemicals will not reflect all production costs - the price will be too low - too many chemical products will be consumed - society will be subsidizing consumers of chemical products - a redistribution of real income in favor of the chemical products consumers will result - economic efficiency will not be achieved.

If the government, local or federal, wishes to promote efficient use of resources what should it do? Should it allow river use to be determined in a free market? Should it prohibit the chemical producer from dumping wastes into the river? The answer to both questions is 'no'. The government should allow the chemical producer to dump waste in the river if it wishes but should charge the firm the decrease in the value of the river as a fishery.

The general rule for economic efficiency is that resources should be allocated until the last dollar spent on any one commodity yields the same satisfaction to society as the last dollar spent on any other commodity.

Given the fundamental fact of scarcity of resources less pollution must mean fewer other goods and services. Thus if society wants less noise, cleaner air and less polluted rivers and seas it must realize that the cost of less pollution is other goods and services foregone. Society must order its priorities. Less developed nations would like to enjoy less pollution but are they prepared to pay the cost of less economic growth, starvation, fewer schools and hospitals? What costs are we prepared to pay to enjoy less pollution? The question really is how much pollution do we want and again the above stated marginal principle must apply.

With any pollution regulation performed in a piecemeal fashion, the danger exists of merely transferring pollution from one form to another. For instance, decreasing air pollution through scrubbing processes in air-polluting industrial processes may mean the creation of the problem of disposing of liquid wastes. That is, less air pollution could imply more water pollution with the waste of scarce resources in making the transformation. To prevent inquities and inefficiencies associated with piecemeal regulation, the marginal principle should still be applied - all the marginal benefits and all the marginal costs must be taken into account. In noise pollution regulation fortunately, transferability to other types of pollution is less of a problem, though instances exist of merely moving the noise from one area to another not always leaving it to an increase in economic efficiency.

For almost all types of pollution, costs rise disproportionately in relation to the degree of non-pollution. Consequent;y, it is at the margin that decisions must be made. To reduce the noise level from the local freeway, the local community must decide if the real costs, i.e., the school or library or any other goods and services foregone, are worth the reduction of noise. The reduction of noise will be the marginal benefit; the alternatives foregone the marginal cost. If the former exceeds the latter the project is worthwhile. Unfortunately with many such projects it is extremely difficult to measure benefits; but unless efforts are made, too little pollution might remain. Examples exist in which freeways have been repaved with smooth surface to cut down noise levels; and the costs have been extremely high and the benefits minimal or negligible. This does not imply that the freeway has not been resurfaced in the most efficient engineering manner, i.e., using the least amount of resources. Rather, it suggests that cost-effectiveness in road resurfacing is no substitute for cost-benefit analysis in dealing with the whole problem.

We can use the following framework to analyze the problem. While instruments of a sufficient degree of accuracy exist for the measurement of noise, each different degree of noise does not cause the same pain or disability to each individual because different individuals have different reception sensitivity. Also the noise source or type of noise about the same level of noise, affects different people in different ways. For example, compare a discotheque, a full grand opera chorus, and a jet aircraft takeoff.

For noise levels people do not seek (the discotheque, freeways, airports, or whatever), there is general agreement that certain levels of noise are acceptable. For example, using a dB(A) scale, people seldom complain for noise levels below 70 whereas permanent ear damage can result at a dB(A) level above 90 for exposure to noise over a protracted period of time. As expected, complaints, legal action, and community activity increase as noise levels increase. What constitutes desirable action to achieve economic efficiency? Consider figure 1. The curve oa represents the cheapest way to achieve various decreases in noise level. For instance, a decrease of 10 units on the dB(A) scale can be achieved at costs of S_1, S_2, S_3, and S_4. If local authorities, for example, decided to decrease noise by 10 dB(A)'s on a freeway passing through a residental area, they would consider not only all reasonable ways to reduce noise by that amount, but also the price tag attached to each. In other words, they would undertake a cost-effectiveness study and consider various alternatives such as reducing speed levels (a 10 m.p.h. speed decrease yields -3 dB(A)) construction of a solid wall (a concrete or large brick wall, 6-foot high yield decreases of about -10 to -15 dB(A)). Resurfacing the road (going from small chip surface to smooth surface yields -1 dB(A)), prohibiting motorcycles and diesel trucks (-10 to -20 dB(A)'s).

Thus, in figure 1 the area above the line oa is essentially made up of an infinite number of points, each representing a cost relating to different levels of noise reduction. Assuming all costs have been correctly assessed, authorities should concentrate on points on the line oa. This line indicates the most efficient

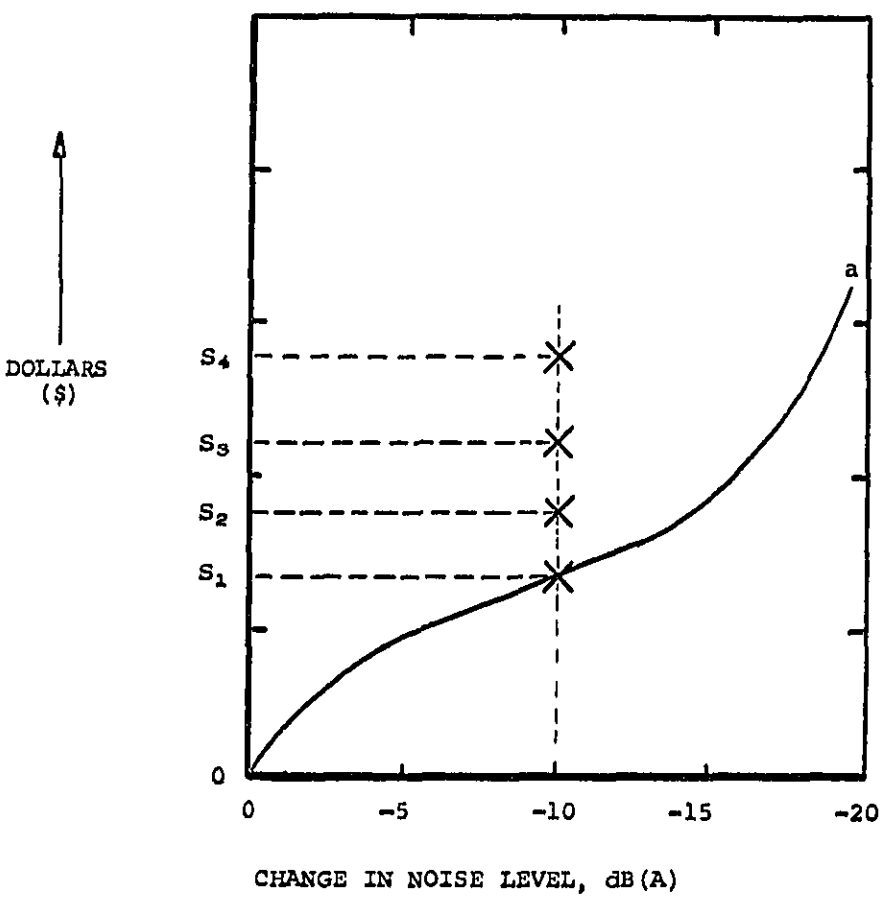

FIGURE 1.- COSTS OF NOISE REDUCTION.

way, (i.e., the least costly) to achieve any desired level of noise reduction. While such information is necessary for rational decision making, it is not sufficient. Cost benefit analysis is required to discover if the lowest cost associated with some prime level of noise reduced is worth the benefit of that noise reduction. Such an analysis requires consideration of the "opportunity-cost" of noise reduction, i.e., what is the community giving up - hospital, school, better police and fire protection, or less-after-tax income to achieve the same level of noise reduction. Thus, whenever the community's demand for noise reduction, perhaps as reflected dollar wise by the size of bond issue imposed by a vote of the people, falls on line oa, the desired level of noise pollution is indicated at the least expense to achieve the level.

There is an additional consideration which most pickets outside polluting factories evidently do not understand. Given that a community decides to decrease some type of pollution, resources are going to be required. If the most effective production process is used to reach the desired level of pollution, costs will be minimized, i.e., society will be using the least amount of its resources to achieve the desired pollution level. The question therefore of who pays for the use of those resources is not a question of efficiency but is a question of income distribution.

If airline companies, for example, have to modify jet engines to decrease noise and if they have to bear the initial cost and this is utlimately reflected in higher prices of air travel, passengers' real income will fall. If, on the other hand, federal taxes are used to modify engines, society at large is bearing the cost to

the benefit of airline users. Perhaps a more obvious example is the smoker versus non-smoker in a room. If a $2.00 widget placed on the end of a cigar stopped cigar smoke pollution the question of efficiently solving the problem is one of $2.00. Should the cigar smoker pay the $2.00 or should the person wanting non-polluted air in the room pay the $2.00? In terms of using society's resources the bill is $2.00 irrespective of who pays. Who actually pays affects income distribution.

The policy implications of all of the above can be stated as follows:

1. Educate the public to understand (a) how pollution arises, (b) the costs of pollution, and (c) the benefits of pollution.

2. Establish criteria for solving the pollution problem - this involves marginal analysis described above.

3. Devote resources to the development of measuring tools of pollution since successful legislation will require an ability to identify polluters and degree of pollution if costs are to be assessed against them.

4. Implementation of the criteria established in (2) necessitates deciding on who should pay to decrease pollution levels, which, by definition, necessitates value judgments.

It must be understood that the presence of pollution in certain instances does not constitute economic inefficiency and second, even if economic inefficiency does exist the curing of certain pollution may lead to undersirable income redistribution effects.

For example, if we assume that airport noise is a source of pollution only for those individuals who live close to an airport, it might well be the case that those individuals prefer living in their noisy low rental houses rather than being forced to look for low priced housing miles away if the noise pollution were removed from the airport area and housing prices rose concomitantly. In other words, this group of airport dwellers might vote that their world was in equilibrium; the benefits of less noise was not worth the extra cost. Similarly for people who move to the Los Angeles area for employment the wage offered presumably takes into account the extra costs incurred by living with smog and noise pollution of that area.

Similarly in St. Louis the authorities, in examining air pollution in that area, discovered that automobile emissions were the largest single cause of air pollution but the citizens showed little enthusiasm for attacking the automobile problem. The authorities decided to concentrate on non-automobile causes, chiefly industry and specifically iron foundries. For all St. Louis iron foundries emission reduction of 83.2% would require an investment of about $1 million and 86.3% would require an investment of about $3 million. This difference of 3.1% reduction was "hardly measurable" but the difference in cost, $2 million, could mean many foundries going out of business. This example points out the necessity of marginal analysis and also highlights the income redistributional effects since the cost of the forced shut-down would fall primarily on the unskilled workers in the area. The majority of those workers are black and such shut-downs could easily reactivate St. Louis's

past unemployment and racial problems, i.e., impose costs which should be included in initially analyzing the pollution problem.

PREPARED STATEMENT OF KENNETH C. ORSKI, HEAD OF DIVISION OF URBAN AFFAIRS ORGANIZATION FOR ECONOMIC COOPERATION AND DEVELOPMENT, PARIS.

I am pleased to have the opportunity to appear before these hearings and to review the results of OECD's work in the field of noise control and abatement, specifically as it relates to the technology and economics of noise emission control.

OECD has been conducting investigations in the field of noise abatement for a number of years as part of its program of international cooperation in the field of environment. The inclusion of noise within the programs has been a reflection of the growing belief on the part of OECD member governments that noise, no less than some of the more visible forms of pollution, represents a real threat to the quality of the environment and to the well-being of people.

It is, of course, no accident that the issue of noise has received tht most serious attention in the more urbanized nations of the OECD family. Just as high levels of pollution in the Los Angeles area have caused the State of California to become an early leader in the campaign against air pollution, so have the high decibel ratings in the crowed, densely populated cities of Western Europe made European nations first aware of the necessity to take vigorous steps to combat the noise nuisance. Today, however, the reduction of noise levels in urban areas ranks high on the environmental agenda of almost every OECD government.

What are the dimensions of the urban noise problem? Although it would be difficult to document a dramatic rise in noise over the past two decades in terms of sound levels, and even more difficult to estimate the rate at which noise is likely to grow in intensity in the future, there is no doubt that the problem is becoming more serious because of the rapid spread of noise in space and in time. Each year noise invades a growing number of previously quiet neighborhoods, and each year it is heard over a greater proportion of the day and night. In terms of manhours of exposure, the urban noise environment has been deteriorating noticeably. (1)

Looking at the problem from this standpoint one is inevitably drawn to the conclusion that the motor vehicle is principally responsible for the situation. While the sources of annoying sound in a city are plentiful - construction equipment, household appliances, barking dogs are some of the examples - few noises have been extending their influence as rapidly and relentlessly as the noise of motor vehicles. It is the seemingly unending spatial and temporal progression of traffic noise, affecting as it does the lives of an ever growing proportion of the population (2) for an even longer

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(1) For example, the 1961-62 noise survey in London showed that the period of calm during night hours had been reduced to approximately 5-6 hours: from midnight to 5-6 a.m. What is more, subsequent surveys in London have shown that the period of night calm has since grown shorter. Similar phenomena have been observed in other major European cities.

(2) In the United States, according to one study, the number of people exposed to noise levels of 55 dB(A) and higher will have quadrupled between 1960 and 1985 ["Trnasporation Noise Pollution: Control and Abatement", NASA (1970)]; in the United Kingdon another study has estimated that the number of people exposed to noise levels of 65-70 dB(A) and above will grow from 46 to 61% total population between 1970 and 1980 ["A Review of Road Traffic Noise, BRL Report LR 357 (1970)]

number of hours each day and night that distinguishes the problem of traffic noise from most other noise-generating activites. This is also the reason why the motor vehicle has become the primary focus of noise abatement efforts almost everywhere.

Within OECD the concern about traffic noise has led to the creation of a special task force to develop the guidelines for a model national traffic noise abatement strategy. The recommendations of the task force, recently published in a report"Urban Traffic Noise: Strategy for an Improved Environment" (3), stress the necessity of vehicle noise emission standards and effective enforcement machinery as a prerequisite to any substantial reductions in urban noise levels. Such standards, according to the task force, should be made progressively more stringent to reflect advances in noise reduction technology. Reconizing the necessity for basing decisions concerning the level of standards on as rational grounds as possible, the task force recommended that governments support detailed appraisal of alternative noise emission limits. Such studies, according to the task force, should attempt to:

(a) define present technological capability to meet initial standards

(b) indentify technological improvements in engine and vehicle design required to meet a range of more stringent standards, and develop realistic estimates of the research, development and production costs of such improvements;

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(3)Attached to and made part of this testimony.

(c) explore how the costs associated with the development of vehicles with reduced noise emission characteristics might be equitably allocated between the taxpayer and the driving public.

Studies within OECD concerning vehicle of a major abatement are currently continuing in the context of a major inquiry, "The Impact of the Motor Vehicle or the Environment". The aim of this two-year project is to carry out a broad technology assessment of the motor vehicle in order to aid member governments in the formulation of comprehensive strategies toward the automobile.

Preliminary investigations in the context of this inquiry indicate that reductions on the order of 2-3 dB(A) could be achieved in the fairly short run by adding acoustical absorbers and by detailed attention to mufflers, aim intakes and coller fans. Such incremental improvements would bring down typical noise emission levels of passenger cars to approximately 80 dB(A) from the typical current levels of 83-84 dB(A); and of heavy trucks and tractor trailers to approximately 87089 dB(A) from the typical current levels of 90-91 dB(A). (4) These state-of-the-art reductions coincide closely with the United Kingdom's proposed 1973 noise emission limits for new vehicles:

passenger cars	80 dB(A)
trucks (less than 200 HP)	86 dB(A)
heavy trycks (more than 200 HP)	89 dB(A)

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(4) Expressed in terms of ISC test procedures, i.e. emissions measured at 7.5 meters (as opposed to 15 meters in the United States), during acceleration in typical city traffic conditions.

By contrast, the limits recently agreed to by the Common Market countries approach more closely the emission characteristics of vehicles currently on the road:

passenger cars	82 dB(A)
trucks (over 3.5 tons)	89 dB(A)
heavy turcks (more than 200 HP)	91 dB(A) (5)

Reductions of 4 decibels or higher are envisageable, but probably only over the longer run since they would seem to require more fundamental changes in the vehicle system. Nevertheless, a British working group has recommended a reduction in noise limits down to 75 dB(A) for passenger cars and 80 dB(A) for trucks, these proposed standards to take effect in 1980.

A research program with the objective of developing a quiet (80 dB(A)) diesel truck is currently underway in Great Britian. The project is looking at ways of minimizing both body and tire noise as well as engine/exhaust system noise. The program, sponsored by the U.K. Department of the Environment, is expected to run for several years.

Also worthy of note is a recent announcement in the United Kingdom by Ricardo & Co. about the design of a diesel engine with noise emission characteristics 4-9 dB(A) lower than those of a conventional diesel of the same horespower. The design is based on work by Professor Priede of the

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(5) According to one recent test, only 4% of a sample of approximately 400 trucks failed to meet the limit of 91 dB(A): but 26% of a sample of approximately 400 passenger cars failed to meet the limit of 82 dB(A)A. A typical U.S. sedan is rated at 84 dB(A) according to ISO test procedures.

SELECTED PAPERS
FROM
THE WASHINGTON HEARINGS
ON
NOISE ABATEMENT AND CONTROL
NOVEMBER 9-12, 1971

U.S. ENVIRONMENTAL PROTECTION AGENCY

University of Southampton. (7)

In Germany, the firm of Heinrich Gillet, in cooperation with the University of Cologne and Essen, is carrying out under the auspices of the German Engineering Society and the Ministry of Transport a technical and economic analysis of alternative vehicle designs with reduced noise emission characteristics. The study will probably be completed by the end of 1972.

Finally, in Sweden, Volvo has recently announced the design of a new 320 HP diesel engine which is 6 dB(A) quieter than current engines of equal horsepower. The cost of the new engine is estimated to be about 5% higher than the cost of the current engine.

As the above brief survey indicates: attention in Europe is principally focused on reducing the noise output of the vehicle system itself, while comparatively little attention is devoted to the problem of tire noise (or, more precisely, the noise due to the interaction between tires and road surface). This is because in the typical European driving conditions the former clearly predominates over the latter. A variety of factors are responsible for this: first, the general absence of urban freeways seldom allows high cruising speeds at which tire noise becomes a significant factor; secondly, streets in European cities tend to be narrower and lined with uninterrrupted building facades, both of which accentuate engine and exhaust noise; thirdly, the typical European car has a low-power (under 2000 cc), high-compression engine with a shorter stroke and higher revolution than its

(7) Automobile Engineer: October 1971.

American counterpart; thus, at prevailing city speeds, engine noise tends to meek tire noise tp a greater extent than in a U.S. model. And finally, the European style of urban driving (fast accelerations and declerations) tneds to accentuate the already high noise emission characteristics of European automobile engines.

The considerable effort devoted in the United States to the problem of tire noise (for example, the truck tire investigation now underway at the National Bureau of Standards) makes any further comment here on this aspect of the problem superfluous.

Appendix A

THE SOURCES OF NOISE OF MOTOR VEHICLES AND POSSIBLE ACTION FOR CONTROL

Source	Action	Comments
MOTOR CYCLES		
air intake	silencer	Available space small. Adverse effect on performance.
exhaust	improved silencer	available space and effect on performance
cover vibrations, valve gear case,	damping on vibration isolation	probably not beneficial unless intake and exhaust first dealt with
engine cylinder block	damping of cooling fins	comments on cover vibrations apply
MOTOR CARS		
exhaust	improved silencer	Space not necessarily a problem. Silencer shape can be designed to fit any space available.
air intake	improved silencer	as exhaust
cooling fan	Location of fan with respect to obstructions. Aerodynamic blade design. Optimisation of design parameters to limit tip speed. Thermally controlled operation.	Styling of the car front can be important. Also design of grille and air paths to radiator.

MOTOR CARS (cont'd)

engine cover vibrations	improved design where necessary, e.g. damping, isolation	
tires		only a problem at high speed
engine vibrations	It is unlikely that engine redesign, shielding or enclosure will be applied to motor cars. The engine is usually well shielded by the engine compartment, but some sound-absorbing material within the engine compartment will be advantageous to minimize reverberations.	

COMMERCIAL VEHICLES

The main source of noise is the engine, secondary sources are exhaust, air intake, fan, tires and transmission.

engine air intake exhaust cooling fan tires	see Appendix B	see Appendix B
	as for motor cars	as for motor cars
transmission	shields enclosure, improved structure design	see Appendix B

Appendix B

ENGINE

SUMMARY OF NOISE SOURCES AND METHODS OF CONTROL GIVING POSSIBLE REDUCTIONS, PROBABE COSTS AND ATTENDANT PROBLEMS

METHOD OF CONTROL	REDUCTION dB	COST	COMMENTS
Combustion	2 - 3	Nil	Possible effect on emissions and economy of operation
Turbochanging	2 - 3	Cost of T.C. unit	Present difficulties in emission control. Has the advantage of increasing power. Also, for the same power rated speed can be reduced giving further noise reduction.
Cover design	2 - 5 posible on initially bad designs	Could increase cost of covers by 100% or more representing 1-2% of total engine	Research needed on suitable cover designs, particularly development of highly damped sandwhich materials and vibration isolation techniques.
Shields	2 - 3	Estimated 2% of total engine cost	Requires consideragle research and development, particularly on suitable materials and methods of fixing

Enclosure	Up to 10	Up to 3% of total vehicle costs	Numerous attendant problems - fire, risk, accessibility, weight, difficulty of maintenance, cooling, etc. Has far greater potential in buses
Operating parameters	e.g. 6 possible by change from long to short stroke design for same engine output	Not necessarily affected	A feature of initial design. Weight, size, torque characteristics etc. have to be considered.
Structure	Up to 10 considered possible	Impossible to assess but need not of necessity be greatly increased.	Considerable amount of research and development required. Comments of cover design and shields apply.

Presentation at

Office of Noise Abatement and Control Hearing

Environmental Protection Agency
Washington, D. C.

November 10, 1971

by: Mr. F. W. Kolk
Vice President
Development Engineering
AMERICAN AIRLINES, INC.
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New York, New York 10017

Mr. Chairman and members of the panel: I appreciate this opportunity to update and supplement the statement I made at your hearing in Chicago on July 28, 1971.

You will recall that my previous testimony cited the DC-10 as a prime example of how noise reduction to the existing state-of-art had been required by airlines of aircraft and engine makers and had resulted in a new jet that is 15 decibels quieter than long-range Boeing 707/Douglas DC-8 jets.

I stated that Federal pre-emption of the field is required to set noise rules correlating design, certification and flight operations factors. I expressed the view that rules setting and enforcement properly belong with the FAA, the agency responsible for flight safety and airworthiness standards, after due consultation with the federal Environmental Protection Agency.

I urged that governments inhibit non-compatible uses of property adjoining airports. And, since local zoning jurisdications often overlap and conflict, I suggested that Federal model ordinances are needed for local consideration and implementation.

I also pointed out that since steeper flight paths reduce noise for both take-off and especially approach, NASA and American Airlines had underway an in-depth program to explore what instrumentation and flight techniques might be required to safely utilize steeper approaches.

I am pleased to be able to report that this program has now been completed. It has demonstrated to us that the two-segment

approach technique may help us bring relief to noise-sensitive areas.

Our program involved the use of a 720B aircraft with JT3D engines. An available Area Navigation system was installed and coupled to a flight director with some special switching circuitry. The system allowed flight down an initial slope of 6 degrees, intercepting the normal 2.65° glide slope at a selectable point, fairly close in to the runway threshhold. The entire maneuver was under flight director command, especially the intercept of the final glide slope.

About 25 pilots were thus able to fly the airplane safely. Admittedly, they did this under very ideal conditions. The airplane was flown on instruments, but not under conditions requiring instrument usage. It was not flown in the presence of adverse weather conditions such as strong winds and wind shears. Only Stockton Airport was used. But the work did produce very considerable noise reductions in the approach phase, and leads us to conclude that an expanded program of exploratory work should be undertaken to establish feasibility on other types of aircraft, on real-life noise-sensitive airports, under real weather conditions, and with a greatly expanded base of pilots. We hope that funding will soon be available to permit us to follow up on this very significant development.

In my earlier testimony, I stated:

> "...Most state and local responses to the Federal Aviation Administration's Advanced Notice of Proposed Rulemaking on Aircraft Noise Retrofit insist that noise retrofit be required.

> These responses have cited publicly available literature to prove technical feasibility and the economic reasonableness of retrofitting. Yet, the tests demonstrating technically achievable reductions relate almost entirely to approach noise only (dominated by high frequency fan noise) and applies only to certain four-engine aircraft, which account for less than a third of the free world's airline fleet."

I went on to say:

> "No noise-reducing retrofit kits of any description whatsoever can be bought today. The fact remains that the noise reductions which would be derived from a billion-dollar noise retrofit program would occur gradually over a period of about three years, starting two years from time of go-ahead. By then — 1976 at the earliest — many of the aircraft would be retired or scheduled for retirement."

These statements are no less true today.

No over-all retrofit program can be defined without taking into account that each airplane type must be treated separately as a distinct project because of the physical differences between aircraft and their engines. As far as I can determine, each publicized retrofit cost estimate has been arrived at differently. I see little or no evidence that any cost estimate put forward to date has been based on either a specific set of hardware or a prescribed program for its installation. Cost quotations that have been bandied about apparently refer only to the cost of manufacturing noise retrofit kits. They do not take into account that the hardware cost represents only a down payment on the entire noise retrofit package.

What are some of the other costs?

First, consider an aircraft which requires the extensive replacement of large pieces of equipment such as engine mounts, cowlings, reversers, etc. All of these components have a book

value which varies according to the date of purchase of the aircraft. Some of these aircraft are now quite old; others were only recently delivered. Under a retrofit program, such equipment would become instantly obsolete and have no resale value; it would have to be written off.

It is also expensive to maintain adequate inventories of essential spare kits and components. These costs must be added in.

When an aircraft is taken out of service for installation of noise retrofit equipment, it is non-productive and can't earn its keep. This cost factor must be taken into account.

Interest must be paid on the long-term capital required to finance retrofitting. This applies no matter who pays for noise retrofitting. No one has asked—or even suggested—that the Government should defray the costs of noise retrofitting. The closest thing to a government subsidy program lies in proposals for a retrofit loan guarantee fund, created from a special passenger surcharge on airline tickets. This sounds reasonable enough until you remember that the surcharge only helps set up the loan guarantee fund. It is still up to the airlines—and its passengers—to pay off the loan principal with interest. This is tantamount to double taxation of the airline passenger.

None of the proposals I have seen to now, mention the outlays required to recertify retrofitted airplanes for duty. Recertification expenses, which vary somewhat according to the size of the airplane, might range from $15 million to $50 million. The only way to get a cheap recertification is to get a very conservative

recertification, and this only degrades further the available performance and safety of the airplane.

Frankly, I don't know what these costs might total in aggregate—but they seem certain to exceed the estimates that have been blithely thrown about at hearings such as this one and in press releases.

Clearly, there should be no Federal requirement of noise retrofits until the total economic cost of the proposal is fully ascertained and until reasonable means are readily available for defraying these costs.

In conclusion, I would stress—as I did in July—that the most pressing basic research need—both in terms of understanding today's problems and guiding future research—is in the area of human response to aircraft noise. Until a more complete understanding is achieved of what type of community noise is "acceptable," judgment as to where the noise research funding should be expended will at best be speculative.

The effects of high and low frequencies, pure tones, spectral shape and absolute level and rate of exposure (repitition) need to be understood in terms of their individual and combined effects on human responses. This research is needed to support current studies on the potential benefits of noise retrofit, to provide direction for advanced research projects, to provide guidance for design of future conventional, high-speed, and STOL

aircraft and propulsion systems, and to determine environmental impact of the air transportation system as a whole. Current procedures, such as the Noise Exposure Forecast, are inadequate in their present form to provide the answers and guidance required. In addition, research must take into account not only the social aspects of noise annoyance, but the medical ones as well.

While we can calculate the amount of noise reduction in decibels, we still have no solid evidence which says how much meaningful relief will be derived per decibel. We know that if we could render aircraft inaudible, complete "benefit" would accrue. But this is beyond our practical grasp. We can only approach full benefit on a cost vs. benefit basis. That is where technology leaves us. Hence, research is incomplete and vitally needed. Facilities to complete this research exist, but funds are insufficient to proceed with their use except at a snail's pace. Until this information is available to responsible agencies, it will be impossible to evaluate the available options intelligently and allocate available resources responsibly.

Thank you again for this opportunity to re-appear. If you have any questions, I will be happy to answer them for you.

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TESTIMONY OF THE NATIONAL ASSOCIATION OF HOME BUILDERS

AT ENVIRONMENTAL PROTECTION AGENCY HEARINGS

ON NOISE ABATEMENT AND CONTROL

NOVEMBER 9, 1971

Mr. Chairman and members of the panel:

My name is Joseph A. Singer and I am a homebuilder from the Philadelphia area. I appear before you today as Chairman of the Environmental Control and Energy Task Force of the National Association of Home Builders. Our organization has over 54,000 members in nearly 500 affiliated state and local associations, and our members build about two-thirds of the housing annually constructed by professional builders.

BACKGROUND

The National Association of Home builders has been conducting technical research and studies for more than 20 years in efforts aimed at reducing the cost and improving the value of homes and apartments and their environment. Nearly a decade ago, we initiated efforts relating to noise and sound conditioning. "Quiet House" programs were undertaken to familiarize the consumer with well-designed housing incorporating special "quiet" features and to determine the consumer's interest in such features. Shortly thereafter, a Residential Sound Conditioning Manual was developed to aid builders in providing cost-effective acoustical housing environments. Some reasonable levels of performance were suggested taking into account the variable effect of background sound levels and occupant satisfaction. It also set forth many practical construction techniques and details aimed at improving acoustical performance. The NAHB Research Foundation, Inc. has just completed a substantial revision and addition to that Manual which we will be glad to supply to the Agency as soon as it has been printed.

In addition, the NAHB Research Foundation, Inc. has been continuing research sponsored by NAHB and other interested industry companies and

organizations to measure in-place acoustical performance in relation to construction, the background noise levels, and the subjective response of the occupants. We believe this research was the first such intensive effort conducted in this country and perhaps the first conducted by private industry not related to public housing or other governmental activities anywhere in the world.

Three such studies have been made, involving measurements of airborne noise reduction, impact sound transmission with various impact sources, plumbing, appliance, and mechanical equipment noise both within an apartment and transmitted to other apartments, and the interior and exterior ambient noise levels. These measurements were made at project sites where normal techniques of construction were being used. In none of the three studies was the builder influenced to change either his construction technique or his supervision. Thus, we believe the structures studied are reasonably representative of general practices. In addition to the observation of construction and acoustical measurements, a survey of the occupants was made (by another independent research firm, expert in conducting and evaluating interviews) using a carefully designed questionnaire to probe the general attitude of tenants to their apartments and surroundings, and to determine specifically their response to intensive questions about their acoustical environment. This testimony is based in part upon the results of these studies, wherein we have been able to identify some of the problem areas that merit consideration for additional research and development.

The problem of determining precise acceptable levels of "quiet" performance is extremely difficult to resolve. It is generally recognized that roughly one-fifth of the population is relatively insensitive to noise, while an equal proportion is unusually sensitive to noise. Thus, we cannot expect to be able to

satisfy everyone. At the same time, we must recognize that each improvement to performance level also increases the cost of housing. It is essential that we strike a balance between cost and performance that provides a reasonable degree of quiet without adversely affecting the ability of all Americans to live in decent housing. In a practical sense, this means, what will the customer pay for more quiet? Several years ago, in one of the "Quiet House" promotions, a builder included sound-conditioning features such as quieter appliances and acoustical ceilings at a cost of some $1,000 per house. While prospective purchasers were appreciative of these features, they were unwilling to purchase homes at the increased cost. After questioning prospective purchasers, the builder cut back the features to a cost of about $100 per house, a level that met with moderate market acceptance.

In these days of high mortgage interest rates, high land costs and high labor costs, when a significant percentage of potential home buyers cannot qualify for purchase of moderate cost housing, it appears unreasonable to require increased costs in construction refinement, when our real efforts should be aimed at providing as much enclosed space as possible. In itself, increasing the available space for each family member is an excellent sound-control technique.

It is both desireable and necessary to provide an environment that protects people from harm and NAHB has long supported model building codes. Criteria should be constantly reviewed in the light of any new scientific evidence of the harmful effects of noise. Research into the long-term effects of moderate noise levels on the health of people might well be expanded.

In view of the present state-of-the-art of noise abatement and control, we would like to present information relating to the satisfaction of people with their home environment.

NOISE PROBLEMS IN RESIDENCES

Our studies and those of others indicate that generally the most significant acoustical problems are those between apartments, while noise sources within the home or apartment are of less concern and exterior noises are least disturbing. In apartment buildings, structure borne noise transmission is the cause of most disturbance, particularly impact noises such as footsteps. Plumbing and appliance noises are the next most bothersome disturbance since they are developed both within units and are transmitted between units. Of course, some specific exterior noise sources, such as airplanes, can be extremely disturbing to both the home owner and apartment dweller in specific situations.

NOISE CONTROL BETWEEN DWELLINGS

Airborne noise control through party walls and floors is not as significant a problem as it was 10 to 20 years ago. Manufacturers have developed and builders use a variety of constructions providing adequate airborne isolation. If proper planning and installation techniques are used, current guidelines of the Department of Housing and Urban Development appear to be adequate. In our studies, we have not been able to identify complaints about airborne noise intrusion where the separation provided a field-effective Sound Transmission Class of about 48 or greater. Unfortunately, electrical outlets in party walls often reduce the effectiveness of otherwise satisfactory construction. Revision of the National Electrical Code, and changes in local enforcement practices are needed so that electrical outlets are not required in party walls. Placing an equal number of outlets near party walls can provide adequate electrical service in most cases.

The problems of economically isolating sources of vibration from the building structure deserve considerable attention. Basic to solutions is the need for development and acceptance of measurement techniques and rating methods which provide a high degree of correlation between changes in performance and subjective response of occupants. For example, the generally used ISO method of test for

impact sound transmission utilizing a standard tapping machine and the Impact Insulation Class rating system have been shown to give equal ratings to floor construction which vary by a factor of almost four-hundred percent in loudness of transmitted footfall noise. The proposed method of test for impact sound transmission to be included "for information only" in the next ASTM Book of Standards does not change this situation. It only provides a much better definition of the test method. Other tests which relate transmitted noise to masking noise levels or detectability offer some promise of showing improvements in the desired correlation, but much research remains to be done. Only when such improved methods of evaluation are developed, can we hope for development of practical constructions and installation techniques that can reduce the problem. Similar comments are applicable to problems of transmitted plumbing and appliance noise.

NOISE CONTROL WITHIN DWELLINGS

People can be disturbed by many noise sources within their home. For some of these, such as the disturbance due to activities of other family members, each family developes their own noise control techniques. Judicious setting of the hi-fi volume control is just one such method.

But for several potentially bothersome noise sources,the occupant cannot control the intensity of noise. In our various studies, it was found that from about one-third to two-thirds of occupants are bothered by the noise of kitchen appliances when they are in another room. Approximately 10 to 15 percent of the people find certain bathroom noises bothersome when they are in the living room. A composite listing of bothersome appliance and fixture sources compiled from our studies in a decreasing order of severity is as follows: The dishwasher, clothes washer, exhaust fan, garbage disposer, bathtub or shower, water closet, clothes dryer, water flow in piping, and heating or air-conditioning system noise. Each of these noise sources is

amenable to some control, but for the most part people have been unwilling to pay the initial cost of "quieter" appliances or modified installation techniques which may reduce the degree of bother. Manufacturers should be encouraged to find more cost-effective noise control techniques.

EXTERIOR NOISE SOURCES

Transportation noises such as those produced by airplanes, trucks, automobiles and trains are the primary source of exterior ambient noise, and the cause of most complaints in urban areas. Other noise sources which are disturbing include building mechanical equipment, powered lawn and garden equipment, power tools, snowmobiles and other off-the-road vehicles. We believe that efforts should be made to reduce the noise output of all these sources. The primary emphasis at this time should be on further research and development and voluntary efforts by producers of the above equipment and devices to reduce excessive noise levels. On the other hand,some legislative or regulatory measures might be considered pertaining to the most bothersome of this equipment provided practically attainable performance levels are established.

One of the recent attempts to provide a good acoustical environment is HUD's establishment of interim standards for evaluation of community noise. While this standard is aimed at avoiding HUD's association with projects where existing or predicted noise levels are unacceptable, similar techniques could be applied to such uses of land as manufacturing, office buildings, institutional buildings and others. Because the interim standard is only a first step and it's effect has not been tested, we must however, reserve judgement on its practicality and, of course, on the criteria themselves. Furthermore, for a subjective phenomenon like sound, the wisdom and flexibility of administration in applying this standard will be especially important.

Obversely, and perhaps more appropriately, government planners at all levels might be required to consider the affect of new highways and airports on the noise levels of existing or planned land uses prior to the decision to impose such facilities on the local community. Obviously, such facilities should be designed to minimize their impact on these other land uses. In extreme cases, where such facilities would produce clearly unacceptable noise levels, the project should be discontinued, rerouted, or relocated.

SOLUTIONS AND RECOMMENDATIONS FOR FURTHER RESEARCH AND STUDY

We believe that the Environmental Protection Agency and other governmental agencies should encourage and support the continuing and coordinated research into the effects of noise on people, the development of techniques of measurement and evaluation of noise, and the development of practical and cost-effective noise-control techniques, all in relation to people and their environment.

Specifically, we suggest that further acoustical research is needed on the following subjects:

1) Automobile and truck noise, including the design of efficient yet quiet engines and exhaust systems, truck and automobile tires, and techniques of highway design to minimize its effects upon the surrounding land use.
2) Aircraft noise control, including the development of quieter engines and aircraft use patterns that minimize intrusive noise while providing safe, efficient movement of people.
3) Structure-borne noise transmission, including development of physical evaluation techniques that permit rating products and elements of dwellings and buildings in the manner that people respond to them in use. This should include studies of the vibration response of buildings and components to impulsive and steady vibration sources, and development of reproducible sources that apply inputs similar to real-life events.

4) More cost effective methods of reducing appliance and fixture noise.

5) Development of economical, practical, and market acceptable window and door systems specifically designed to minimize excessive exterior noise intrusion, such as from aircraft and heavy traffic, in single and multifamily housing.

Additionally, EPA might consider study of enforceable legislation and regulations which local and state governmental bodies could use to keep exterior noise and distrubance at reasonable levels.

Finally, EPA should encourage manufacturers to label noise levels of appliances, equipment, and related items under a rational and consistent rating system to inform consumers so they may evaluate the equipment in relation to noise.

I thank you for the opportunity of appearing before you today on this important subject and will attempt to answer any questions you might have.

MOTOR VEHICLE NOISE REDUCTION

Testimony before

NATIONAL HEARINGS ON NOISE ABATEMENT AND CONTROL

November 9, 1971

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MOTOR VEHICLE NOISE REDUCTION[1]

The motor vehicle was designed to meet the transportation needs of people. Unfortunately, this has meant that motor vehicles[2] tend to concentrate where people concentrate, in the cities. Consequently, there are large numbers of motor vehicles in the cities and these vehicles create significant environmental problems; not the least of these is noise pollution.

Because motor vehicles are the major source of urban noise, my discussion focuses on policies which can reduce motor vehicle noise pollution. The thrust is to identify issues and emphasize what can be done now to prevent future noise from mass use of motor vehicles, as well as identifying needs for implementation of these strategies.

INTRODUCTION[3]

While air pollution caused by motor vehicles is widely viewed as a serious problem to be dealt with immediately, noise pollution is not.

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1. This testimony draws heavily on "The Impact of the Motor Vehicle on Air, Noise and Safety: Problems and Policies," written for the United Nations Conference on Human Environment in Stockholm on June of 1972. It was written by Sumner Myers, Director of Urban Systems Studies for the Institute of Public Administration, Washington, D. C.

2. The noise pollution problems caused by motor vehicles result almost exclusively from vehicles powered by internal combustion engines. Other sources contribute in only a minor way.

3. This section draws heavily on research of the Organization for Economic Co-operation and Development published in Urban Traffic Noise; report to the Consultative Group on Transportation, August 1970.

This is true despite mounting evidence that noise can have deleterious psychological and physiological effects on human beings. It is also true despite the fact that people normally prefer a quiet to a noisy environment. Currently, they will tolerate a noisy one -- but that attitude is changing.[1]

In short, expectations are rising and noise abatement plans must be drawn up to recognize it. Even in areas where noise abatement may not be a serious problem at this time, many preventive measures can most profitably be taken now.

Unquestionably, the major effect of noise due to transportation is aesthetic. It degrades the quality of life -- especially in densely populated centers where there is both more noise and more people to hear it. Most of the noise generated in urban centers is traffic noise, as evidenced by a three-year long study in Chicago which concluded that:

> The most prevalent city noise unquestionably is that of traffic. The most prevalent source of noise in industrial areas is also that of traffic. In many cases, the noise in an industrial area is that due to related traffic, such as the motor trucking identified with a particular plant.

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1. According to a prestigious panel which studied the subject: "At present most people seem not to be greatly concerned or aware of the noise problem...However, the Panel finds that the level of awareness of noise pollution is rising...Because of the great upswing of interest in environmental quality, the Panel believes that a demand for action to combat noise is now in the making." The Noise Around Us: Findings and Recommendations, Report of the Panel on Noise Abatement, Commerce Technical Advisory Board, September, 1970.

> In residential areas, the so-called unidentifiable background can usually be identified as noise of distant traffic.[1]

Other surveys in other cities draw similar conclusions -- traffic noise dominates other urban noises.

While, cumulatively, noise might affect people psychologically and physiologically, its immediate effect is almost entirely subjective -- that is, to people who are aware of it, noise is disturbing. Because the effect of noise is subjective, it is difficult to measure that effect. The difficulty is compounded because people are annoyed, not so much by the steady "hum" or "roar" of traffic, but by the "peak" noises which more or less randomly intrude over the background noise. Thus a relatively few noisy vehicles, such as trucks, motorcycles, or sports cars, disturb people more than the greater number of automobiles which create background noise.

Just as motor vehicles might be designed to reduce the pollutants they emit, so they might be designed to reduce noise. For any given class of vehicles this might include: redesign of the engine, intake and exhaust silencers, brakes, gear boxes, engine enclosures, and fans. Tires might also be redesigned to reduce the noise from tire-roadway interaction. Finally, the aerodynamic design of the vehicle itself might be changed to reduce wind noise. However, to accomplish a meaningful reduction of urban

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1. G. L. Bonvallet, "Level and Spectra of Traffic, Industrial, and Residential Area Noise," The Journal of the Acoustical Society of America, Vol. 23, No. 4 (1951).

traffic noise, it probably would not be cost effective to redesign every class of vehicle, even if it were practical to do so. Clearly, the ones contributing most of the annoying sounds deserve the more immediate attention.

While the major noise control strategy must be the redesigning of the motor vehicle, this may not be sufficient to reduce noise to tolerable levels in some areas. For example, in spite of the extremely stiff air pollution emission standards for 1975 cars, it is estimated that 60 American cities will have to take additional measures to control cars.[1] Similarly, vehicles may be so concentrated in downtown urban areas that noise reduction policies, other than redesigning motor vehicles, may be required.[2] These policies include:

(1) planning metropolitan areas so as to (a) prevent the construction of inadequately protected buildings in zones too noisy for them, and (b) to reduce motor vehicle trips (and thus presumably noise) by providing alternative means of transportation;

(2) designing highways and related facilities (a) to minimize vehicular noise through the interaction of the vehicle and road bed, and by (b) locating and shielding buildings adjacent to roadways so as to minimize noise;

(3) operating streets and highways in order to minimize noise resulting from stop-and-go traffic; and

(4) restricting either (a) motorist behavior in order to reduce noise or (b) the vehicle itself to prevent noise in particular parts of the city.

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1. John T. Middleton, Deputy Assistant Administrator for Air Programs in the Environmental Protection Agency. National Journal, October 30, 1971, p. 2197.

2. The Institute of Public Administration is now evaluating the use of such policies to control air pollution for the Office of Air Programs in the Environmental Protection Agency.

PLANNING

Theoretically at least, a metropolis might be planned to reduce the effects of traffic noise, if not the noise itself, by clustering facilities which are to be served by noisy vehicles -- particularly trucks. If these facilities -- industrial parks and shopping centers, for example -- were set in what amounts to a greenbelt, the resulting traffic noise would affect relatively few people. The trouble is that land surrounding either industrial parks or shopping centers becomes too valuable to be used only for acoustic screening. People seem anxious to move close to noisy activity centers for the sake of convenience. Perhaps they should be protected against their shortsightedness, but this will be costly to do.

Noise control zoning is a way of protecting people against their shortsightedness in much the same way that building codes protect them. Under this concept, specific zones, perhaps with maximum permissible sound levels, might be established to exclude users who would be unduly bothered by the noise in that zone.[1]

ALTERNATIVE TRANSPORTATION MODES

It is unlikely that the provision of alternative transportation facilities represents a feasible way to diminish road traffic noises. It

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1. In the noisiest, Zone I, no residential buildings would be permitted. In Zone II, which is slightly less noisy, residential buildings would be permitted but only if buildings were specifically constructed to shield its residents from outside noises. In Zone III, a quieter zone, normally constructed residences would be permitted. However, hospitals and schools would have to be acoustically insulated. Zone IV, presumably the quietest, could be settled with normally constructed housing, hospitals, and schools.

can succeed only if there is sufficient inducement to the user to prevail over the economic or other reasons which caused him to choose a noisier transportation mode.[1]

It is doubtful that subways or other rapid rail transit can reduce auto usage enough to make much difference in the noise levels on our roads. While diverting auto users to mass transit would help reduce background noise levels, it would have little effect on peak noises, such as those created by trucks. In addition, there are some who think that providing rapid rail transit facilities would increase noise levels downtown by encouraging more development and hence more traffic.

ROADWAY

By designing and locating roadways properly, noise generated through their use may be minimized or ameliorated. For example, designing a roadway with smooth rather than rough asphalt surface can reduce noise levels by about 5 db(A).[2] There is a trade-off, however. Smooth asphalt provides less traction and is, therefore, less safe in wet weather.

Another design alternative to ameliorate the effects of roadway

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1. For example, the decision to use trucks over rail transportation is an economic decision and aesthetic considerations in themselves are insufficient to induce the user to switch. Furthermore, two other major producers of disturbing peak noises, motorcycles and sports cars, appeal to personal tastes which may be even more difficult to change.

2. G. J. Thiessen and N. Olson, "Community Noise - Surface Transportation," Sound and Vibration, Vol. 2, No. 4 (1968).

noise on the adjacent environment is to put the roadway in a cut -- or better -- a tunnel. This approach, often advanced by urban planners, may not be cost-effective. Granted, the adjacent environment will be quieter, but the trade-off results in both overly expensive road facilities and serious degradation of the environment for all persons using those facilities. The very idea of burying highways runs directly opposite to the concept of beautifying them for the enjoyment of their many users. In any event, narrow cuts and long tunnels concentrate air pollutants and amplify noise, sometimes to the severe discomfort of roadway users. It can be argued that this makes inherently unsafe designs even less safe.

Noise can be minimized by designing roadways with increased width. Streets and highways less than approximately 24 meters wide reverberate and amplify the sounds generated by vehicles using them. For example, sounds generated in a narrow street six meters wide will be amplified by over ten percent. In a street twice that width, twelve meters, sound will be increased by five percent.[1]

The increased noise of a narrow street affects the people who use the buildings on the street as well as motorists and the pedestrians who use the street itself. Rather than widening the street by tearing down and replacing the buildings abutting it, modifications may be made to the buildings themselves to protect their occupants from traffic noise. The

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1. Organization for Economic Co-operation and Development, "Urban Traffic Noise: Status of Research and Legislation in Different Countries," Paris, January, 1969.

most cost-effective modification involves the acoustical treatment of existing window openings.[1]

The problem of traffic noise intruding on building occupants might be prevented in the first place by properly locating or shielding the building from the roadway's noise. Inside noise levels can be further reduced by screening the building with other structures.[2] Non-residential buildings might be located along the roadway to act as sound screens for residential buildings located in back of them. The spaces between the buildings could be planted with trees and shrubs to provide still more acoustical protection.[3]

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1. Swiss and British research have documented the fact that single glazed windows sealed closed will reduce sound penetration by about 10-15 db (A) and double glazed windows by 15-25 db (A). Sealing windows closed, of course, implies mechanical ventilation of some sort. And this, of course, adds to the expense of the acoustical treatment.

2. Bolt Beranek and Newman Inc., "Noise in Urban and Suburban Areas: Results of Field Studies," Report No. 1395, January, 1967.

3. University of Nebraska, "Trees and Shrubs for Noise Abatement," Research Bulletin 246, Lincoln, Nebraska, 1971. Unfortunately, trees and shrubs do not provide very effective protection against sound intrusions from the roadways. Swiss and Scandinavian studies show that even very thick plantings attenuate sounds by only 5 db (A) per 100 meters. If more than 5 db (A) of reduction is needed, other screening techniques are required. According to various British, French and German studies such screening usually involves the construction of impervious sound absorbing elements of various heights. However, expensive as they are, they can achieve sound attenuations of 15-20 db (A).

TRAFFIC FLOW

The most annoying sounds of traffic are generated when vehicles accelerate, decelerate, and stop. One way to reduce traffic noise, therefore, is to eliminate the stop-and-go driving which creates much of it. Street traffic control systems can also reduce pollution by reducing stop-and-go driving. There are a wide variety of techniques which might be used for this purpose. They range from demand-responsive signalization of intersections to grade separations of pedestrians and vehicles. Most of these techniques are familiar to traffic engineers who would apply them all -- if money were available to do so. There are two major problems in controlling noise with these systems. First, increasing traffic speed beyond 35 mph. is counter productive in terms of noise abatement. Second, traffic seems to be so great in some areas of our cities, such as the CBD, that it practically overwhelms whatever improvements can be made in traffic flow. In these situations, only outright traffic bans or other restrictions on demand are likely to work.

RESTRICTIONS

Noise Prohibitions. A good deal of noise due to transportation can be abated by requiring few, if any, physical changes in either the vehicle or the facilities it uses. Instead, changes may be required in how motorists behave and where vehicles are used.

Certain prohibitions can, of course, be imposed directly on behavior affecting traffic noise. Some of these -- like slamming car doors at night are difficult to enforce and must necessarily depend on what amounts to voluntary cooperation. Others are simple to enforce and have been quite

successful. For example, in many cities throughout the world, horn blowing has been made illegal except in cases of imminent danger. The resulting difference to the environment is remarkable and most welcome in previously noisy cities, like Paris, Vienna, and New York.

Traffic Bans. Completely banning traffic from certain parts of the city will almost by definition reduce motor vehicle noise. However, partial traffic bans such as those applied in Gothenburg, Sweden,[1] do not help the noise environment very much. General background noise may have been reduced, but to the extent that trucks, motorcycles, and buses use restricted streets, the background is pierced with annoying sounds. If anything, these intrusions might seem even more annoying against a lowered background noise level.[2]

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1. Gothenburg noted that half of the congested traffic downtown was just passing thru, which is not unusual. To force this traffic to use the city's ring road (beltway), Gothenburg erected barriers which prevented driving thru downtown while still permitting access to downtown.

2. The annoyances due to motorcycles, buses, and trucks may be tolerable during the day but they are considerably less tolerable at night. Experiments undertaken in the USSR have established that 35 db (A), an accepted standard for inside noise levels, is the threshold level for optimum sleeping conditions. In addition, higher noise levels disturb sleepers even though they may not waken them. See J. Lang and G. Jansen, "Report on the Environmental Health Aspects of Noise Research and Noise Control," United Nations, World Health Organization Report, May, 1967.
The only effective way to handle the night noise situation is completely to ban noisy vehicles -- certainly trucks and perhaps motorcycles and sports cars -- from areas where people live.

CONCLUSIONS

This paper has focused on policies which result in the reduction of noise from motor vehicles because they are the major source of urban noise pollution. However, it is important to remember that motor vehicles strongly affect the environment in other ways, particularly in the form of air pollution. Each policy discussed here must be studied in the context of a broader environmental approach, but unfortunately little has been done in synthesizing the effects on different aspects of the environment. We must develop transportation policies which optimize the control of both air and noise pollution, as well as other social factors.

Furthermore, much has been said about the noise reduction potential of various transportation policies, but little has been said about their costs and economic feasibility. We must develop a cost analysis of the various motor vehicle noise reduction strategies so that we know what their effect will be and at what cost. In addition, little consideration has been given to the institutional difficulties in implementing these strategies. We need to know the economic, social, legal, and political impediments to each policy and the resulting consequences. These sorts of questions need to be answered and the answers are quite important because our ability to control the noise in our environment depends upon their resolution.

SOME PROSPECTIVE IMPLICATIONS OF FEDERAL NOISE EMISSION STANDARDS ON STATE/LOCAL NOISE REGULATION

Professor Louis H. Mayo
November 11, 1971

Statement prepared for the
OFFICE OF NOISE ABATEMENT AND CONTROL
Environmental Protection Agency

on the topic of

"Technology and Economics of Noise Control;
National Programs and Their Relations with
State and Local Programs"

for

NATIONAL HEARINGS ON NOISE ABATEMENT AND CONTPOL
Shoreham Hotel, Washington, D.C.
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I - ADVANCING TECHNOLOGY AND CHANGING SOCIAL VALUES

Only in recent years has environmental noise gained sufficient attention as a social problem to generate assessments of the situation, proposals for comprehensive public programs of noise abatement, and enactment of a few innovative regulatory schemes. Various factors have forced the problem to the focus of public attention, as for example, the introduction of commercial jet-powered aircraft over the past 15 years and increasing vehicular traffic resulting from urbanization and further stimulated by the Interstate Highway System. The decibel level in various noise environments is definitely increasing. But there is more involved than this simple explanation of the growing concern with noise. This can be described as a rather drastic shift in social value priorities. This general concern, of which noise intrusion is but one element, is reflected in various statutory schemes enacted over the past several years of which the most prominent is the National Environmental Policy Act of 1969 which requires pursuant to §102(2)(C), the submission of environmental impact statements on "major Federal actions" and which established the Council on Environmental Quality.

However, the value shift reflected in the policies and prescribed practices of some recent environmental quality statutes is not overwelmingly representative of public attitudes. There remains an extremely strong and pervasive sentiment that such amenities as a "noise-free environment" are of small significance in comparison with the social utility of the products of technological advance. Judicial decisions provide us with a reasonably accurate assessment of prevailing community value choices. The conventional attitude of the courts has been to view such effects as highway/vehicular environmental pollutants, including noise, as incidental to the principal needs and functions of a progressing technological society and hence, as adverse side-effects which we must accept without complaint. For example, in the 1931 case of Campbell v. Arkansas State Highway Commission (38 S.W. 2d 753, 754) the court refused recovery to an abutting landowner who had complained of various inconveniences attendant to the change in a highway grade, stating that:

> We do not think the plaintiff,...should recover anything for noise, dust, and matters of that sort, which, in varying form, are incidents to living upon a public highway or street, and, as such, must be borne by all owners of abutting property.

An in the 1953 New York case of People on Complaint of Gersberg v. Arkow (204 Misc. 635, 124 N.Y.S. 704, 707, 708) the court held

that the ordinary operation of a properly functioning home air conditioner did not constitute a public nuisance, commenting:

> The air conditioning machine is a product of man's constant search for the improvement of his own comfort and enjoyment of life. That its use may cause some annoyance to others does not justify denouncing its use as a criminal. It is an unfortunate truth that virtually every scientific invention has carried with it not only advantages but burdens. The airplane, invented for the purpose of speeding transportation, has become the principal weapon of inflicting death in war. The automobile, designed for man's pleasure, has become the most destructive peacetime weapon. And so it is with many other inventions.
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> Unfortunately, progress is not marked by a straight line in a constant forward direction, but rather by a zig-zag course, only the ultimate direction of which is clearly marked. A conviction in this case would not only ignore the way pointed out by firmly established principles in the law of nuisance, but would constitute a vain attempt to arrest scientific progress.

In the 1968 California case of Lombardy v. Peter Kiewit Son's Co. (72 Cal. Rept. 240, 244) the court dismissed a nuisance complaint displaying little sympathy for mental, physical and emotional distress, noting that:

> All householders who live in the vicinity of crowded freeways, highways and city streets streets suffer in like manner and in varying degrees. The roar of automobiles and trucks, the shock of hearing screeching brakes and collisions and the smoke and fumes which are in proportion to the density of the motor

> vehicle traffic all contribute to the loss of peace and quiet which our forefathers enjoyed before the invention of the gas engine.

In the highway/vehicular noise context, courts in those states having considered the matter still hold tenaciously to the proposition that there can be no recovery for noise damage to property owners whose tracts are adjacent to the highway right-of-way but whose property has not actually been physically "taken" through eminent domain (condemnation) proceedings. Courts in the various states have adopted different positions with respect to noise intrusion where there has been a partial, physical "taking of the plaintiff's property.

The wrenching experience of the courts in confronting insistent demands that noise intrusion is a social harm (or in reciprocal terms, freedom from abusive noise is a social interest) that should be given legal recognition is, perhaps, best exemplified by decisions of the Florida courts. In City of Jacksonville v. Schumann (199 So. 2d 727 [1st D.C.A. Fla. 1967] cert. denied 204 So. 2d 327 [Fla. 1967], cert. denied 390 U.S. 981 [1968]), 57 property owners adjacent to the municipally-owned Imeson Airport (in a suit for inverse condemnation) sought and secured injunctive relief for reason of noise and vibration nuisance originating with aircraft using the field. But in the

subsequent 1968 case of Northcutt v. State Road Department (209 So. 2d 710), an abutting property owner who suffered injury from highway construction was denied damages resulting from noise, dust and vibration. In Northcutt the court followed the traditional Florida rule that a physical invasion or trespass is necessary for a "taking" before injunctive relief or damages will be afforded to adjacent or abutting landowners. A comment in the Florida Law Review (Honeywell, "Eminent Domain: Inverse Condemnation - What Constitutes a Taking?" 21 U. Fla. L. Rev. 257, 262 [1968]) on this situation concludes:

> It is apparent that the consequential damage and physical trespass limitation currently in vogue in many states is an attempt to draw an arbitrary line to prevent frivolous claims. But it is at least arguable that yesterday's frivolous claim may have become both real and justified today because of the increased potential of automotive noise and vibration.

II - ENVIRONMENTAL NOISE REGULATION: CONDITIONS & TRENDS

Among the more significant conditions of the current (1971) environmental noise regulatory situation are the following:

- The existing Environmental Noise Regulatory Structure is fragmented in organization and *ad hoc* in operation. Abatement functions are distributed among Federal, State and local governmental levels but are largely uncoordinated.

- The environmental noise problem context is composed of a wide variety of discrete noise sources and noise environments. Numerous partial efforts have been made to regulate "excessive" or "unnecessary" noise through regulatory schemes directed to abatement at the source, reduction of the effects of noise, and to remedies (by private action) to abate the source or to reduce the effects.

- Regulation by the Federal government has been slight. Even with respect to aircraft noise the pace of abatement at the source has been gradual with no short-term prospects for substantial relief.

- Regulation by the states has for the most part been limited to selected noise sources, although some states are now in process of enacting comprehensive noise abatement statutes.

- Most noise abatement regulation has taken place at the local level by means of general noise ordinances or ordinances directed to specific noise sources or by the creation of "quiet zones."

- Both State and local governmental levels are handicapped in police power regulation of some of the more critical noise sources as a result of preemptive Federal legislation (aircraft noise) or by the threat of impinging upon a strong national interest maintaining the free flow of interstate commerce.

- Very little attention has been given to construction equipment or site noise, or to domestic noise sources.

- Enforcement of noise abatement State statutes and municipal noise ordinances has been notoriously spasmodic and uniformly weak; in general, noise control enforcement has been placed on already overburdened State Highway Patrols or local police officers.

- While both the Federal government and State governments have been slow to intervene in the noise regulatory area, certain trends point to a substantially increased level of effort:

Federal level:	Noise abatement (occupational) of all businesses operating in interstate commerce
	Construction site noise abatement under the Construction Safety Act
	Highway design to reduce noise effects
State level:	Enactment of comprehensive environmental quality statutes, including environmental noise abatement codes
	Enactment of specific legislation designed to control the total noise emissions of vehicles and to regulate the noise level operations of vehicles

Local level: Initial efforts by a few cities to enact comprehensive Environmental Noise Codes covering all or most of the serious noise sources and noise environments subject to municipal regulation

Growing sophistication at all governmental levels in noise abatement and control techniques, including the establishment of decibel levels to replace or supplement verbal-subjective standards

Increasing dispostion to broaden coverage of noise sources and noise environments by regulatory schemes and to disseminate through labelling or by other means useful information on noise dangers and abatement techniques to the general public.

Among the more significant continuing problems in the regulation of environmental noise are the following:

- Conflict of the social interest in noise abatement with other social values such as safety or free expression which are accorded higher priority in the scheme of social interests.

- Intensification of the stress between Federal efforts and State/local noise abatement efforts, especially in those regulatory contexts where Federal preemptive legislation is involved.

- Continuing difficulty by State or local authorities to regulate noise to the satisfaction of local conditions and needs where such regulation requires control over the noise source or effects of vehicles, equipment, and appliances regularly moving in or operating in interstate commerce.

> Continuing difficulty, due to the multiplicity of noise sources and noise environments, of determining what noise sources or effects are to be controlled by what level of government with respect to the setting of standards or to operating procedures, having appropriate regard for the need of uniformity of regulation in some areas and the need for diversity of regulation to suit unique local conditions in others.

The foregoing questions and other relevant inquiries must, of course, be analyzed and evaluated in the context of certain influential conditions and trends which are, in effect, constraints on effective noise abatement programs.

- To date, environmental noise as a social problem has been given relatively little organized attention. This area has not been considered high in the priority of public concerns and, for the most part, abatement efforts have been ad hoc and spasmodic. Noise abatement has come into conflict with other social values which have traditionally been given great weight in our overall social value scheme: need for transportation and private mobility, technological progress, and economic expansion.

- This general observation can be expressed in more specific social value and institutional terms, as for example:

  > Just in the last few years have organized constituencies of noise-abused citizens come into being.
  >
  > Government, at all levels, has been slow to take effective noise abatement action although the growing seriousness of the problem has been recognized for many years.
  >
  > Industrial and commercial interests have been even more lax than the public sector in taking an aggressive stance toward environmental noise reduction.

Past emphasis on the economic value (increasing production and indiscriminate consumption) with little concern for environmental amenities has encouraged industry to "externalize" social costs of detrimental "side-effects" such as excessive and unnecessary noise.

There has existed an almost crass indifference to the detrimental effects of noise on neighborhood, family, educational, and health care environments.

Overall, the research effort directed to the study of the effects of noise, alternative means of abating noise at the source and the effects of noise, and into various regulatory configurations which would provide adequate means of coping with excessive and unnecessary noise has been modest.

Concomitant to the point immediately above, there is a lack of public understanding of the noise problem and of personnel skilled in the administration and enforcement of noise abatement programs.

III - CONSTITUTIONAL DISTRIBUTION OF REGULATORY POWER

The abatement of environmental noise presents a severe challenge to legal-political improvisation as well as to technological ingenuity. The problem context of environmental noise is a complex one in that noise is not associated with one - or a few - social functions but is emitted from a vast variety of completely unrelated sources. Many of the most obnoxious noises come from moving sources or from multiple and diverse activities acting in concert. Hence, various techniques (abatement at the source, reduction of effects, or compensation for noise harm) have been devised in an attempt to cope with the multiplicity of sources and affected persons or activities. The noise abatement task is further complicated by the necessity to determine at what level of government these various techniques can best be prescribed and implemented.

It is sometimes said that noise is a "local problem," but this characterization can be a bit misleading. No doubt, noise is a "local problem" with respect to the Effects of noise. It is not necessarily a local problem with respect to the Control over the abatement of noise at the source or over the reduction of the magnitude of noise effects. The "noise context" selected for control purposes will ordinarily be defined in terms of the

noise effects emitted from particular discrete noise sources or identifiable noise environments.

What then is the basic legal-political framework within which the environmental noise problem must be analyzed? Environmental noise is primarily the result of a highly industrialized society. In a most thoughtful book of a few years back entitled Industrialism and Industrial Man (1960), the authors state:

> Pluralistic industrialism will never reach a final equilibrium. The contest between the forces of uniformity and for diversity will give it life and movement and change.
>
> The themes of uniformity and diversity, and manager and managed which mark the world today will characterize it in the future as well. There will be constant adjustments between these eternally conflicting themes, but no permanent settlement. They will constitute the everlasting threads of history: the uniformity that draws on technology and the diversity that draws on individuality; the authority that stems from the managers and the rebellions, however muted, that stem from the managed. (p. 296)

Our Constititutional development seems consistent with this formulation. For example, Art.I,§8(3) provides that the Congress shall have power "To regulate Commerce with foreign Nations, and among the several States, and with the Indian Tribes;" and Art.I§8(8) provides that the Congress shall have the power "To promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective

Writings and Discoveries." The 1824 Supreme Court case of Gibbons v. Ogden (9 Wheaton 1; 6 L.Ed. 23) gave impetus to the promotion of the "Commerce Clause" and interstate commerce by holding a New York law providing for a State "steamboat monopoly" invalid. The subsequent 1851 case of Cooley v. The Board of Wardens of the Port of Philadelphia (53 U.S. [12 How.] 299) has had great significance in terms of mediating between the themes of uniformity and diversity noted above. In that case the Supreme Court undertook to determine whether the power of the Congress to regulate foreign and interstate commerce was exclusive of whether it might be in part shared by the states. The Court adopted a rule which placed a segment of control in the states, the test being whether a particular subject or activity of commerce requires uniform national control or whether it is sufficiently local (and unique) in character to permit State regulation. For example, a strong national interest has been asserted in railway regulation. In Southern Pacific Co. v. Arizona (325 U.S. 761 [1945]) the Supreme Court, relying on the Cooley Doctrine held that the Arizona Train Limit Law (limiting train length) contravened the Commerce Clause, the majority opinion stating that "Here examination of all the relevant factors makes it plain that the state interest

is outweighed by the interest of the nation in an adequate, economical, efficient railway transportation service, which must prevail." But a strong State/local interest has been recognized in the regulation of the use of interstate as well as State highways. In South Carolina State Highway Department v. Barnwell Bros. (303 U.S. 177 [1938]), a State statute limiting the width and weight of motor trucks which was more restrictive than those of most other states was held not to be an undue burden on interstate commerce even though "interstate carriage by motor trucks has become a national industry," the Court stating: "Few subjects of state regulation are so peculiarly of local concern as is the use of state highways." But compare Bibb v. Navajo Freight Lines, Inc. (359 U.S. 520 [1959]), wherein the Supreme Court found an Illinois contour mudguard requirement for motor freight carriers to be in conflict with the Commerce Clause even though such "local safety measures" are normally not found to place an unconstitutional burden on interstate commerce.

The "states and their instrumentalities may act, in many areas of interstate commerce,...concurrently with the Federal government" and "Evenhanded local regulation to effectuate a legitimate local public interest is valid unless preempted by Federal action,...or unduly burdensome on...interstate commerce...."

In general, preemption by Federal legislation is not to be inferred "unless the act of Congress, fairly interpreted, is in actual conflict with the law of the state."

IV - ADVANTAGES OF COMPREHENSIVE FEDERAL NOISE REGULATION

The foregoing Constitutional setting focused primarily on the contending authority of the Federal government pursuant to the Commerce Clause on the one hand and the Police Power of the states pursuant to the 10th Amendment ("The powers not delegated to the United States by the Constitution, nor prohibited by it to the States, are reserved to the States respectively, or to the people") on the other. The authority of the states to legislate in support of the health, safety and general welfare of its citizens has, of course, been used extensively. In many social problem contexts, as previously indicated, the Cooley Doctrine has provided the fundamental test of the appropriate distribution of legislative power.

The Cooley Doctrine has customarily been applied to specific issues or a Federal v. State/Local conflict over the regulation of a particular activity. But as previously noted, the environmental noise context encompasses a multiplicity of particularized problem areas. Nevertheless, the basic rationale of the Cooley Doctrine underlies §6(d) of one current legislative proposal (H.R. 11021, 92d Cong., 1st Sess., Sept. 30, 1971) which recites:

> (1) Subject to paragraph (2), no State or political subdivision thereof may adopt or enforce, with respect to (A) any new product for which a noise emission standard has been prescribed by the Administrator under this section or (B) any component incorporated into such new product by the manufacturer of such new product, any standard setting a limit on noise emissions from such product which is not identical to the standard prescribed by the Administrator.
>
> (2) Nothing in this section shall diminish or enhance the rights of any State or political subdivision thereof to control, regulate, or restrict the use, operation, or movement of any product.

This section (and a similar provision in H.R. 5275, 92d Cong., 1st Sess., March 1, 1971) clearly recognizes that national uniform regulation of certain activities (industrial processes and commercial operations) is required to achieve necessary noise abatement objectives while it concurrently provides for a degree of flexibility over other activities which will satisfy the diversity of noise control conditions demanded by multiple (and different) constituencies.

Reference to proposed §6(d) and to the activities of the Office of Noise Abatement and Control carried out pursuant to the Noise Pollution and Abatement Act of 1970 reflect the need for more effective Federal regulation of noise sources and effects. This can take many forms: research and development on noise effects, public education in noise effects, requirement

for noise to be considered as a design factor in the development of noise-producing systems such as highways, the establishment of maximum decibel standards for products or devices or even for definable noise environments, Federal assistance to State and local authorities in the planning and operations of noise abatement programs, etc.

For present purposes, attention will be directed to the advantages of establishing Federal standards and to the implications of such standards for State/Local noise abatement legislation and enforcement wherein the relationship is guided by a provision the same as or similar to §6(d).

Despite the fact that environmental noise regulation poses some difficult questions of public policy and public administration, this challenge should be welcome. An unusual opportunity is offered for the systematic application of available analytical resources to the achievement of a significant social goal. The environmental noise problem is serious but by no means out of control. The comprehensive study conducted by the Office of Noise Abatement and Control and this series of hearings, designed to solicit the opinions of all affected participants demonstrate how independent analytical capabilities can be effectively linked to public participation. Put another way,

the incremental, ad hoc development of Federal control over aircraft noise can and should be supplanted by a systematic, comprehensive regulatory approach by the Federal government which will assure that desirable environmental noise levels will be achieved within a reasonable period of time.

In their impressive review of the "Preemption Question" (53 Ky. L. Jou. 289 1965), Abraham and Loder conclude that "The uniqueness of the preemption cases makes it impossible to decide all of them on a strict precedent basis," but their comment on the Congressional role in preemptive legislative situations is of more relevance here:

> One must sympathize with the (Supreme) Court as it tries to resolve preemption questions. It is hard to find legislative intent because Congress is very vague and sometimes it fails to really consider the preemption question or the impact of its legislation upon federal-state relationships. (p. 333)

The point here is that through such hearings as the ONAC series an effort is being made to provide the Congress with the data upon which it can make an intelligent judgment on appropriate legislation for environmental noise abatement. While §6(d) may very well be the most satisfactory manner of handling the Federal v. State/Local distribution of control over this problem, we need to explore with some precision the necessary, probable, and possible

implications of the preemptive effects of this provision.

One can hardly dispute the efficacy of certain types of strong, Federal intervention. Federal standards normally tend to focus greater attention on given social ills and to the urgency of dealing effectively with identifiable problems. Often, Federal intervention is the only efficacious means of attacking a problem or segments of a fragmented problem area such as environmental noise. For example, Federal standards may take up the slack resulting from local indifference or incapability (for financial reasons or otherwise) to deal with the problem. Further, the establishment of Federal standards is a means of generating an incentive for the responsible public and private sector participants to take effective action. The last function is strikingly illustrated by the enactment of §611 (Control and Abatement of Aircraft Noise and Sonic Boom) in 1968 as an amendment to the Federal Aviation Act of 1958. While there had been clear recognition both within the Public and Private sectors that aircraft noise presented a problem of increasing concern, this legislation and the subsequent setting of aircraft noise standards for the first time thrust the Federal government directly into an active program of aircraft noise abatement. This legislation also provided the aircrart engine manufacturers and airlines a compelling

incentive to introduce noise criteria into their engine design and airline operations.

One of the major advantages of initiating noise regulation at the Federal level as proposed in pending bills will be the ability (research, development, and testing resources) to enact noise standards which are compatible with the most advanced state of technological feasibility, with economic reasonableness and with adequate regard for safety.

V - SOME POSSIBLE STATE/LOCAL REGULATORY IMPLICATIONS OF §6(d)

Having suggested the potential useful impact of Federal standards on technological development as well as on operational compliance consistent with social acceptability, one reservation must be noted. Federal standards may impose more rigorous technological design specifications and prescribed operational procedures in order to achieve socially desirable goals. But this very act also tends to approve mechanisms, device, product design performance characteristics (and even operational use) up to the maximum allowable. This caveat is of importance since it may impose limitations on State and local noise abatement initiatives felt consistent with State/local needs. With this consideration in mind, a brief discussion on some of the possible implications of a §6(d) provision on State and local noise regulation is now in order.

A. State Noise Abatement Laws or Comprehensive Environmental Codes

1. What might be the implications of Federal noise emission standards for the following types of products:

   - Construction equipment
   - Transportation equipment (including recreational vehicles and related equipment)
   - Any motor or engine (including any equipment of which an engine or motor is an integral part)
   - Electrical or electronic equipment

On State Environmental Noise Codes (or related Vehicular Codes) such as that of California which has one provision relating to permissible emission levels at the time of "sale" (vehicular noise standards) and another relating to permissible "operational" noise levels (vehicular noise limits)?

The California Vehicular Code has an elaborate system of prescribed (graduated through time) standards, some of which provide for higher "operating standards" than "sale" standards, others which are the same, and still others which provide for lower "operating" standards than "sale" standards. Further, the California Vehicle Code is a "total vehicle" noise emission standard.

Does the proposed Federal provision for "transportation" equipment (including recreational vehicles and related equipment)" or the provision for "any motor or engine (including any equipment of which an engine or motor is an integral part)" purport to encompass "total vehicle" noise, including emissions from engine, transmission, exhaust, tires, etc.?

If not, then what if the combined noise emissions from these separate devices (all complying with Federal standards) exceed the "total vehicle" noise standards of the California law? Would the California standards be preempted? The Federal standards would not have explicitly been directed to the <u>same</u> noise source.

2. Assuming enacted Federal noise emission standards would cover "Total Vehicle" noise, will not these standards necessarily preempt in whole or in part those State noise regulations relating to automobiles, trucks, buses, motorcycles, etc., which set both quantitative decibel level standards and a graduated time schedule (future year of required compliance) with respect to "sales" of such products? New Federal noise emission standards simply cannot be consistent with all existing State standards which even now differ somewhat among the states. If this is a correct assumption, then what advice should be given to those states which wish to prescribe new noise regulatory standards prior to the promulgation of the anticipated Federal standards?

3. If the Federal emission standards purport to apply only to the "sale" to the first ultimate purchaser and thereby preclude the establishment of more stringent State noise standards re "sales," might the state, nevertheless, be permitted to establish "operating" standards which are set at lower levels than the "sale" standard with respect to place and time?

   This requirement would be over and above the usual restrictions set re speed limits, "quiet zones," etc., by local jurisdictions.

4. Related to Question #3 immediately above is that of the continuing viability of State "verbal" or "subjective" noise control standards.

   Would not the retention of verbal standards provide the states a means of assuring that "operational noise levels" could be kept lower than "sale" standards which, with respect to some products at least, would be preempted by the Federal "product" noise emission standards?

   Most states have "muffler" statutes. In the 1966 New York case of People v. Byron (215 N.E. 2d 345 [1966]), the validity of the State Vehicle and Traffic Law §375 was challenged. This section provides:

> Mufflers. Prevention of noise. Every motor vehicle, operated or driven upon the highways of the state, shall at all times be equipped with an adequate muffler, in constant operation and properly maintained to prevent any excessive or unusual noise and no muffler or exhaust system shall be equipped with a cut-out, bypass or similar device. No person shall modify the exhaust system of a motor vehicle in a manner which will amplify or increase the noise emitted by the motor of such vehicle above that emitted by the muffler orginally installed on the vehicle and such original muffler shall comply with all the requirements of this section. (Italics supplied.)

The court found that what is "excessive or unusual noise" has become common knowledge to the reasonable man and that the standard is constitutionally adequate, citing Kovacs v. Cooper (336 U.S. 77 [1949]). Responding to the defendant's contention that a new §386 added in 1956 on motor vehicle noise limits established a decibel sound level defining excessive or unusual noise was a "conscious attempt of the Legislature to supply the missing objective standard of the precise quantity of noise prohibited," the court stated:

> The addition of section 386 was not an attempt to shore up subdivision 31 of section 375. On the contrary, it makes no effort to amend the earlier provision and the two are meant to stand side by side. One now sets a limit beyond which no vehicle noise may go while the other requires each motorist to minimize the noise his particular vehicle makes within that limit.

The court also noted that the States of Texas and California have statutes virtually the same as §375 and that the courts in those states have upheld their constitutionality.

5. Even if control over "operation" of products is retained in the states by the Federal legislation, will not the Federal standards practically (and perhaps legally as an incident thereto) affect the "operational" noise limits that a state or municipality can set, i.e., "operational" levels could not be set drastically below the "sale" emission levels?

6. Will not the existence of Federal noise standards as to "sale" strongly influence the states to establish reasonably uniform "operation" standards? While this is no doubt desirable for some purposes (interstate motor freight carriers), does it not militate against the exercise of police power for the best interest of the public as to particular State and local conditions?

7. In view of some of the foregoing considerations, how might we go about formulating Model Codes at the State level?

   Should they be "alternative" model code provisions to accommodate varying State needs?

8. Will not the Federal standards on mechanisms and devices provide some measure of relief for noise-abused citizens who in fact suffer an actual deprivation in the use and enjoyment of their property as a result of such activities as highway construction but who are denied relief by virtue of State legislation which provides that no nuisance can be found by a court to exist where such activity is carried on pursuant to a State statute?

   Put otherwise, the Federal standards (as applied to various construction mechanisms, devices, and vehicles) may contribute some appreciable reduction in the total noise emitted from construction noise environments (sites).

9. Even if the proposed Federal standards do in effect preempt existing or proposed State noise emission standards for "sale" of designated noise-producing products, what type of Federal assistance might be necessary for the effective enforcement of such Federal standards at the State and local level?

B. Municipal Noise Ordinances or Comprehensive Environmental Noise Codes

1. What State and local regulatory efforts can be anticipated in order to assure that the "police power" (10th Amendment) acknowledged in proposed §6(d)(2) can be asserted to the maximum possible degree? The assertion that noise control is a "local problem," reserved to the states and their instrumentalities has strong support in that states and municipalities have historically exercised considerable discretion in the protection of the health, safety, and general welfare of State/local citizens.

2. Will defendant noise sources in nuisance actions or in suits for injunction be able to avoid liability if they can show that each noise-emitting device is operating within the maximum permissible noise level prescribed by Federal standards (absent a local ordinance) no matter what the actual interference with the use and enjoyment of plaintiff's land and the diminution in the value of his property may result?

   The cacophony of sound may far exceed the maximum for any single product or device such as that from a "rock band" or any activity (industrial, processing, quarrying, etc.) which may utilize multiple noise-making products.

   But is the implication that municipalities should concentrate their noise abatement efforts on qualifying "use" and "operation" ordinances and on the establishment by ordinance or by noise codes "zones of quiet" or specified maximum noise levels for significant "noise environments"?

3. The preceding question #2 refers to situations where a multiplicity of sources, each of which is in compliance with Federal noise emission standards, create a noise level which exceeds the maximum permissible emission from any single source.

   But what of the situation where the municipality may wish to assure the minimum level of noise from particular sources, that is, a level which is not only lower than maximum allowable by Federal standards but lower than that permitted by ordinance or code for locally controlled "noise environments"?

   Can such noise be regulated through "excessive" or "unnecessary" verbal standards similar to the procedure approved by the New York court in the Byron case?

   Will local courts be likely to uphold allegations of noise as a nuisance in such circumstances?

   Or will local and State courts be likely to dismiss such complaints if the particular noise source is operating within Federal standards (absent local regulation as to "zones of quiet") or within the quantitative noise levels prescribed locally for "zones of quiet" even if the noise source is

actually a nuisance in the sense that it interferes to a demonstrable degree with the use and enjoyment of plaintiff's property?

The proposed New York City Environmental Noise Code retains "unnecessary and loud" standards for their "precedent value" along with quantitative standards prescribed for specific noise sources.

Should Model Codes be differentiated among cities at varying population levels, taking into account such factors as the probable level of ambient noise, the density of vehicular traffic, the frequency of major construction, and the ability of cities of varying size to finance an effective noise abatement program?

VI - THE CONTINUING REGULATORY TASK

This recital has suggested several implications for State and local environmental noise control if Federal standards are adopted. Of course, the extent of the revisions which will or may have to be made in existing State and local regulatory and enforcement schemes will be directly related to the specific standards and accompanying regulations which will issue from the Office of Noise Abatement and Control pursuant to new Federal legislation. In this regard, it will be useful in the drafting of such standards and procedures for the Office of Noise Abatement and Control to have an approximate idea of the permissible noise levels now provided in State/local legislation and ordinances and the number of State and local entities following various patterns of regulation. This information has to some degree already been provided in the ONAC Environmental Noise Study noted above, but a substantial evaluative task will arise for the ONAC in assessing the precise implications of alternative Federal standards on the existing State/local regulatory process. Of course, the critical criterion will be the establishment of standards which will effectively contribute to the braking of the rising noise level and, over time, to the reduction of current noise levels in certain environments. But the ease

with which existing State/local noise abatement programs and new State/local initiatives can be incorporated into an overall national program of environmental noise control will be an important factor in the timely implementation of this effort.

It is a recognized fact that the existing Federal/State/Local regulatory relationships are in a situation of substantial disarray. One outcome of Federal intervention may likely be a realignment of the Federal/State/Local regulatory arrangements into a relatively symmetrical structure of laws, regulations, and enforcement practices. This will come about in time through the promulgation of Federal standards, through negotiation among various jurisdictional levels, through agreements for Federal support to states and municipalities, and by court decisions (where disputes arise) which will, hopefully, tend to bring the overall regulatory scheme into coherent and workable alignment. Surely, this development will come about with appropriate consideration being given to the movement of goods and products in interstate commerce and to other activities requiring a substantial level of uniform regulation. But there remains a question of the fashioning of appropriate provisions to assure adaptation of noise regulation to particular State and local concerns. In short, in addition to the promise of Federal standards to shape a well-

structured national system of regulation of environmental noise sources, we must keep the primary objective in mind, namely, the arresting of and the eventual reduction in the actual noise made by specific noise sources and the actual decibel levels of significant noise environments.

What is needed in order to assure that the real objective of actual noise reduction is achieved? No doubt the establishment of Federal standards for certain mechanisms, devices, and products transmitted in or operating in interstate commerce providing maximum emission levels clearly designed to lower current decibel levels, promise (through time) some reduction in environmental noise. But supplemental State and local programs regulating the use, operation, and movement of noise sources will be indispensable to effective noise abatement, i.e., measurable progress in noise level arrestment and reduction. We know that most State and local noise abatement programs are relatively ineffective. There are many reasons for this: lack of appropriate "model" codes, lack of skilled personnel and equipment, and lack of enforcement manpower. The Federal government will have to give thought to providing assistance of various types if noise abatement is to be effective at the State and local levels.

There are, of course, further dimensions to the environmental noise abatement effort not encompassed in the complex of §6(d) relationships, as for example, the requirements imposed by §611 (1968) amendment to the Federal Aviation Act, the 1970 amendment to the Federal-Aid Highway Act, the Airport and Airway Development Act of 1970, and the Occupational Safety and Health Act of 1970. And, of course, §102(2)(C) of the National Environmental Policy Act of 1969 which requires environmental impact statements for all major Federal actions. These combined initiatives should serve to give greater visibility to the noise factor in various future programs and projects. Furthermore, §401(c) of the Noise Pollution and Abatement Act of 1970 provides for consolidation of the reviewing function of noise-producing activities by Federal agencies in EPA.

But in order to determine if the actual noise levels of major noise environments are in fact being reduced, it will be necessary to monitor and evaluate all Federal, State and Municipal noise abatement programs. The importance of a Continuing Monitoring and Evaluation System cannot be too strongly emphasized. Such a project would assess on a continuing basis:

> The degree to which Federal noise abatement programs are achieving their intended objectives.

- The scope and nature of permissible and desirable State and Local Regulatory Schemes for environmental noise abatement and control

- The degree of effectiveness of enforcement of State and Local Regulatory programs

- The actual reduction, if any, as of prescribed future dates, in ambient noise levels of particular noise environments and in the operation of specific noise sources.

In sum, a splendid opportunity is presented to administer e noise abatement and control regulatory scheme in a manner nsistent with both our social aspirations and our best manarial capabilities.

Gentlemen:

I am Thomas C. Young, Executive Director of the Engine Manufacturers Association. The Association is located at 111 E. Wacker Drive, Chicago, Illinois. A list of members of this Association is attached and includes major manufacturing companies in the United States producing gasoline, diesel and gas turbine types of internal combustion engines for all applications except passenger car and aircraft. The engines of our members are used in truck and bus, off-highway and construction, farm and industrial, stationary, marine, locomotive, lawn and garden, and recreational applications.

We should like to make it quite clear that we are speaking as an Association representing engine manufacturers only, with technical and legal expertise and experience in engine emissions. We do not speak for vehicle manufacturers or construction equipment manufacturers, or any other end use or end product manufacturers or trade associations utilizing the engines covered by our Association. We do feel a responsibility and are quite willing to share our knowledge and information with other associations or with branches of state and federal governments where we can be of assistance.

The Association deals primarily with the development of non-proprietary base line data, the development of test procedures, Model Regulatory Codes and instrumentation, and studies technical and legal aspects of the control of all types of emissions including noise from internal combustion engines. We have much experience in the smoke and gaseous emissions area. This experience increases our concern with inconsistent standards now being applied as noise regulations, which we feel will detract from

and not improve the noise abatement program. Mr. Jonathan T. Howe, Legal Counsel for EMA, will speak to this subject and other legal aspects.

I would like to address three basic topics in these final summary hearings. It is important to attempt to summarize some of the important aspects of noise abatement and control. It is also important to relate these noise abatement efforts to the broad attack on pollution control in our society, particularly from the viewpoint of the consumer or voter. Thus, my comments will discuss the following subjects:

1. Economics & Cost Effectiveness
2. National Noise Monitoring Network
3. Need for a Balanced Approach.

1. Economics & Cost Effectiveness

Published literature and research reports on cost and other economic data concerning noise abatement and control is fragmentary. Unfortunately we must initiate the abatement effort largely on intuition. However, we should attempt to include all available economic data in the development of an abatement program, even though the data base may be inadequate, at the present time. Naturally, we should plan appropriate research on this important parameter of the noise abatement effort.

Those familiar with research and development activities know that many laboratory solutions to technical problems cannot be applied in the marketplace, since their

costs exceed those of the methods or products in use. Since noise abatement efforts must eventually meet the test of the marketplace, it is imperative to evaluate the economics to ensure a successful abatement program.

We feel the following factors need evaluation to the extent of the available data. This is very important since it is prudent to avoid the type of pollution abatement contradictions now facing us in phosphate and mercury pollution, where the credibility of the regulations are under question, apparently due to inadequate research. It is for this reason that we support and commend the survey of the present state-of-the-art contained in the Title IV of the Clean Air Act, of which these final summary hearings are an important part. We should take time to study the relevant lessons of our past.

We feel the following comments on economics and cost effectiveness are important.

1. The data base on cost effectiveness of noise abatement alternatives and on the cost parameters of noise abatement devices, and procedures is inadequate. Due to extreme lack of data it would be dangerous to generalize, but some data available indicates certain aspects of cost changes which should be investigated.
2. It is a commonly held view that the primary change necessary to lower significantly the noise emissions of engine powered equipment is the installation of a better muffler. Naturally, in our urban environments there are other noise sources which contribute to the prevailing ambient noise level.

- The California Highway Patrol has been active in measurement of vehicle noise for some period of time. As is well known, they do find some vehicles operating with minimum mufflers frequently different than those recommended by the vehicle manufacturer. The user has the option of purchasing a cheaper and perhaps more noisy muffler when it is replaced. Thus, the abatement effort must recognize that effective enforcement also must control the user, who shares some of the responsibility for noise emissions in our society.

- It is true that significant noise reductions can be achieved by design changes in mufflers or muffler systems. In the Chicago hearings of EPA, Caterpillar Tractor Co. testified that reductions of 10 dBA and more, comparing experimental mufflers with the bare engine noise emissions, had been achieved. They also stated that this noise reduction caused an increase in back pressure and thus included a performance trade-off.

- Briggs & Stratton testified in Denver EPA hearings that muffler and other engine modifications on an eight horsepower riding mower could: (graph included)

  (1) Lower noise emissions 5 to 6 dBA for muffler modification and 10 to 12 dBA including other changes.

  (2) Increase costs about $55 to $58 on equipment selling at about $250 or a percentage increase of 22% in first cost alone. This is for muffler and other engine installation modifications.

3. Noise abatement design and devices will cause increases in several kinds of costs in addition to equipment costs, and performance trade-offs will be required to lower engine powered equipment noise emissions.

- Both of these points are demonstrated clearly by testimony of Outboard Marine Corporation in Denver EPA hearings. I would like to repeat it briefly here as EMA testimony, since it clarifies these two aspects of noise abatement economics. We do feel these comments apply to several important classes of engine powered equipment.

(Quote) "Because we are not sure at this time which design techniques will be employed to achieve the varying degrees of quietness, we can only estimate the increased costs. For the record, these new quieter products will - probably without exception: (1) weigh more; (2) be bigger and bulkier; (3) cost more; and (4) be more difficult and expensive to service and maintain in their original 'factory-quiet condition.' We expect that costs and weight penalties will be in the range of 10% to 30% depending on what is demanded of us for each product's noise levels.

To attain quieter products, we must be prepared to trade off, to some degree, many of the design goals which have been achieved in response to market demands.

Light weight, low cost, portability, ease of operation and use, and simplicity of maintenance are design goals which should not be cast aside lightly. Recognizing that price increases will be inevitable,

and will deprive some people of the use of the product, we must study the cost/benefit curve in each case. In his recent report to Congress, President Nixon stated that a sense of realism must be applied when seeking to make environmental improvements. Mr. Nixon said 'It is simplistic to seek ecological perfection at the cost of bankrupting the very taxpaying enterprises which must pay for the social advances the nation seeks.' He called for development of a 'realistic sense of what it will cost to achieve our national environmental goals and choose a specific level of goal with an understanding of its costs and benefits." (unquote)

- Thus, it is important to emphasize that in addition to increases in original equipment costs of 10 to 30%, the consumer will also bear the burden of increased costs of:

  --For the user

  (1) Operating Costs

  - Heavier weight mobile equipment may well reduce fuel economy or payload.

  (2) Maintenance and Service Costs

  - Noise abatement devices and controls will increase hardware in the engine compartment and may well increase labor costs in removal for service of the engine.

-- For the equipment manufacturer several types of costs will increase including

(1) Research and development costs

(2) Testing costs

(3) Tooling costs

(4) Material and labor costs

-- For the control agency, primary costs increases will occur in:

(1) Research and development costs

(2) Enforcement and abatement program costs.

For these reasons it is important to recognize that, in the long term, all of the above costs will be ultimately borne by the consumer, in the marketplace and as a taxpayer.

4. Noise abatement costs discussed above must be related to overall environmental programs, each of which include similar potentiality of major cost increases and will come to bear on the consumer's pocketbook in the decade of the seventies.

- WE URGE CAREFUL CONSIDERATION OF THE IMPACT OF TOTAL POLLUTION ABATEMENT COSTS FOR ALL POLLUTANTS ON THE CONSUMER AND THE NATIONAL ECONOMY. The consumer will feel the total impacts of the following major pollution programs.

(1) Noise abatement

- Engine powered equipment

- Appliances (perhaps depending on labeling)

(2) Mobile Source Air Pollution

- Autos, trucks and buses

(3) Stationary Source Air Pollution

- Electric power; SO_2 and particulates
- Industrial plants

(4) Solid Waste & Sewage

(5) Water Pollution

(6) In addition to pollution abatement costs, there are safety costs

Motor Vehicle Safety

- Air bags
- Bumper modifications
- Safety autos

- EPA, DOT, FAA, and many other federal and state agencies are pursuing parallel programs of pollution abatement.

- The costs of pollution abatement lag development of standards and control devices. Thus, it appears that the full cost impact of total U.S. pollution efforts may be placed on the consumer between the years 1973 and 1980.

- We are attempting to overcome 50 years of relatively uncontrolled pollution in the decade of the 70's. The noise abatement effort and all other pollution abatement efforts must be coordinated if cost-effective abatement acceptable to the consumer is to be achieved. We do not believe that the consumer is willing to accept a program of pollution abatement, without full

consideration of basic cost aspects as a major parameter.

II. National Noise Monitoring Network

1. We have not heard of any recommendations that a national noise monitoring network be established. We recommend that this become an objective of the Office of Noise Abatement and Control and that they investigate and select the cost method most effective to establish and implement such a control network.

- The Chicago Noise Report of Bolt, Beranek & Newman, Inc.[1] commented on this problem for the municipal situation. Quotations from their report state:

(Quote)

- "There seems to be little debate that the noise environment in urban areas has become progressively worse over the last few decades."
- "Yet in contrast to air pollution evaluation, very little is known about the actual existing noise environment and how it changes on a daily or seasonal basis, and nothing about the changes over a period of years."
- "In the present state of establishing urban noise criteria and determining their validity, we are, therefore, working completely on intuitive notions supplemented with fragments of data in a few specialized situations. We have no long-term noise histories to guide us in the appropriate statistical measure of noise, and we have no knowledge of where the statistical approach fails and must be supplemented with knowledge of the noise levels for specific events."

1 Bolt, Beranek & Newman, Report No. 1413, pg 97,98

- "It appears highly desirable to obtain specific knowledge of the short and long-term statistics of noise exposure at representative locations in the major metropolitan area." (unquote)

- We believe that a National Noise Monitoring Network can be shown to be the most cost effective means to survey ambient noise emissions levels and monitor performance of noise pollution abatement efforts.

2. Surveys of ambient emission levels in our urban (and total) environments must be made to develop standards which will result in abatement of these levels. A national noise monitoring network could perform such surveys.

Prevailing ambient noise levels in our cities should be the primary focus of the abatement efforts and standards. They result from the operating modes of a wide variety of equipment and total emission levels comprise the net effect of the density of the noise sources and affected population. Yet most present test procedures measure maximum noise emissions from engine powered equipment.

Point-source standards set on engine powered equipment which reduce noise emissions for that specific application as measured by maximum noise test procedures may or may not reduce ambient levels depending on the difference between the maximum level and the equipment's normal operating mode, and density of the equipment in the city.

The ambient noise emissions from each vehicle in a line of traffic is lower than its maximum noise emission level since city operation is not normally at

conditions where maximum noise emissions occur. Further, since data on the net effects of varying densities is fragmentary, it is not possible to set technologically feasible standards without surveys of existing ambient levels in our urban environments.

Several charts from the BBN Chicago Noise Study on noise levels in various cities are attached. The test procedures may differ somewhat, but they illustrate the point that ambient levels in different cities differ by a significant amount. A national monitoring network should consider this problem in its selection of appropriate sample cities.

3. A performance yardstick is required.

Measurement of ambient noise levels and the rate of change of ambient noise levels in our urban environments is required for several important reasons, as follows:

- Measurement of the cost effectiveness of abatement efforts requires validation of the change in annual levels, on an appropriate sample of cities.

- Measurement of annual improvements in emission levels will allow the abatement agency to speed up or slow down the abatement effort.

- We know that densities of noise sources and population are changing rapidly and annual data will record the net effect of the change.

- BBN noted that historical data is totally absent and a data base for forecasting the trend and rate of change must be established.

4. "Noise levels are increasing 1 dB per year." [1]

There is a widely misquoted statement attributed to Dr. Vern O. Knudsen with regard to the rate of change of noise levels in our society. We would like to provide the proper interpretation of this statement.

Dr. Vern O. Knudsen, Professor of Physics and Chancellor, Emeritus, University of California actually said:

(Quote)

- "In 1954, on the occasion of the twenty-fifth anniversary of the founding of the Acoustical Society of America, I reminded acousticians and the public that during the preceeding twenty-five years the loudest noises to which man was exposed increased 25 decibels, from 125 to 150 dBC (about 110 to 135 dBA), an average of one decibel per year."

And again:

- "An article in the February 1970 issue of Scientific American[2] reports that from 1936 to 1963 the take-off noise from civilian aircraft increased from about 100 to 130 dBC, thus continuing its inexorable rise of at least one decibel per year." (unquote)

We do not know the extent of the data base involved but this quotation refers to maximum noise, not ambient noise, and it does not refer to the twenty-five years preceeding 1971 (i.e. 1946-1971) but to the twenty-five years prior to 1954 or the twenty-seven years prior to 1963. As BBN has said, we do not have

1 House Hearings, Serial No. 92-30, page 138

2 "The Assessment of Technology" Scientific American, Feb. 1970, Vol. 222, No. 2, pg 13-21.

an adequate data base on the historical trend in ambient noise levels.

Finally, EMA wants to state that some types of engine powered applications are already being improved with regard to their noise emission levels. Inspector Craig of the California Highway Patrol testified in San Francisco that engine powered vehicle manufacturers were cooperating with the California Highway Patrol and, as a result, noise emissions from those classes of equipment were being abated successfully in the state. (Present California standard is 88 dBA for new commercial vehicles.)

III. Need for a Balanced Approach

To use a "reductio ad absurdum" analysis one can say that only a very small percentage of our population wants noise levels so low that they would have to push lawn mowers and ride bicycles to eliminate all of the engine powered equipment which provides for our social and recreational needs.

On the other hand, no one would be inclined to conclude that noise is not a problem and that controls and standards are completely unnecessary. EMA concurs that there are sufficient data to indicate that noise is a national concern and that uniform enforcement and control are vitally necessary.

The primary pressure for noise abatement and control seems to come from special interest groups, offended by noise levels and sincere in their dedication to lower such levels. We respect their rights to seek such social changes. However, respectfully, we would like to suggest that there are other groups who also have rights which must be considered

in a balanced approach to noise abatement. The three primary groups involved in noise abatement programs include the following:

1. The user who purchases and uses a machine for a social good.

   For example:

   - A citizen buys a power lawn mower to maintain an attractive property and reduce time and effort required to cut his lawn. This machine emits noise.

2. The neighbor is bothered by the noise emitted from his neighbor's mower and requests quieter equipment or complains to your agency, even though he may use a power mower on his own lawn, (possibly of equal or higher sound level).

3. The manufacturer produces the product using mass production techniques to serve the public and answer the desires of consumers trained to seek the most value at the lowest prices. In the process, he provides jobs and contributes to the economy and the welfare of the country. Adequate protection through uniform enforcement procedures should be provided to the manufacturer, who must add weight, bulk and cost to his product to meet noise abatement regulations.

Proper noise regulations must consider the interests of all of these persons by balancing economic reasonableness and technological feasibility, with the degree of acoustic annoyance.

Thus, the EMA agrees that noise is a matter for national concern, however, there is a severe lack of adequate data on important parameters of the problem, hence, the need for research and development. Means to abate noise must be researched, developed, tested, tooling purchased, production tested and field tested before introduction into the mass produced products which are a hallmark of the U.S. economic scene. This requires substantial lead time, generally measured in years, ranging from about 3 to 7 years for most engine powered equipment manufacturers.

In addition to major technical and economic problems, there are serious enforcement problems which require a uniform approach and we encourage development of uniform model codes, test procedures, enforcement, and training methods. Our summary of State Legislation, submitted in San Francisco, proves beyond a doubt that the states will provide an undesirably diverse approach to noise abatement. Since we can find no alternative method to gain uniformity of regulatory control, we strongly support federal standards and federal preemption. Although data on important parameters are scarce at this time, we must attempt to minimize the intuitive aspects of our approach and maximize the objective aspects as we research the problem areas and move forward to a quieter society. No one wants to hear the clarion call of Joshua's trumpets and see the walls come tumbling down around our feet.

The Engine Manufacturers Association deeply appreciates this opportunity to present its views. The Association is ready to provide its services to other trade associations or the federal government in any way that will aid in proper control and abatement of noise

emission under conditions of reasonable cost acceptable to the general public. We will be pleased to try to answer any questions you may have after Mr. Howe completes his remarks.

MEMBERS
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CATERPILLAR TRACTOR COMPANY
Peoria, Illinois 61602

CUMMINS ENGINE COMPANY, INC.
Columbus, Indiana 47201

DEERE & COMPANY
Moline, Illinois 61265

GENERAL ELECTRIC COMPANY
Erie, Pennsylvania 15601

DETROIT DIESEL ALLISON DIVISION
General Motors Corporation
Detroit, Michigan 48228

INTERNATIONAL HARVESTER COMPANY
Melrose Park, Illinois 60160

MACK TRUCKS, INC.
Hagerstown, Maryland 21741

OUTBOARD MARINE CORPORATION
Milwaukee, Wisconsin 53216

PERKINS ENGINES, INC.
Farmington, Michigan 48024

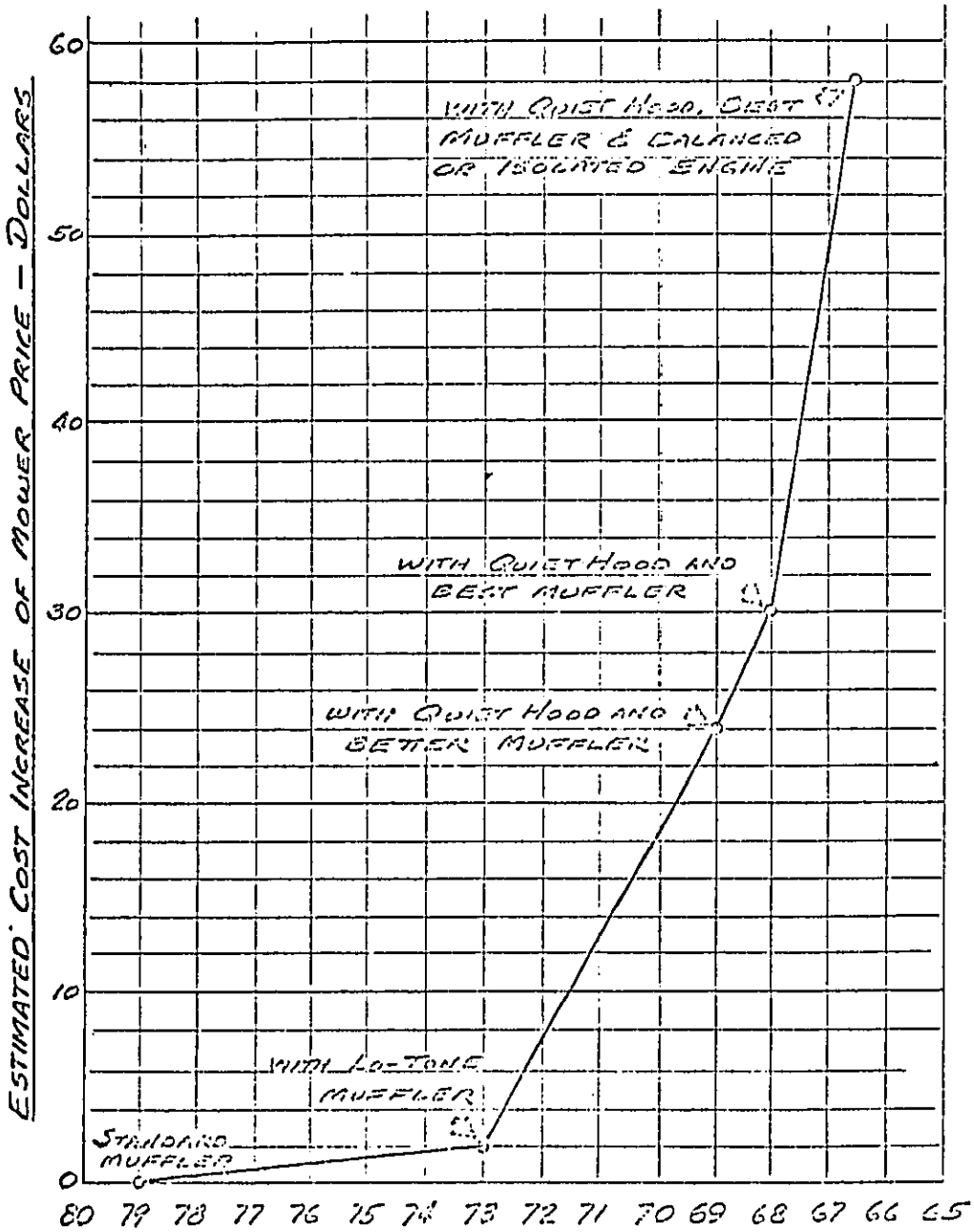
TELEDYNE CONTINENTAL
Warren, Michigan 48093

TELEDYNE WISCONSIN MOTORS
Milwaukee, Wisconsin 53246

WAUKESHA MOTOR COMPANY
Waukesha, Wisconsin 53186

WHITE ENGINES, INC.
Canton, Ohio 44704

INCREASE IN SELLING PRICE OF A 6 HORSEPOWER RIDING MOWER WITH NOISE REDUCTION TREATMENT



BRIGGS & STRATTON CORP.

Introduction

Noise, at long last, is being recognized as a major pollutant. It is often referred to as the New Pollutant. In fact, it is one of the oldest. Thus, two thousand years ago, Horace could find about the noise that annoyed the man of letters in the Eternal City. A free version of his Epist. II.2 follows:

> "The hot-tempered coppersmith is banging about with his anvil and mallet;
> A mighty noise turns here a stone, fills there a wooden horn.
> Mournful funerals contend with heavy wagons (to see which makes the most noise);
> A mad bitch flies over that way, a filthy sow wallows around here.
> But now, along with you, I am resolved to meditate on my songs."

English law (Act of 1864) allows a householder to send away street musicians, and to this day they are required to keep moving. James Sully, writing on Civilization and Noise in the *Fortnightly Review* (1876), discusses this and other legal aspects of noise control. He assures us that it was possible to restrain noise as a nuisance, and cites a celebrated case in which the plaintiff obtained an injunction to restrain the ringing of bells at unseasonable hours in a chapel near his dwelling.

Recent attempts in our own country at the control of noise by legal action and injunction have been generally futile. Much of this futility, I believe, is attributable to the lack of proper regulatory codes based upon appropriate quantitative standards and regulations. What is needed to formulate the required standards and regulations is clearly set forth in this report, a subject in which the principal author, Dr. Melville C. Branch, has had an active and laudable interest during the past five years.

Among acousticians, at least until recently, I have been dubbed the Number One Noise Maker in the nation. I have inveighed against noise for over forty years. Among my clippings about noise I find one from the Los Angeles Times dated September 2, 1927. The title reads "Noise Said to Shorten Lifespan", and the subtitle "Dr. Knudsen of UCLA Declares Everlasting Din One of America's Banes". The first sentence reads: "Americans today, to a large extent, are paying in a shortened tenure of life, and reduced efficiency, for the noise amid which they must work and live."

About five years ago, Victor Gruen—distinguished architect and urban planner—cogently and pithily declared: "Noise and Smog are Slow Agents of Death." Unless we arrest the relentless and monstrous growth of smog and noise in the metropolitan environment, Victor Gruen's slogan can be revised to read: "Noise and Smog are Sure Agents of Death."

In 1954, on the occasion of the twenty-fifth anniversary of the founding of the Acoustical Society of America, I reminded acousticians and the public that during the preceding twenty-five years the loudest noises to which urban man was then exposed had increased from 120 to 130 dB(C) [about 110 to 135 dB(A)], an average of one decibel per year. I further reminded them that if this rate of increase continued for another 25 years, noise would reach a maximum level of 175 dB(C) [about 160 dB(A)], which probably would be lethal for man. Already in 1954, it was known from researches of Dr. I. Rudnick, now President of the Acoustical Society of America, that a noise level of 165 dB(C) [about 151 dB(A)] was lethal for cockroaches and rats.

The loudest noises to which urban man is presently exposed are generated by aircraft. Although motor vehicles are still the most ubiquitous contributor to urban noise pollution, aircraft noise is increasing at an alarming rate. An article in the February 1970 issue of *Scientific American* reports that from 1956 to 1969 the take-off noise from civilian aircraft increased from about 100 to 130 dB(C), thus continuing its inexorable rise of at least one decibel per year.

This comprehensive study and report by Dr. Branch —an authority on planning of the highest rank—and his graduate student collaborators contributes importantly to our knowledge of growing urban environmental noise pollution. The literature linking outdor noise and urban planning is very sparse. Furthermore, based on his extensive city planning experience in Los Angeles, Dr. Branch makes relevant and realistic recommendations for noise standards and governmental actions which would insure the safety, benefits and amenities resulting from communities free of noise pollution.

Achievement of the noise environment which would result from the standards and actions recommended in this report will take time. In the meanwhile, I urge sensitive and sensible persons who are disturbed by noise to obtain temporary relief and protection by wearing ear plugs (Mine Safety Appliances Ear Defenders, Willson Sound Silencers, or equivalent). These can reduce noise by about 30 dB; a harmful noise level of 90 dB(A) is reduced to a tolerable 60 dB(A). Many people routinely wear dark glasses to reduce sun glare. Those bothered by noise should wear ear plugs.

It would be a tragic error, however, to tolerate growing urban environmental noise or excuse noisy manufactured products because ear plugs can be worn. This would be like ceasing to concern ourselves with smog because gas masks are available. Not only are our natural senses further dulled when artificially filtered or masked, but if we are to adjust in this way to our environment as it is trending, we will be wearing ear plugs or muffs, nose masks, lead foil underwear, a biologically and chemically protective overgarment, and, of course, our dark glasses.

Vern O. Knudsen
Professor of Physics and Chancellor, Emeritus
University of California, Los Angeles

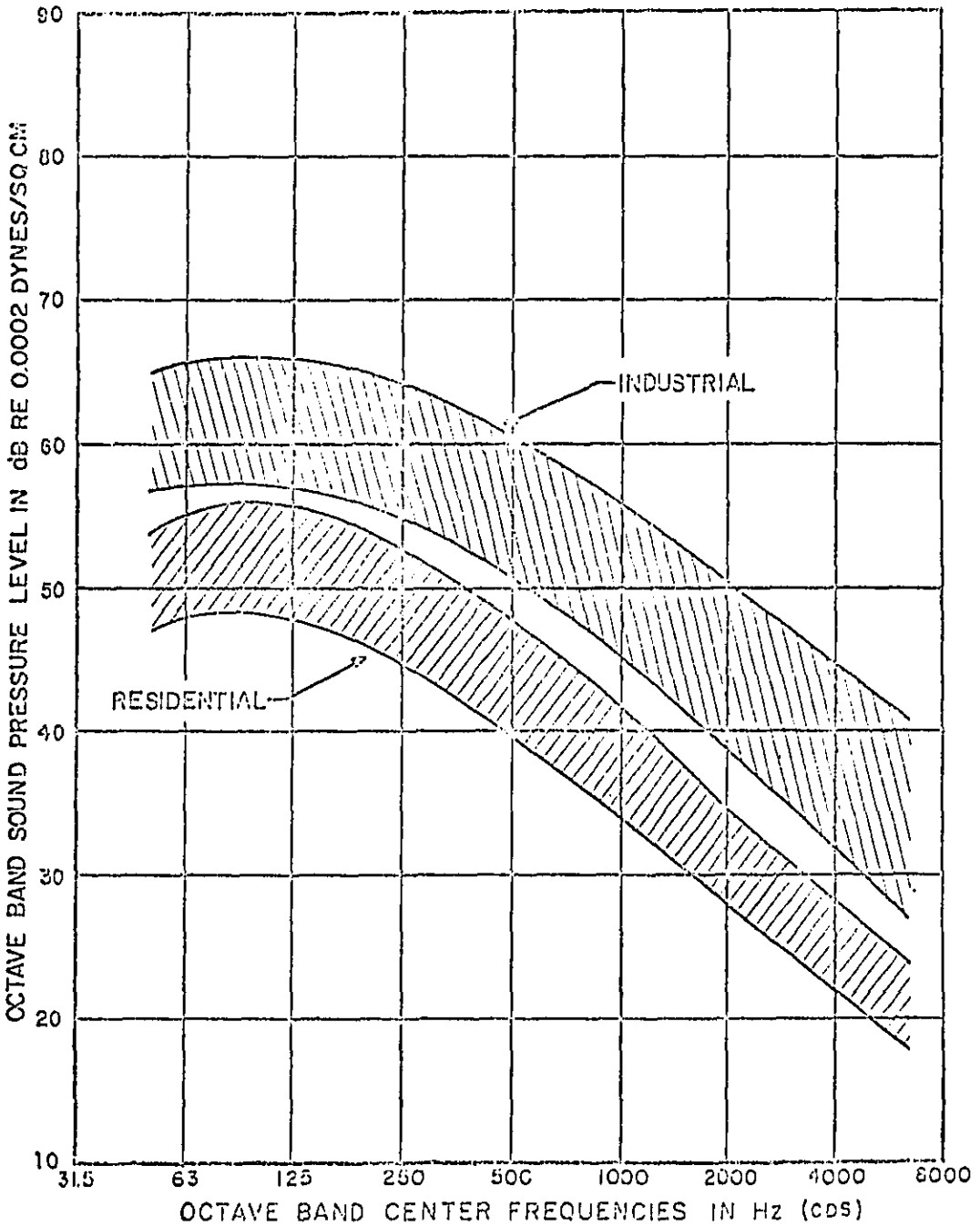


FIG. 1 NOISE OF CHICAGO INDUSTRIAL AND RESIDENTIAL TRAFFIC, 1947. (Ref. 242)

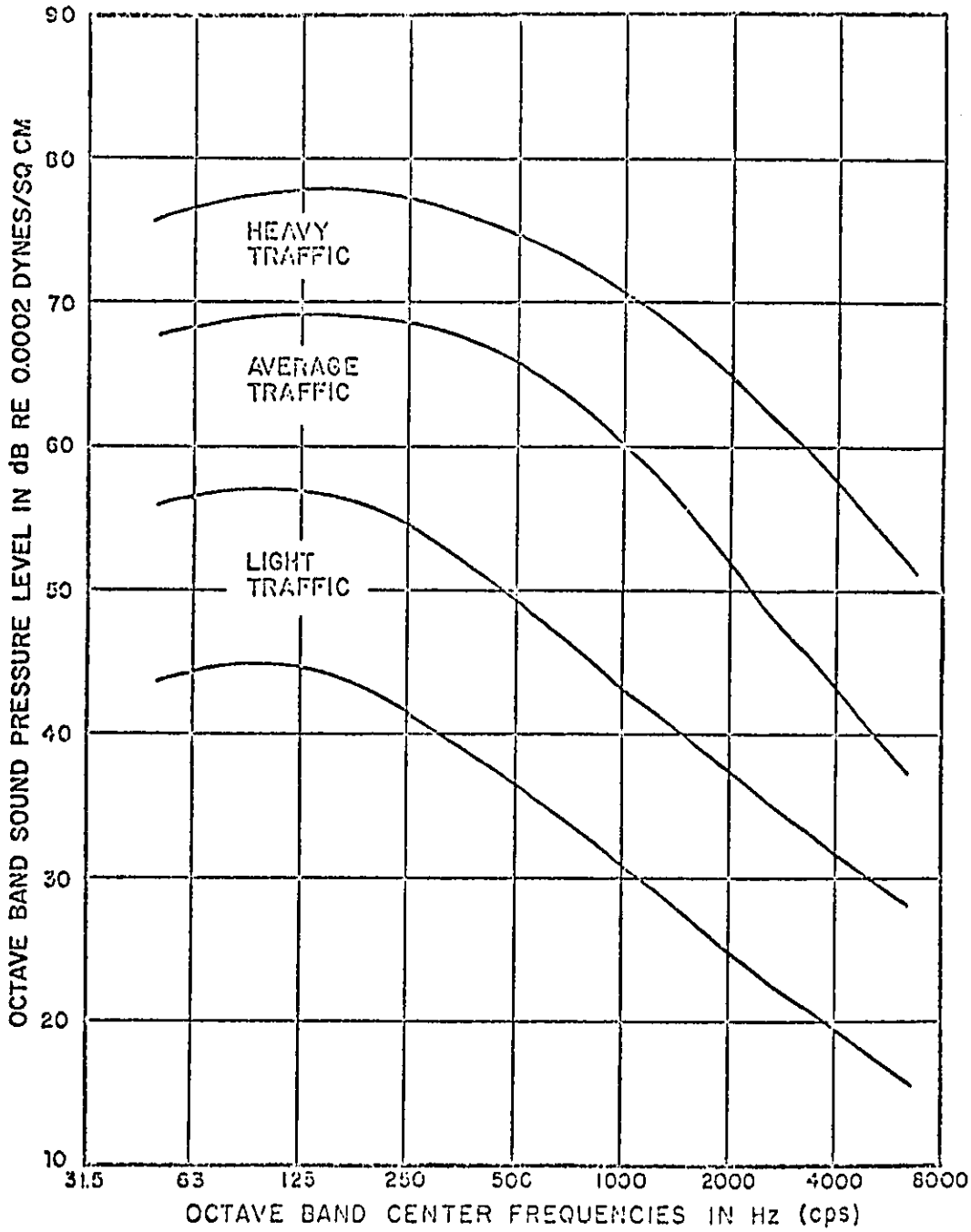


FIG. 2 NOISE OF CHICAGO STREET TRAFFIC, HEAVY, AVERAGE AND LIGHT, 1947. (Ref. 242)

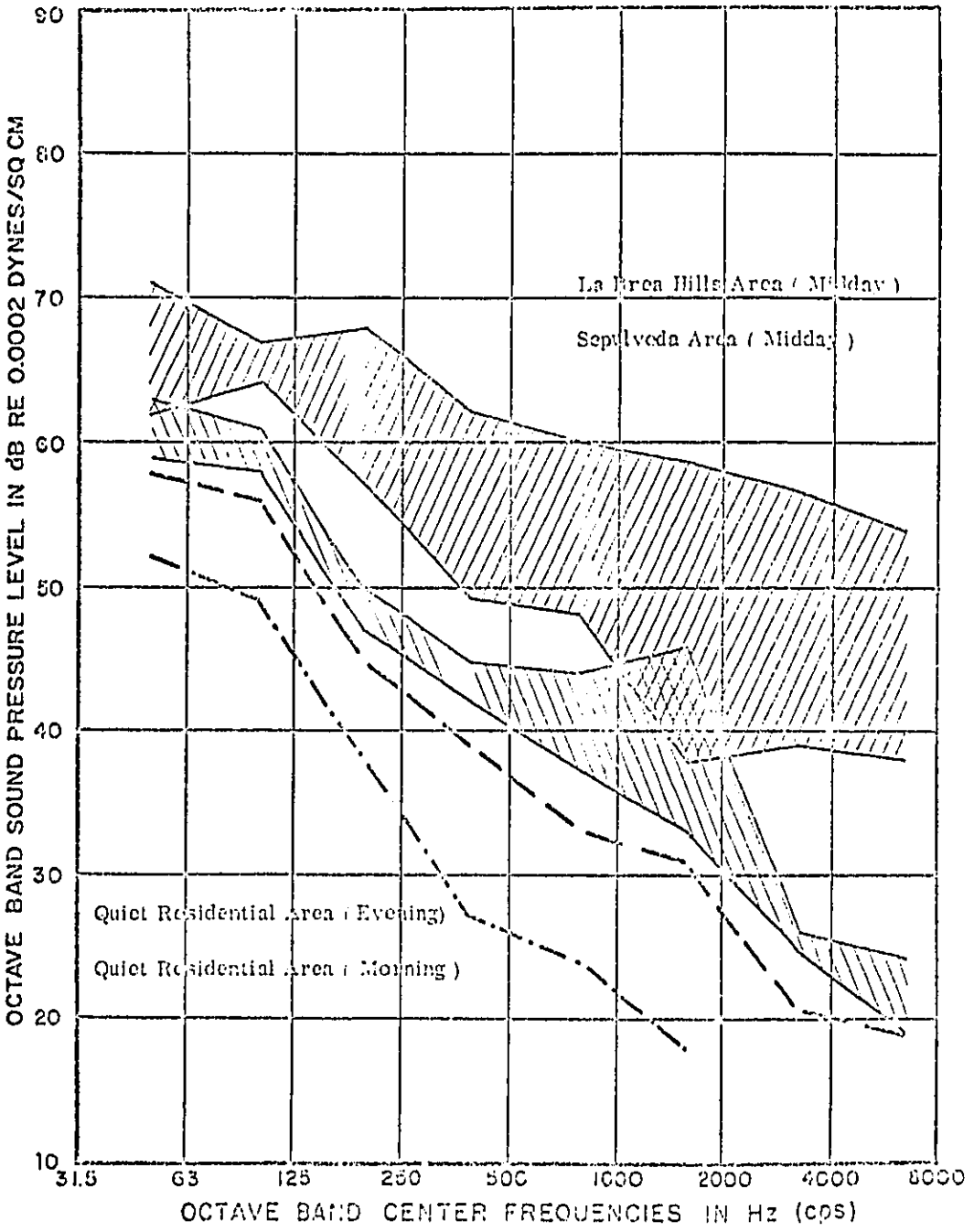


FIG. 3 REPRESENTATIVE BACKGROUND NOISE LEVELS IN LOS ANGELES RESIDENTIAL AREAS, 1955. (Ref. 244)

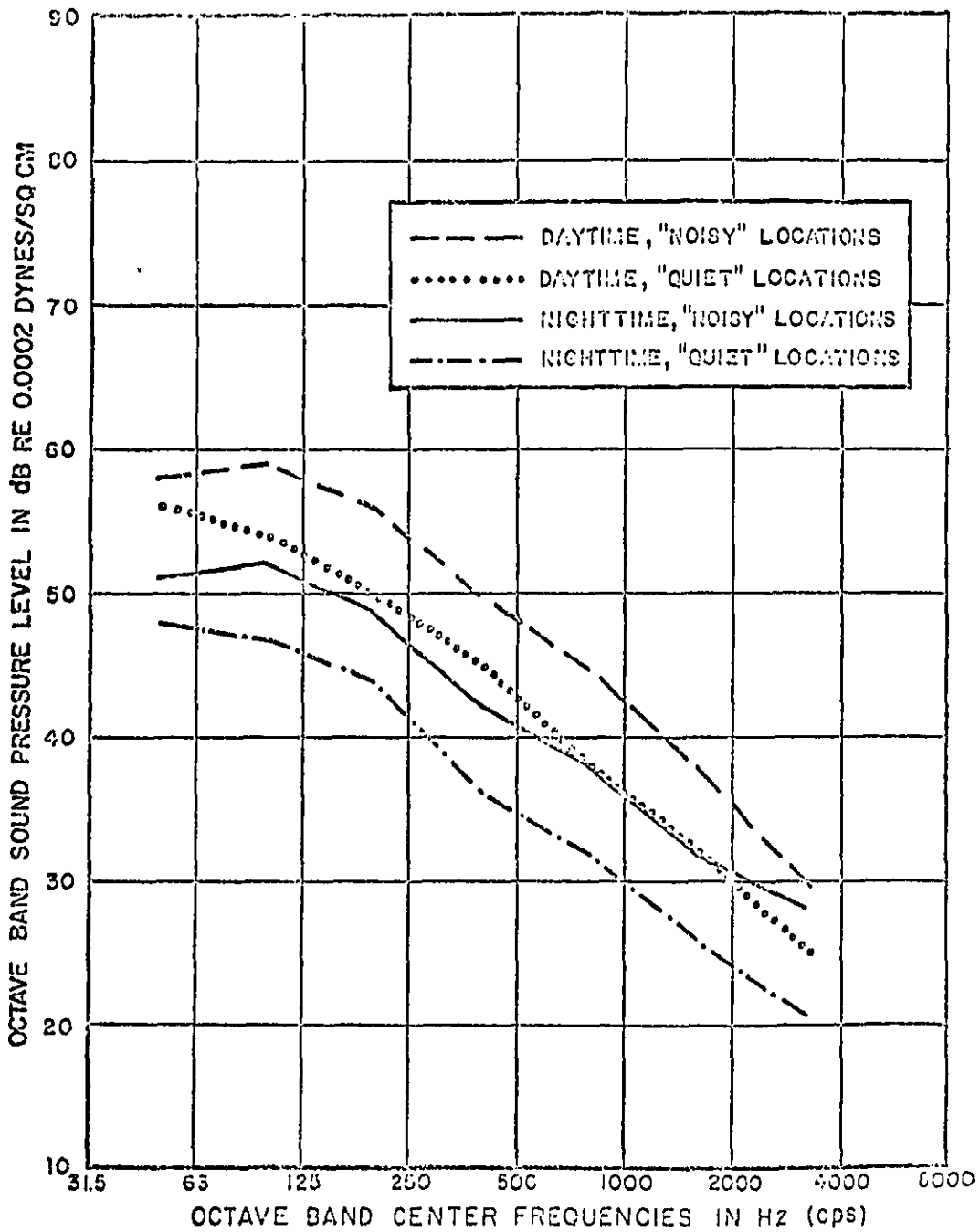


FIG. 4 URBAN NOISE LEVELS IN TUCSON, 1958 (Ref. 245)

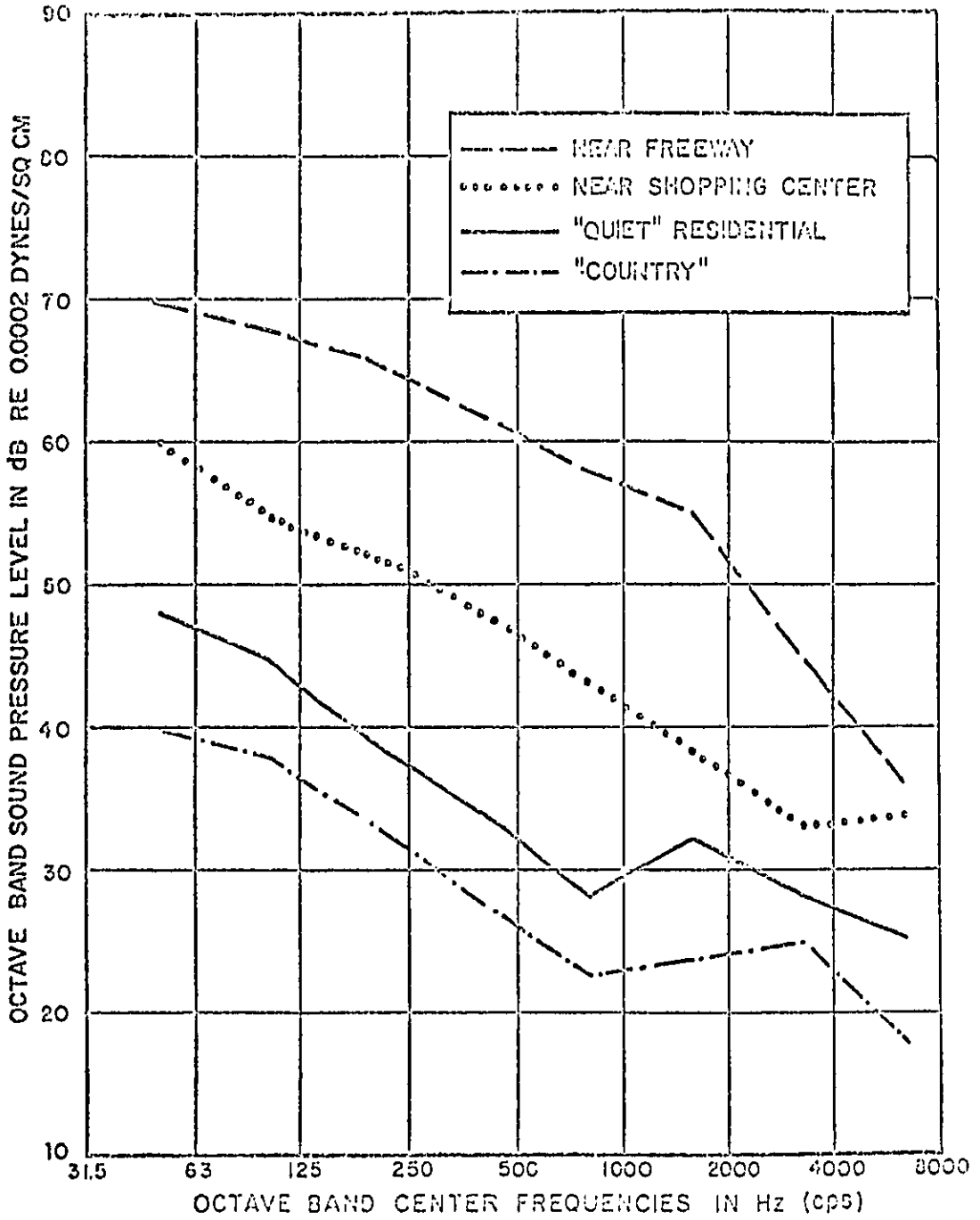


FIG. 5 COMMUNITY NOISE LEVELS IN AUSTIN, 1958 (Ref. 246)

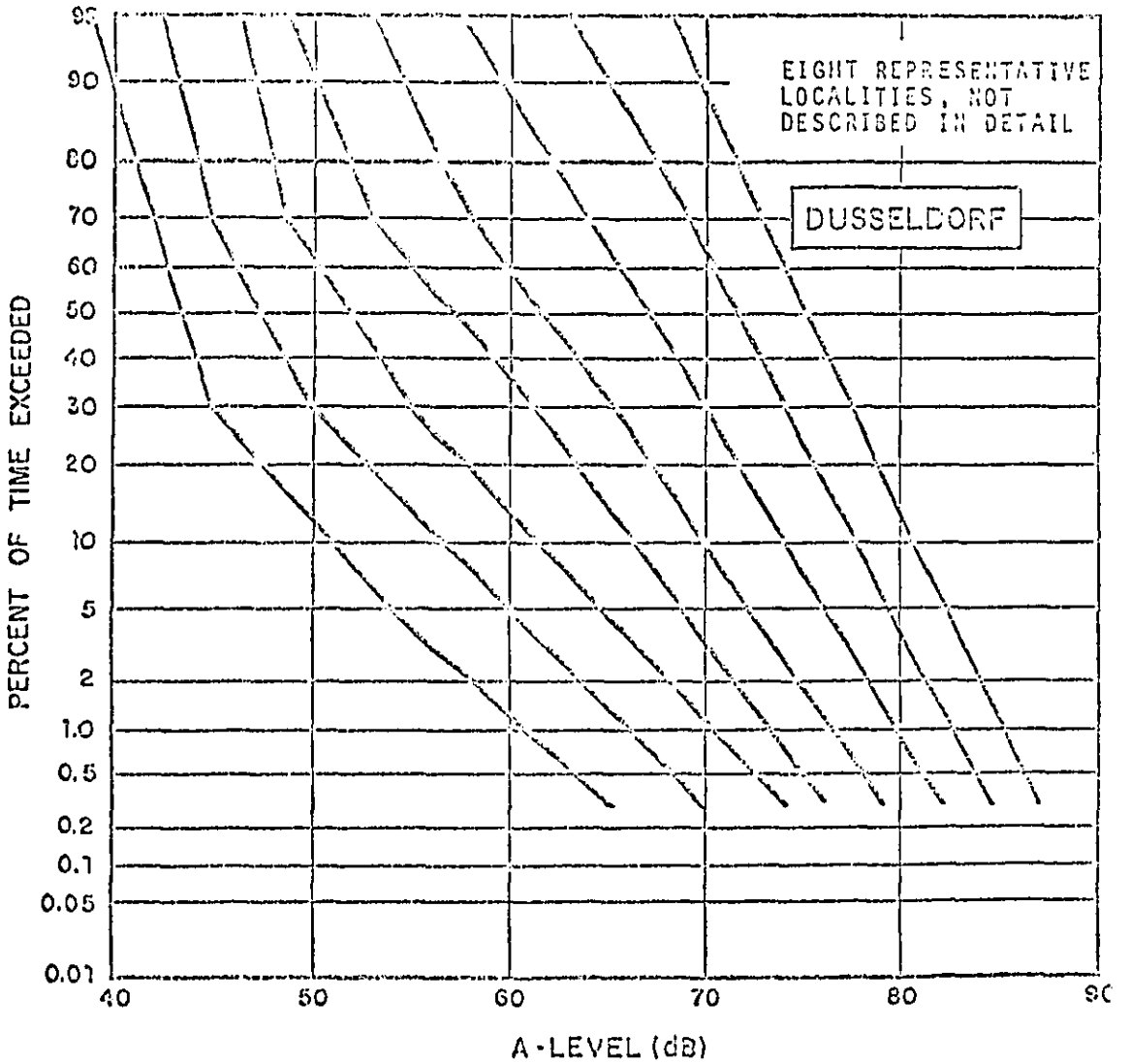


FIG. 10 URBAN NOISE LEVELS: DUSSELDORF, WEST GERMANY, (DAYTIME ONLY).(Ref. 29)

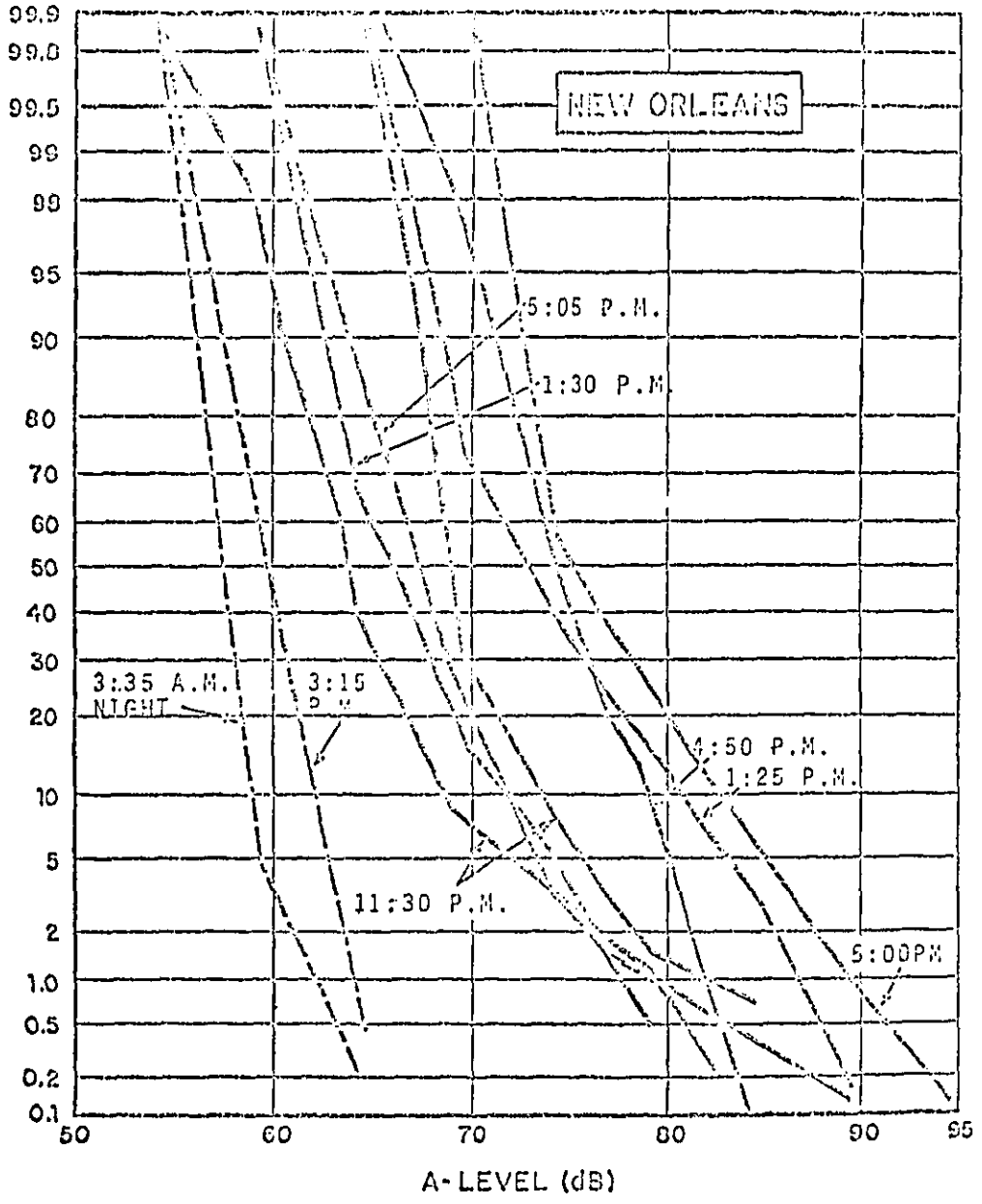


FIG. 11 URBAN NOISE LEVELS: JACKSON SQUARE, NEW ORLEANS, (Ref. 48)

TESTIMONY

Presented by

CIMA

to the

ENVIRONMENTAL PROTECTION AGENCY

NATIONAL HEARING ON NOISE ABATEMENT AND CONTROL
WASHINGTON, D.C. NOVEMBER 9-12,1971

CONSTRUCTION INDUSTRY MANUFACTURERS ASSOCIATION

111 E. Wisconsin Ave. • Milwaukee, Wisconsin 53202

My name is H. T. Larmore, Deputy Director for Technical and Safety Services of the Construction Industry Manufacturers Association (CIMA). Previous CIMA testimony presented at the EPA hearing in San Francisco on September 27 through 29, 1971, elaborated on the membership of this organization and the broad spectrum of construction equipment manufactured by its members.

It is our intent at this hearing to address various economic factors related to noise reduction of construction equipment, present some statistics which suggest where the primary thrust of investigations, standards development and enforcement might be concentrated, I shall also highlight the pertinent points of previous testimony given by CIMA and individual CIMA members at the EPA hearings in Atlanta and San Francisco.

Generally speaking, manufacturers of construction equipment acknowledge the fact that many of their products are noisy. Previous testimony has pointed out the extremes of variability involving sizes and types of machines, mounted tools, machine groupings and job site conditions -- all having a major bearing on the noise level of a specific job site. Obviously, although a construction machine does contribute to the noise impact of a construction job on the nearby community, it should not be singled out from the total construction process.

It might well be asked why construction sites are usually noisy and why so little has been done to alleviate this situation. A review

of a Department of Commerce publication entitled, "The Noise Around Us",[1] makes the point that up until now "There is no mechanism for measuring the value of the absence of noise nor is there any way a producer can be charged for using a portion of the quiet environment". Construction contractors have not been motivated to engage in research for methods to reduce noise and have not asked manufacturers for quieter machines. Thus, the machinery manufacturers have not in the past concentrated their research efforts on noise reduction for their products but, instead, have developed machines to respond to user requirements for increased productivity and lower costs per unit of work output.

Unfortunately, the current state of this relatively new art doesn't offer ready solutions to major noise reductions for most construction machines. There doesn't seem to be any imminent technical breakthrough which can overcome the problem. Previous testimony has demonstrated that noise reduction is a step-by-step process of analyzing each noise producing element of a machine and reducing it to a level which is below the dB(A) level of other sound-producing components. It is an expensive and time consuming process. One company in earlier testimony has indicated that in general, modifications to new machines currently being manufactured could reduce noise output from 3 to 8 dB(A) at a cost penalty of 1 to 3 percent with a development time of two years. An additional 3 to 6 dB(A) reduction could be achieved at a cost penalty of 10 to 25 percent and be accomplished over a period of 5 years. These figures are only estimates but they emphasize the

(1) See Attachment Reference 1

additional costs of construction if overall stringent noise levels are applied to all construction machines regardless of how or where they are used.

In various studies of environmental noise, emphasis is primarily given to urban areas of high population density. Demolition and construction have in many of these locations become almost a continuous process. This is in contrast to highway and civil works construction projects which, when completed, are utilized for many years without new projects being undertaken nearby. In these latter cases, the projects are completed and the crew moves on. The noise in one specific location is of a temporary or transitory nature and it usually occurs in a rural or unpopulated area. If the population density exposure and the time exposure were comparable, then regulations could also be justifiably comparable.

A review of Bureau of Labor statistics information reveals that there is a substantial difference in the expenditures for machinery used for buildings (1 to 2 percent of project cost) compared to the machinery used on highways (12 percent) and civil works -- land (20 percent).(2) It can easily be seen that increases in machinery cost will be reflected to a much greater extent in project costs on large rural earthmoving jobs rather than on building projects. In other words, the cost/effectiveness ratio of noise reduction is far better in urban areas. It would therefore seem appropriate that current efforts of noise reduction on construction equipment be initially limited to urban site construction.

(2) See Attachment Reference 2

It is interesting to note that government, i.e., Federal, State and Local, is the largest customer of the construction industry. In a Conference Board article entitled, "Economics of the Construction Industry," the author states -- "the share of public construction in total construction has increased from 22 percent in 1945 to 34 percent in 1967. It is generally believed that this trend will continue". (3)

On a trial basis it would appear that the Federal Government, through EPA, is in the best position to initiate pilot cost studies. On certain selected contracts, the Government could specify maximum noise levels for the construction site. Separate accounting could be established to determine the costs, record the techniques used to limit noise radiation and note compliance difficulties. This approach would provide some preliminary data that would indicate the range of costs that could be expected in order to achieve a quieter environment.

We believe that the pilot program approach will accentuate the complexities of the total problem and forestall a crash "band-aid" solution in deference to a systematic R & D program that will offer the opportunity to evaluate the major relevant factors and the additional economic burden on the public for noise abatement. It also could provide some guidelines or parameters of tolerable annoyance levels that the public is willing to accept. As stated in previous testimony, the Construction Industry Manufacturers Association and its member companies offer our services and strongly urge that we be given the opportunity to participate fully in the area of our particular expertise. We believe that only by involving all interested segments of the construction

(3) See Attachment Reference 3

industry, the public, and the government, can full consideration of research and test data, safety factors, economic reasonableness and technological practicability, be incorporated in drawing up future regulations.

We believe major points made in previous testimony warrant a synopsized treatment at this final public EPA hearing prior to submission of recommendation for legislation to the President and Congress.

1. Member companies are working on machine noise reduction now and are faced with the necessity of pushing the threshold of the art onto new technological ground.

2. In response to CIMA Performance Standards action, various Standard writing bodies, including SAE, are working diligently on establishing uniform, definitive and repeatable noise measurement Standards. Such Standards utilize the widely used and accepted noise measurement unit of dB(A) and our industry is conducting its research and development accordingly.(4) We strongly oppose reported current efforts by some noise technicians to develop a different scale. Such action could seriously delay the noise abatement effort by causing several years of noise measurement to be re-studied.

3. Our member companies generally do not oppose realistic individual noise limits for selected machines measured under

(4) See Attachment Reference 4

standardized conditions and test methods to give the repeatable results necessary for any certification or labeling requirement.

4. Our member companies do not oppose individual machine noise output labeling. However, we do not think that labeling requirements should be applicable to export shipments until such time as this may become a requirement for all manufacturers on an international basis.

5. CIMA strongly recommends that standard measurement methods, maximum dB(A) levels for individual machines, and labeling requirements have national uniformity for the reasons outlined in previous testimony.

6. Our members generally believe that national noise limit Standards could apply to selected individual machines, but control of the total job site noise impact on the adjacent community should be a State and/or Local Government prerogative

The Construction Industry Manufacturers ASsociation is most pleased to have had this opportunity to testify at these national EPA noise hearings. We support the obvious and laudable intent of EPA to approach the complex problem of noise abatement on the basis of all available information and facts -- and to replace possible "panic" legislation and regulation with constructive planning that reflects the capabilities and total needs of our society.

A UNITED STATES DEPARTMENT OF COMMERCE PUBLICATION

The Noise Around Us

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7. The Economics of Noise Abatement and Control

Noise is a form of environmental pollution, analogous to air and water pollution. Like these other forms of pollution it has economic dimensions, both with respect to generation and to abatement and control. Noise has some similarities with other forms of environmental pollution, but also some important differences. Noise pollution is like air and water pollution in that it arises as a by-product of important and desirable social and economic functions and processes. However, it is unlike these other forms of pollution in important ways:

-- Unless the producing process continues, noise dies out rapidly;

-- Noise generally dies away rapidly as one's distance from its source increases.

These two properties of noise -- that it dies out rapidly with time and with distance -- make noise much more of a local problem than other forms of pollution. Only in our great cities, where tens of thousands of local noise problems coalesce into a large continuous mass, does the noise problem begin to betray the wide-area properties that we associate, for example, with air pollution.

These two properties play key roles in determining how we must design our responses to the noise problem, and they are important factors in the economics of noise generation, abatement, and control.

7.1. An Economic View of Noise

Most of the noise that we are subjected to today emanates from final products, or is emitted in the process of producing final goods and services. It is an unfortunate fact of life that it generally would cost the producer of products, goods, and services more to give these end items quieter properties, or to produce them in a quieter manner.

If we assume an economy in which price competition plays a central role, and in which profit maximization is an important goal for a firm, then the firm's products and

services must be produced as inexpensively as possible (given a fixed quality level) in order to obtain wide acceptance in the marketplace. A simple corollary is that features without marginal value in the marketplace will be omitted, even if their production cost is low -- and such features often include quieting ones.

There is, in an economic sense, no noise problem if the costs of the emitted noise are kept internal to the person or firm that produces them -- there is no problem until an outside third party is affected. For example, if a firm has a noisy production process, and labor considers such an environment to be a health hazard, then the firm will have to pay higher wages to attract men to work in the noisy areas. Similarly, it will have to bear the costs of any decreased worker productivity that may occur due to the noise level.

A process whereby a firm "pays" for the noise it emits is known as "internalizing the costs" of noise. If the firm finds this noisy process to be the most profitable one after the noise costs are taken into account, then it is behaving in an economically logical manner when it produces noise as a by-product. Similarly, a housewife who buys a noisy product rather than a quiet one of the same type is internalizing her costs if she is aware of the annoyance the product may cause her, yet still decides to accept it.

The economic problem of noise arises when people not involved in the noise-producing activity or process are affected by it. In such cases, costs -- known as social costs -- are imposed on others, who have nothing to do with the production of the noise, and who are not compensated for the increased health hazard or annoyance to which they are subjected. When this situation occurs, an "external diseconomy" is said to exist. This inevitably leads to unfair situations: Benefits and costs do not accrue properly to whom they should, and our free market system does not adequately impute pollution costs to the producer; they are borne by the public as social costs.

Consider the case of the resident whose home is next to a construction site where numerous jackhammers, pile

drivers, and air compressors are in use. All the benefits of being able to perform the construction in the most profitable way (i.e., noisily) accrue to the construction firm, but only the private internal costs of construction are paid by the firm. All the social costs of the resident's inability to sleep, concentrate, or carry on a normal conversation accrue to the unfortunate homeowner, not to the construction firm. The resident must, in effect, "pay" for the firm's freedom to emit noise pollution.

Whenever a factor input closely associated with a production or service process is under- or overvalued, the market's pricing system, which normally allocates resources in an efficient manner, does not function properly. To apply this concept to the case of noise pollution, we need only recognize that the normally quiet environment is one of the natural resources used up in a noisy production or service process. Thus, society tolerates as much noise pollution as it does today because its attitudes, and resulting market processes, undervalue the quiet environment.

In the market as it exists now there is no mechanism for measuring the value of the absence of noise, nor is there any way a producer can be charged for using up a portion of the quiet environment. As a result, a quiet environment is considered to be a free good, and more of it is used in a production process than is economically desirable, since the resource price of silence is undervalued. Private costs become less than social costs in this case, and the resource is used wastefully. Consequently, more noise is emitted than is desirable from society's point of view, since the market does not adequately impose pollution costs on the producer.

The market distortion does not stop here, though. If a good or service is produced in a noisy fashion, the final selling price is lower than it should be because the true values of the inputs that went into the production process have not all been paid for by the firm (since silence was undervalued the firm did not have to pay for its use). Thus, the price of the good or service is lower than it should be, and does not represent the full cost to

society of all the inputs that went into its production. Consequently, more of the good or service is produced and sold than is economically efficient -- once again with benefits and costs not accruing properly. Purchasers or users benefit by paying a reduced price, but the costs accrue to those affected by the noise emitted in the production and use processes.

Finally, the consumption of noise abatement can be both individual and collective; that is, once produced, quiet is available to everyone to consume without charge -- a classic problem of market failure. Some consumers thus can benefit from noise abatement financed by others, and are not motivated to pay for abatement on their own.

Since economic considerations occupy a central place in the noise pollution problem, solutions that make appropriate use of economic forces are more likely to be easy to implement and have more far-reaching and lasting effects than those which conflict with these forces -- even though it seems unlikely that the problem can be solved entirely through the traditional workings of the marketplace.

Economics of the Construction Industry

Reference 2

By

Peter J. Cassimatis

Associate Professor of Economics

Fairleigh Dickinson University

THE CONFERENCE BOARD

Studies in Business Economics

Number One Hundred and Eleven

Materials Requirements

The inputs of materials and equipment in construction activity are even greater than the inputs of on-site employment. A measure of inputs is provided by the distribution of the factor costs of major types of construction using BLS data (Table D4).

It can be seen that, for every $1,000 of new construction, about $300 are expended on wages for construction workers, $500 on materials and equipment, and $200 on overhead and profit.

Differences in materials requirements for the various types of construction reflect the cost of materials of construction or structural components. For example, civil work projects such as dams, tunnels, and ports require large amounts of mass-produced materials such as concrete, steel, asphalt. Building construction requires relatively many types of materials but in small quantities.

Table D4: Per Cent Distribution of Factor Costs of Selected Types of Construction

Type of Construction	On-site Wages	Materials and Supplies	Equipment Rental or Depreciation	Overhead and Profit
Single houses	22.0	47.0	1.0	29.0
Public housing	35.5	45.0	2.5	17.0
College housing	29.3	52.6	1.6	16.5
Highways	23.9	50.6	12.0	13.5
Schools	25.7	54.1	1.4	18.8
Hospitals	28.8	53.3	1.1	16.8
Office buildings	29.0	51.3	1.9	17.8
Civil works — land	25.0	35.0	20.0	20.0
Civil works — dredging	32.5	17.5	25.0	25.0

Source: Calculated from data published by the Bureau of Labor Statistics, Bulletin Nos. 1299, 1331, 1340, 1362, 1390, 1402, 1404, 1441, 1490.

Equipment costs are relatively a small portion of construction activity, except for highways and civil works. These two types of construction involve moving equipment of huge size for earthwork and lifting of heavy materials.

Although construction requires a very large number of materials or fabricated products, on the average 80% of these were accounted for by five types: stone and clay products, 28%; lumber products, 10%; metal products, 25%; plumbing and heating, 15%; electrical products, 10%.

The above distribution of materials also suggests the type of labor, i.e., craft skills, required for major types of construction. A breakdown of the man-hours on-site shows that four trades – masons, carpenters, plumbers, and electricians – perform the bulk of construction work, and receive two thirds of on-site wages.

Reference 3

Economics of the Construction Industry

By

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THE NATURE OF CONSTRUCTION

Construction is an ubiquitous activity. In general, "construction" refers to all types of construction activity usually associated with the erection and repairs of immobile structures and facilities, such as buildings of all types, highways and streets, ports and airports, dams and conservation projects, railroad lines and canals, and other similar types of work.[1]

"Contract construction," however, refers to an industry consisting of a large number of firms that perform construction work for others. Consequently, statistics of construction are often misinterpreted because some statistical series refer to the contract construction industry and others to construction activity.

PLACE OF INDUSTRY IN THE ECONOMY

Size of the Industry

Construction activity in the United States totaled $100 billion in 1967, or about 13% of the GNP. New construction put in place accounted for $76 billion; the remaining $24 billion was expended on maintenance and repairs. The contract construction industry's total business receipts are currently estimated at $90 billion.[2] (Chart 2.1).

The share of the contract construction industry is said to range from between 85% and 90% of all construction activity.

The remaining 10% to 15% of construction is referred to as force-account construction, and it is performed by the owners of the structures utilizing their own labor (i.e., do-it-yourself construction). Since the contract construction industry has business receipts equal to 10% of GNP, it is obviously one of the crucial sectors of the economy, both in terms of private enterprise and government planning.

[1] Mobile homes and travel trailer construction are not included in construction because they are products of manufacturing.

GOVERNMENT SPENDING

The government plays a significant, if not dominant, role in construction activity.

During expansion, the rise in government construction expenditures seems to coincide with increased activity in the private sector. In time of recession, government activity nearly always exceeds the construction generated by all others. As market conditions ease and commercial bank credit is more readily available, first the residential construction and then the industrial construction sectors begin to expand and once again catch up with government in both outlays and physical output.[9]

Problems of Public Policy

Government is the largest customer of the construction industry. In 1967, $26 billion of the total construction activity was for public construction projects, representing 15% of government purchases of goods and services.[12] One third of these expenditures was for federally owned construction, the other two thirds were for state and local government construction.[13] The share of public construction in total construction has increased from 22% in 1945 to 34% in 1967.[14] It is generally believed that this trend will continue. Government is also a principal source of financing construction activity. In 1967 about 18% of all private home construction was financed by Federal Government mortgage insurance programs.[15] This dual role of government – principal purchaser of and lender to construction – exerts an enormous influence on the structure and performance of the industry.

Finally, we must consider the importance of research and development either sponsored or induced by government in order to encourage innovation and economies of scale.

[11] *Construction Review*, December, 1966, p.4.

[12] *Survey of Current Business*, "Income and Product Accounts," July, 1968, p.7.

[13] *Construction Review*, July, 1968, p. 14.

[14] Idem.

[15] U.S. Savings and Loan League, *Savings and Loan Fact Book* (Chicago: 1968), p.39.

Reference 4

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Volume II
Measurement Criterion

16. Abstract

Evaluations of the effectiveness of transportation noise abatement require the use of a measure which relates individual and community reactions to transportation noise. Previous studies were examined to determine how well various measures predicted response to noise. A-weighted Sound Level (in dBA) and Noise Pollution Level (in dBA) were examined to determine their relationships to other measures and their prediction of reaction, i.e., loudness, annoyance, noisiness.

The A-weighted sound level, on the average, correlated as well with subjective response as the other measures. Only for jet aircraft pure tones was there a significant predictive performance difference between Effective Perceived Noise Level (EPNL) and dBA, favoring EPNL. These differences were not considered important for this study since the correlations between dBA and subjective responses were generally greater than 0.90.

Average community response measures have been developed for aircraft and motor vehicle noise. Using the aircraft Noise and Number Index and motor vehicle Traffic Noise Index data, the Noise Pollution Level was shown to correlate as well with average community response as both of the measures. Since Noise Pollution Level is compatible with the use of dBA for individual vehicles, its selection as a community measure complements the choice of dBA as a vehicle measure.

17. Key Words	18. Distribution Statement
noise, transportation noise, motor vehicle noise, aircraft noise, noise pollution, noise measurement, community response, individual reaction, criterion measures	Availability is unlimited. Document may be released to the National Technical Information Service, Operations Div., Springfield, Va., 22151 for sale to the public.

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PRESENTATION TO THE OFFICE OF NOISE ABATEMENT AND CONTROL OF THE ENVIRONMENTAL PROTECTION AGENCY

Hearings in Washington, D.C. November 9 - 12, 1971

Panel representing the Rubber Manufacturers Association:

W. W. Curtiss	- Goodyear Tire & Rubber Co.
J. P. Kigin	- Rubber Manufacturers Assoc.
S. A. Lippmann	- Uniroyal Tire Company
Dr. George Thurman	- Firestone Tire & Rubber Co.
T. R. Wik	- B. F. Goodrich Tire Co.

The enclosed material and the two attachments describe the results of a variety of measurements of truck tire sounds. The conditions of measurement, the parameters adjusted, and the types of data analysis are intended to provide an insight and background for consideration of the related problems of noise control.

1. Scope

At two previous hearings of The Office of Noise Abatement and Control, the Rubber Manufacturers Association has presented evaluations of the state of knowledge pertaining to the Technology of Truck Tires as generators of sound. Those presentations emphasized the broad relationships between the properties of tires and some of the objectives of the Environmental Protection Agency. The presentations also contain judgments based on the stated relationships. The intention has been to supply an orientation so as to facilitate the agency's initial exposure in an area that is not generally understood.

The RMA recognizes that the ONAC will wish to examine data typical of that which underly the assertions and judgments offered by the RMA. Furthermore, the ONAC has a further objective of expanding the base of knowledge in those technologies that will enable a reduction in acoustical intrusions of sounds from truck tires. Here too, quantitative data are required to establish and justify a reasonable course of action.

For the reasons just stated, the RMA is submitting at this time the results of a variety of quantitative studies at the Hearing of the ONAC. The information comes from a number of member companies of the RMA.

The data are attached to the written submission in two separate forms. One of the forms is a document on Truck Tire Noise recently prepared by the RMA. This document summarizes the salient points of interest and contains typical experimental data. The other form is a packet of tables and graphs relating to these points and also to others of potential significance to the ONAC.

The data are as collected, with possible experimental errors unrationalized, as are the effects due to differences in operating conditions and testing facilities. We anticipate that the recipients of the information would rather apply their own judgments to consistency and underlying relationships.

Except where otherwise indicated, the data are taken according to the standard procedure outlined in the RMA's presentation to the ONAC in San Francisco on September 29, 1971.

In addition to placing quantitative information before the Agency, the RMA is undertaking one further objective at this time. That is to review before the Hearing the strengths and pitfalls of the dBA rating for measuring the significance of radiated truck tire sounds.

II. Review of the Data

The following is a brief review of the measurements described in the brochure and the data packet.

a. Time vs level and meter rate

Slide 1 shows the variations in instantaneous sound level as a coasting truck bearing test tires approaches and then recedes from the test location. The reference marks on the curve show the span of time-integration for slow meter response and fast response. Fast response captures the character of the peak more closely than slow response, and gives less weight to the sustained components of the sound than to the highly transient components.

b. Spectral Characteristics

Slide 2 is a typical power density spectrum for a coast test employing lug tires. For other tires,more than two peaks may occur and the number of significant peaks depends on the speed as well as on the tire. This is illustrated in Slide 3 which is a tenth octave analysis of sound pressure.

Slide 4 shows one aspect of the differences between tonal tire sounds and non-tonal. The tonal sounds persist after the sound level has passed its peak and this persistence, not the frequency content at peak, appears in general to represent the important aspect of these sounds.

There are four graphs, the upper two are spectra of a tonal tire and a non-tonal tire at the peak level. These two spectra show only slight distinctions. The lower two graphs are spectra of the same tires at about 2 seconds after the peak. The presence of tones is now in evidence in the upper of the two (not in the lower) and the distinction between tires is clear.

c. Tire Sounds Compared With Other Truck Sounds

Slide 5 illustrates the overlapping of sounds normally produced by circumferentially ribbed tires and by other components of a two axled test vehicle. There are two 1/3rd octave spectra on the slide. One is for a test which tends to minimize the vehicle sound by coasting the test vehicle past the microphone with the engine off. The other is for a similar test but with the engine running, and with special quiet tires. In terms of radiated power at the microphone,the truck sounds are thirty times (fifteen dB higher) for the combination than the tire sounds at 250 hz. As the frequency increases the relative contributions change progressively. The two sources are about equal at 630 hz (3dB higher for the combination) and at 1000 hz the truck contributes only 20% of the sound (0.8dB higher for the combination).

Slide 6 is similar data but in this instance for a tire with a typical lug design. The slide also shows a spectral curve for the vehicle coasting on the lug tires.

Here the relative contributions of the truck and tires are not progressive with increasing frequency because of the spectral peaks in the tire sounds. Up to 250 hz the truck contributes five times as much sound power as the tires (7dB difference). At 315 hz the levels equalize. From 315 hz upward, the power levels of the tire sounds are about twice that of the vehicle in the spectral valleys (3dB difference) and are about twelve times that of the vehicle at the peaks (7dB difference).

d. Influence of Tread Design

Slide 7 demonstrates the progression of changes in spectrum as the design of the treading evolves in stages from a smooth surface to meet the practical performance requirements for which it is designed.

e. Attenuation With Distance

Slide 8 is a table of typical data showing the change in A-weighted peak that accompanies variations in location of the microphone.

f. Road Surface and Tire Sound

Slide 9 illustrates the dependency of the sound level and the spectral characteristics of tire sounds on the nature of the road surface. Similar types of spectra occur on all typical road surfaces, but the spectral weighting differs.

g. The Sound Level and Speed of Travel

The table of Slide 11 demonstrates the effect of varying the load borne by the tire on the peak A-weighted level. The table contains data both for a rib and a lug tire and for concrete and asphalt surfaces. For the rib tire variations in load produce only small changes in the level. For the lug tire the change in level is again small but only for loads over 80% of rated load, but are significantly reduced at lower loads.

Data obtained for other tires than employed for Slide 11(on an asphalt surface and obtained by another testing group)differ in the indicated dependency of sound level on load at constant inflation. The level is found to increase with load. The apparent discrepancy has not been resolved. Slide 12 for these other tests show that the character of the spectrum does not change appreciably with load.

The effect of variations in inflation pressure at rated load is summarized in Slide 13. Only small differences in level are found to occur over a $\pm$ 25% change in pressure.

Data is also presented in the packet which shows that for simultaneous variations in load and pressure so as to maintain constant axle height, the sound level is insensitive to the load for variations down to 75% of the maximum rated load.

h. Detected Levels and Wheel Position

Published data indicate that rear tires on the axles of a 13 axle truck assembly are more efficient radiators of sound than the other tires. Slide 14 contains data of a test program designed to explore this indication. Smooth relatively noiseless tires are substituted for loud lug tires in various tests to establish the contribution from each of the axle locations (excluding the steering axle). The data indicate equal contributions to the peak noise level from tires at each of the axles. The tests are conducted both for asphalt and concrete surfaces.

The addition of sounds from the various axles depends among other factors on the separation in time of the tire sources as they pass the micropnone. Slide 15 shows what the totalized contributions of identical drive and rear trailer tires should be in the test. The sound level due to the drive axle tires is below its peak and contributes only moderately to the level at the time the sounds of the rear tires peak.

i. Construction Changes in the Tire

Data arealso presented showing that the 8.25-20 tire and the 10.00-20 tire in rib and lug designs(and each at their rated loads and inflation)produce about equal levels of sound. Carrying the same load on more smaller tires therefore would result in increased sound levels.

One set of experimental results illustrates the effect of tube-type and tubeless constructions. The tires are in both ribbed and lug designs and run on asphalt and concrete. There is no detectable effect due to the interchange of tube-type and tubeless constructions.

There are no definitive data as yet on the influence of radial and bias ply constructions on sound levels. Tires of these constructions and identical tread designs do not exist. However, the packet contains data for some available types in these designs.

j. Tread Wear and Sound Level

Worn tires are significantly louder than new tires. The difference depends on the design and details of wear. Both on asphalt and on concrete increases of sound level from 3dB to 6dB are in evidence. Sample data are submitted showing the effect of wear. The increase in sound level is not necessarily progressive with continued wear. The maximum levels often occur at 25 - 50% of wear.

k. Coefficient of Friction and Tire Type

The available frictional forces at the drive wheels is often a significant factor in the control of trucks under hazardous conditions (low coefficient surfaces). In general cross lug tires exhibit over 15% more braking force and driving traction under these conditions. This difference often disappears on high coefficient surfaces, but at high coefficients the advantage to be gained through the coefficient is greatly reduced.

III. Evaluation Procedure for Truck Tire Noise for Purposes of Manufacturers Certification and Technical Communications

A. General Considerations

It is common to rate the level of complex sounds after weighting the bands of the spectrum by the A-contour. This procedure roughly acknowledges the tonal sensitivity of the average person. However, it is recognized among acoustical experts that the A-scale pertains to the auditory sensitivity of sustained pure tones (not mixed transient sounds), and also does not account for physcho-acoustical factors other than sensitivity. Nevertheless, the totalized dB on the A-weighted scale does often provide a good measure of loudness and annoyance for sounds under many circumstances.

In view of this background it is desireable to establish whether the peak level measured on a sound level meter weighted by the A scale is an adequate indicator for rating truck tire noise. There are a number of factors that need to be considered in arriving at a conclusion.

For instance -

1. The ultimate objective to be served by a measuring scheme and the measurement (i.e. evaluating community disturbance and/or the peak radiated levels).

2. The consistency of the rating with other measurements with which it is to be used (i.e. - to predict along with other vehicle sounds, the total sound level radiated by vehicles).

3. Whether the measurement is overly restrictive of factors not involved in the usage of the measurement, due to an artifact of its makeup (i.e. - does it also measure and weigh sounds not contributing to the usage of the measurement).

4. Whether the measurement is properly sensitive to those factors requiring quantitative identification.

5. The practicality of the measuring scheme in the operations of industry and governmental agencies.

B. Objectives

It has been our general experience that there are two separate aspects to the ultimate objectives to be served by the rating for truck-tire noise. One is to measure, communicate, and to assist in the control of the tire's contribution to the total sound levels radiating from vehicles (however measured). Another is to measure, communicate, and control the intrusion of tire sounds into roadside communities.

The second objective differs from the first in that the level of tonal characteristics rather than the total level often is the more pertinent factor.

C. Consistency of Rating Procedures for Truck Tires and for the Mechanical Noises of Trucks

The peak sounds from trucks are currently rated on the A scale using a fast meter response. As shown in the preceeding material, peak tire sounds (A-weighted) correlate best against jury data at a slow meter response. This has been interpreted to signify that the tonal content is somewhat better accounted for by the slow response because of the longer duration of tones than the remainder of the spectrum detected at the peak.Consequently, we do not now have a single consistent measure that encompasses both the need for a tire rating that is directly additive to the rating for mechanical sounds, and that simultaneously detects the intrusion properties of tire sounds.

Perhaps a dual rating scheme, or a compromise scheme might be found to serve both purposes.

It should be pointed out that the jury data that substantiated the utility of slow response was obtained with a small number of similar commercial designs and because of the limited range of spectral types does not adequately test the human reaction to tire noises.

D. Over-Restrictions due to Artifacts and Appropriateness

If the A-weighted level at fast response were to be used for tires, a situation might well develop that penalizes desireable sound spectra of tires to the advantage of undesireable spectra. Tonal concentrations at moderate levels from careless manufacturers would be rated equal to a more distributed spectrum (arrived at through the application of expertise and diligence). Controlling agencies would probably be tempted to lower the acceptance levels to restrict the spectrum of the poorly designed tire. This in turn would disqualify acceptable tires, and might well interfere with the engineering compromises for arriving at desireable spectra.

The same considerations apply to A-weighting at slow response, but perhaps are less severe than at fast response.

E. Practicality of Various Measures of Sound Level

Since, as indicated in previous testimony, we are concerned here with a manufacturer's certification of tire sounds, the question of data handling and sound analysis do not bear on the practicality of arriving at a measurement. Once the sound tapes are processed for spectral content, a computer can carry out simple and complex manipulations of the data leading to the composite evaluation.

F. Proposals for Measures of Truck Tire Noise

1. Despite the errors indicated in summing the various measures of tire sound with those of the vehicle sound (to attain the total level) on theoretical grounds there appears to be a reasonable utility to the dB(A) slow meter rate measurement. This measurement is integrated over a one second time span and therefore should emphasize overlapping in time (required for additivity) of vehicle and tire sounds to a greater extent than the fast rate measurement. The RMA feels that for the present the slow rate, A-weighted measurement might well serve the purpose for evaluating contributions to the peak levels of truck-tire combinations.

2. The tonal characteristics, that in the long run might be the matter of major concern, are currently being investigated in considerable depth by the industry. Several ideas have been proposed but are yet not resolved.

   A-weighting of the spectra appeared desireable. The sound evaluated probably should correspond to that which occurs about six seconds after the peak level. The A-weighted spectrum should probably be further weighed for spectral concentrations which deviate from the average energy level. The spectral detail needed (octave , 1/3rd octave, 1/10th octave), is not clear at this point. and also has to be resolved.

IV. Possible Programs for the ONAC

The disparity between the present state of knowledge and ultimate objectives offers opportunities for the ONAC to supplement the actions of industry, the professional societies and other governmental agencies in the work on truck tire sounds.

While fully appreciating the ability of the ONAC to formulate such programs from available data, the RMA nevertheless hopes that its suggestions might be of value to the agency. The following are some suggested possibilities:

1. Define the standard road surface.
2. Define the standard worn tire.
3. Evaluate the importance of tonality of tire sounds to the objectives of the ONAC.
4. Determine the most suitable measure and the procedure for adding tire sound to truck sound for totalizing.

STATEMENT BY DORN C. McGRATH, JR., AIP, PRESIDENT, AMERICAN INSTITUTE OF PLANNERS, BEFORE THE SPECIAL PANEL OF THE OFFICE OF NOISE ABATEMENT AND CONTROL, ENVIRONMENTAL PROTECTION AGENCY, ON ENVIRONMENTAL NOISE ABATEMENT AND CONTROL, WASHINGTON, D. C., NOVEMBER 12, 1971

Mr. Chairman, Members of the Committee -

I am Dorn C. McGrath, President of the American Institute of Planners. The AIP is a national professional society, devoted to the study and advancement of the art and science of city, regional, state, and federal comprehensive planning. The principal concern of the Institute is the planning of the unified development of urban communities and their environs and of states, regions, and the nation.

The nearly 7,000 members of the Institute have major responsibilities in government and the private industry as consultants in the development of programs, policies and projects plans to guide processes of urban gorwth and change throughout the United States. The work of professional planners is directly concerned with the quality of the nation's urban environment. Many planners are responsible for translating legislative goals concerning environmental quality into specific project development decisions exercised through the governmental institutions of land use planning and regulation. In addition, many professional planners are involved in the process of transportation system planning and in the formulation of performance standards and environmental protection criteria which such systems increasingly require.

On behalf of the members of the Institute, I want to thank the Office of Noise Abatement and Control for the opportunity to appear and present our views on the issues and problems which EPA must face in fulfilling its obligations pursuant to the Noise Pollution and Abatement Act of 1970.

My remarks today will be directed principally to the central theme of national programs affecting environmental noise control as they may be applied in both preventive and remedial actions to deal with problems of environmental noise exposure through the comprehensive planning process. I would like to emphasize applications of urban planning techniques and programs for the alleviation of environmental noise associated with transportation sources and particularly those associated with highways and airports. Noise from the myriad fixed sources that comprise metropolitan areas represents a collective problem of rising ambient noise levels in cities; however, there is sufficient authority under the police power to control the great majority of these sources through zoning and ad hoc noise ordinances once the problem is perceived in its true perspective by units of local government.

Land Use Planning and Noise Abatement

Land use planning can be a principal tool of environmental noise abatement and control. The insulating effect of sheer distance from sources of high noise output is the most reliable protection for the majority of people in urban areas against the intrusion of noise from powerful sources such as jet aircraft and vehicles moving at high speeds on expressways.

The key to providing the insulating benefits of distance lies in a planning process that comprehends the projected effects and areal extent of noise from these major modes of transportation and which provides accordingly for the separation of land uses sensitive to noise from such facilities as airports, expressways, and truck terminals. Obviously, it is not always possible to provide the protection of sheer distance against environmental noise from aviation or highway transport sources, and compromises must be

made which bring noise sensitive land uses and noise generators too close together. Under such circumstances, acoustical treatment of structures may afford a measure of relief. Prescribing needed acoustical treatment for housing and schools is not within the authority of most comprehensive planning agencies, but the advisability, or, as in the case of schools, churches, and other facilities where freedom from noise intrusion has premium value, the necessity for such treatment is well understood by most planning agencies. Unfortunately, there is a substantial gap between the recommendations of planning agencies for either land use planning or acoustical treatment of established facilities and the implementation of such recommendations through the normal political process. The result of this failure in the translation of planning recommendations into public policy in the form of zoning or building code requirements through the local legislative process is serious environmental degradation near many metropolitan airports and expressways.

Four factors have hindered the realization of the potential benefits of land use planning as a primary tool for preventing the emergence and aggravation of noise exposure problems:

1) The rapid advance of aviation technology during the 1960's, with the introduction and widespread use of jet aircraft at airports never designed to provide the benefits of sheer distance from neighboring land use as a safeguard against noise exposure; as a result the zones of severe noise exposure near most major U. S. airports are typically three to four times greater in acreage than the airports themselves.
2) Ignorance of the psychological and physiological effects of continued exposure to transportation noise in the environment

has retarded the development of land use restrictions against noise exposure as a matter of public health, safety and welfare.

3) Political expediency in approving requests for intensified land usage in the noise exposure zones of airports in pursuit of short-term revenue gains without regard for the costs of long-term environmental deterioration.

4) The absence of any concept of reciprocal limits on the growth of the noise exposure zones associated with airports and the patterns of growth of land uses incompatible with aircraft noise; as a result, the zones of severe noise exposure around most major airports continue to expand as a function of increasing air traffic (primarily jet aircraft), and at the same time community growth (primarily residential) intensifies in the areas subject to noise exposure.

The combination of these factors throughout the country has resulted in costly restrictions on airport operations, extensive litigation against airports to recover the losses of property value attributable to noise exposure, and substantial interference with many essential activities of people who happen to live near airports. In a somewhat lesser degree, the same problems have arisen in the vicinity of urban expressways, even though the levels of noise produced by automotive traffic are not as punishing as those produced by airport operations.

The slow growth of comprehensive land use planning, even where assisted by Federal grant-in-aid programs, has imposed costly penalties on the nation's metropolitan areas. In most such areas, critical gaps in the comprehensive planning process have aggravated the problem of developing

compatible land use patterns which would minimize or eliminate environmental noise exposure problems.

Planning for individual airports, which airport operators usually do, and planning for the development of surrounding communities, which is always done by others, both require open and direct consideration of aircraft noise as a potential environmental problem. Unfortunately, in most areas, neither planning for airports nor planning for nearby communities reflects adequate recognition of the noise factor. Absent adequate planning--which would include projection and evaluation of noise effects before airport construction or intensification of airport use--even the most enlightened public policy-making process in pursuit of compatible land usage, airport expansion, or overall environmental quality goals, is rendered ineffective. There is, however, little evidence to suggest that realistic estimates of aircraft noise projected beyond airport boundaries affected either public policy for metropolitan land use or airport expansion plans until the jet age was well advanced.

The evidence in fact suggests the opposite. The majority of the airports comprising the country's most popular major hubs are almost hopelessly hemmed in by communities to whom the airports pose a serious environmental threat. A study of 21 Large Hubs conducted by the Department of Housing and Urban Development in 1967 revealed that of the 36 air carrier airports within the hubs, 12 are almost completely surrounded by intensive development and 16 others are at least 50% encircled. The plight of these airports is underscored by the fact that half of the 36 are located within 10 miles of the Central Business Districts of the major cities they serve; this means that while they enjoy special advantages of in-town accessibility, they also suffer

from having higher land values as a constraint to expansion. Moreover, by 1980, an increase of 143% in scheduled air carrier operations is expected for all of the 21 Large Hubs studied. There is a strong correlation between increased air traffic volumes and community consciousness of the airport itself, and thus, as air traffic intensifies at an encircled airport, the noose of community objections within which it must operate draws tighter every year. This fact only increases the urgency of developing other airports in all of the Large Hub metropolitan areas. It also dictates the need to accept the new realities of aircraft noise in locating and developing other airports of any size to create a system of interdependent facilities for aviation in each metropolitan area. Failure to accept the known realities of environmental noise impact for each new airport in a metropolitan area can only cause a proliferation of the current "hard core" noise problems characteristic of most of the hubs in the national system. Instead of being relieved by the establishment of alternate and reliever airports systematically related to major hubs, the current noise problems may instead simply be reproduced in suburban communities already hostile to airport environmental impact.

Major problems of environmental pollution by aircraft noise are now in clear prospect in the suburban areas surrounding airports serving Atlanta, St. Louis, Phoenix, Chicago, and San Francisco, to name but a few. In some localities, such as West Palm Beach and St. Louis, there is evidence that more land has been developed for suburban residential use in noisy locations since 1950 than the acreage occupied by the principal airports serving those cities. By ignoring both the noise-control potential areas, citizens in these airport-affected areas are gambling with the quality of their basic environment, not to mention their prospective investment return.

Elsewhere there are more encouraging signs that environmental considerations in airport and community development planning are being recognized and applied beneficially. Since 1967, the North Central Texas Region, centered on Dallas and Forth Worth and including both cities and nearly two dozen fiercely independent separate municipalities, has been engaged in an unprecedented joint venture to plan and build the largest airport in the world. As a major departure from conventional airport planning practice, the cities of the Region have faced the reality of jet noise squarely at the outset and applied their strongest natural resource--open space--to the problems that aircraft noise creates. The decision to acquire sufficient land for the airport to keep potentially incompatible adjacent development at a safe distance resulted in a basic site requirement of 29 sq miles.[1] As a further departure from tradition, the regional community of North Central Texas has organized a program of integrative planning functions for airport development in collaboration with those for all of the surrounding separate but interdependent communities. Through a program of information-sharing and joint participation in zoning and highway and utilities planning, the Regional Airport and its neighboring communities have been able to achieve synergistic results from their efforts.

Pressing their natural advantage of having open buildable land, the communities of the North Central Texas Region have adopted and are carrying out a strategy of land use designed to hold open for future development land in several municipalities lying within a mile of the 16,500-acre new Regional Airport. Zoning to conserve such land for actual use in the 1970's will afford an even greater degree of protection against noise for both the airport and its associated communities, but will not deprive individual owners of

development opportunities for appropriate land usage.

Action to capitalize on aviation growth and to preserve future options for development has not been restricted to the major cities, however. In Salina, N. Y., where the town has a long-term interest in the viability of the nearby Clarence E. Hancock Airport serving the Syracuse metropolitan area, the Town Board took the initiative in 1967 to adopt a comprehensive land use plan designed to maintain compatibility between town and airport in the airport environs. Acting in the interests of a metropolitan public, the Town Planning Board and the Onondaga County Department of Planning developed the following goals in relation to the town for the airport vicinity:

"To discourage, within the airport noise zone, the construction of residential structures, etc., that cannot be sufficiently insulated against externally generated aircraft noise, at a reasonable cost;

To recommend and adopt a comprehensive land use plan for that portion of the Town of Salina within the Aircraft Noise Zone, which would: (1) permit the owners of vacant parcels of land to develop their properties with uses that would be compatible with aircraft noise, and surrounding land uses; and (2) provide land uses and physical buffers for the protection and preservation of existing established residential neighborhoods; ..."[2]

The action of the town in adopting these goals stands as an especially significant contribution to the continuation of nuisance-free operations at the airport, particularly since more than 2,000 acres of potentially buildable land in municipality is affected by this policy decision.

On an even more precise scale of development, with profound implications for local development policy, are several recent court decisions involving airport-related zoning. In Santa Barbara County in California, rezoning

designed to prevent urban sprawl and to forestall the development of a residential zone in areas susceptible to excessive noise was upheld on appeal.[3] In Pennsylvania, the right of a municipality to establish legislative policy for regulating development potentially inimical to the utility of an airport was upheld: the court affirmed the right of the township to prohibit residential dwelling units in industrial as well as airport districts even though the result was that residents' uses were exccluded from 85% of the township's 30 sq miles.[4] Such definitive actions, while hardly typical of local urban development policy of the 1960's, must be recognized as essential to the realization of the potential benefits of the rapidly rising national trends in aviation growth and productivity.

Mechanisms are now available in most metropolitan areas to bring the present and future problems of environmental noise from aircraft into public perspective and to encourage the use of preventive measures. Congressional concern about trends in development problems in metropolitan areas resulted in the enactment in 1966 of legislation requiring referral of grant applications for a wide range of public facilities to a metropolitan agency for planning review and comment prior to funding.[5] This was done to insure that maximum benefits, including the implementation of area-wide plans for development, might be achieved. More than 200 metropolitan areas across the United States now have such referral agencies. Proposals for major public facility construction, including airports, highways, water and sewer facilities, open-space land acquisition and conservation area development, are affected by this metropolitan referral and review requirement. As a result, it is possible to bring to bear the perspective of an official areawide agency and to give consideration to problems and development proposals that may have both broad

and specific implications for land use, environmental quality, and development policy. In addition, the Bureau of the Budget initiated a system of project referral and review at the state, regional, and metropolitan levels.[6] The system is designed to marshall informational resources and promote coordination among development planning agencies throughout the country.

The project notification and review system created by this executive action provides a vehicle for making advance evaluative judgments on over 100 different types of projects having potential to affect the quality of both social and physical environments in urban and rural areas, including the troublesome suburban fringe. The mere existence of this administrative machinery provides no automatic assurance that it will be used effectively. It remains for the localities to put these metropolitan referral and review systems to work to enlarge public understanding of specific functional and environmental problems of urban areas and to implement local and areawide land development policy. The support of the Environmental Protection Agency can be an important incentive to these areawide planning agencies and localities to apply noise abatement criteria in their project review and comprehensive planning activities.

The pollution of the metropolitan environment by aircraft noise is an emergent problem for most major cities, and in this fact lie both challenges and opportunities for comprehensive land use planning to make a significant contribution to the nation's evolving air transportation systems. Having ignored the realities of noise exposure in transportation planning for many years, the Federal government and local agencies are now faced with needs to provide remedies for several hundred thousand urban dwellers whose homes are no longer satisfactory havens of peace and quiet. Moreover, many localities are enjoying a completely false sense of security about what their present

zoning and building regulations can do to protect their homes and schools from noise and thus prevent their coming into conflict with their own airports.

Comprehensive land use planning, if carried on at the appropriate metropolitan scale, affords a means of dealing with these growing problems of urban environmental noise.

The growing fund of experience with airport noise problems should make it clear that new community development, especially for housing and schools, in areas of projected noise exposure should be deferred until current research on engines gives real promise of quieter planes. It is always easier to rezone to increase population density, and to build schools, hospitals, and houses after the noise climate has been tested, than to remove people who object to noise, to pay them for damages, or to insulate their homes to remedy a foreseeable problem.

In previous years, effective land use planning to prevent serious noise exposure problems in communities near airports has been handicapped by official reluctance to admit the disparity between airport acreage and the noise zones that planes project, by a lack of knowledge of the noise levels generated by different types of aircraft and the noise distribution patterns associated with varying airport operations, and by a tendency to gamble on the nature of community response to be expected under several degrees of noise exposure. Information on all of these factors is available now, however, as is a rational method for predicting aircraft noise as a function of future airport operations. Federal leadership to apply this information is needed.

Mr. Chairman, I appreciate this opportunity to appear before your panel in behalf of the American Institute of Planners. We would be pleased to

provide your Agency any additional information or assistance that you might require to develop and apply the process and institutions of comprehensive planning to the abatement of environmental noise pollution.

* * *

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I. Introduction

Mr. Chairman, members of the Panel.

My name is Franklin M. Kreml. I am president of the Automobile Manufacturers Association. The AMA is the national trade association of manufacturers of trucks and passenger motor vehicles in this country. We welcome the opportunity to appear today. AMA is in accord with the intent of these hearings and we offer our full cooperation in gathering information for your report to the President and Congress.

Since this is the concluding session in your series of public hearings I would like to summarize, very briefly, some of the more significant positions expressed by AMA member companies at this, and previous hearings.

Following the summary of company testimony I will introduce material which will suggest a strategy for reduction of annoyance to the public by motor vehicle traffic noise, and will address remarks to the subjects of technology and economics of noise control which are the prime topics of this hearing.

II. Summary of AMA Member Company Testimony

At previous hearings conducted by the EPA Office of Noise Abatement and Control and in other public statements, various AMA member companies have provided extensive testimony and technical data. Of course, there are antitrust constraints on AMA discussion of competitive aspects of vehicle noise control. Therefore, I am presenting a summary of points made by individual companies at previous hearings. Points made by any one company cannot, of course, be imputed to other companies. The points made are as follows:

A. The technology exists for moderate reduction of vehicle noise levels using present design concepts.[1]

B. There would be an as-yet undetermined product cost increase associated with these reductions.[2]

C. Noise standards sufficiently stringent to require substantial redesign of trucks would involve significant increases in vehicle cost and reductions in load carrying efficiency.[3] 1.5%

D. Uniform national standards are needed to eliminate unnecessary burdens which result from conflicting state standards.[4]

E. Federal preemption of standards-making authority is necessary for orderly and efficient interstate commerce.[5]

F. Motor vehicle noise control standards must be compatible with the stringent constraints imposed on vehicle design and construction by Federal safety and emissions standards.[6]

G. Research is needed in some aspects of vehicle noise reduction and noise testing technology.[7]

III. A Strategy for Reduction of Annoyance Caused by Motor Vehicle Noise

Since the object of motor vehicle noise control is to minimize annoyance to the public, the AMA recently commissioned a major study[8] to define what aspects of motor vehicle operation are most annoying to people. The study was intended to establish guidelines to needed areas of acoustical improvement of vehicles by manufacturers. The results of the study suggest an approach to diminishing the noise impact of motor vehicle traffic.

Some of the findings of the study are:

A. To reduce annoyance from motor vehicles most rapidly, the noise from vehicles that cause peaks above background levels should be reduced, because it is the occasional noise excursion that produces most complaints.

B. In the majority of cases where people expressed annoyance at a specific vehicle noise event they felt that it was a situation the driver could control such as tire squeal, hot rodding, and similar operations.

C. Annoying noise sources are relatively close to the auditor, e.g., 70 percent of the exposures described as annoying were within one hundred feet of the noise source.

D. Most people who express annoyance indicate that they are at home when the annoyance occurs and it is generally in the evening.

These are only a few of the findings of the study but they have particular interest in terms of their application to noise annoyance reduction programs.

First, the assertion that peak noise levels are major contributors to annoyance is not to imply that reduction of an excessively high overall background level would not be a worthwhile objective. It is intended to show that the most cost-effective means of reducing annoyance is to start with Federal standards that restrict the noise output of known sources that exceed the ambient level significantly. These include motorcycles, buses, sports cars, large trucks, poorly maintained vehicles and any mechanical device whose noise output is noticeably above the general background level.

Second, the fact that people are annoyed by situations that are controllable by the operator suggests that local control of vehicle operation is necessary regardless of specifications for vehicle construction. Reckless driving, speeding, "reving the engines," and modification of exhaust systems are amenable to local control only.

Preparation of model ordinances for the guidance of local communities, and development of simple, effective techniques which can be used by state and local officials to apprehend and convict violators are constructive actions that should be undertaken by the Office of Noise Abatement and Control.

Third, the fact that people are annoyed by those noise sources that are relatively near them suggests that land use policy might be a highly effective tool in dealing with objectionable noise. Freeways and other major traffic routes should be planned with noise criteria taken into account. As indicated above, relatively short changes in distances or spacing might have a considerable impact on reduction of annoyance. This is particularly important when dealing with high speed traffic routes where tire noise is prominent, because of serious technical problems in the reduction of tire noise.

And finally, if people are most concerned with noise annoyance in their home neighborhoods, and particularly in the evening, traffic routes for particular types of noisy vehicles should be specified. Ordinances covering the operation of all vehicles in residential areas could be established, taking the hour of operation into particular account. The quality of the environment in the neighborhood of our homes should be a primary consideration in controlling noise.

The foregoing is, I submit, a broad outline of a program that if implemented would significantly improve the noise environment.

IV. Technology and Economics of Noise Reduction

Modification of motor vehicles to improve their acoustical characteristics and to comply with regulations has been a competitive issue among individual manufacturers. AMA does not have knowledge on costs or plans of individual manufacturers, hence cannot offer specific testimony. However, there are some general considerations that should be called to your attention.

Since they are essentially different in their construction and use we will discuss two classes of vehicles; trucks and passenger automobiles.

Trucks

Reduction of truck noise is a difficult task because of the varied characteristics of the many sources of noise on each vehicle. They include exhaust, engine mechanical noise, air intake, fan, transmission gears, tires, and other miscellaneous mechanical appurtenances.

Some general observations can be made about these noise sources:

Truck noise reduction is not simply a question of putting on an improved muffler. Actions by truck manufacturers (development of test methods and a 125-sone recommendation of the 1950's is

an example), and by state and local governments (the New York and California vehicle noise regulations of the 1960's), have driven down maximum truck noise levels to the point where muffling is available for most trucks that effectively eliminates exhaust noise as a consideration.

Tire noise is one of the most serious obstacles to noise reduction at higher operating speeds. Tire types considered to have the best durability and safety operating characteristics tend to have higher noise levels.

Several manufacturers have testified about the specific problems of dealing with other individual sources, including wind noise and engine mechanical noise, so I will confine my remarks to observations about the impact on the cost of transporting goods due to vehicle modification to achieve stringent noise levels.

First, there may be some increase in initial equipment cost, such as cost of larger cooling systems , for example. To place this in context I would point out that factory sales of trucks and buses in the U.S. in 1970 amounted to $4.8 billion. Therefore each percent of increase in cost due to noise regulations would be $48 million that must be borne by the general public.

Second, to the extent that vehicle redesign for noise reduction involves need for more space and increased weight, and assuming overall weight and length restrictions on trucks -- the added space can be acquired only at the expense of reduced cargo capacity. For example, in a combination of tractor and trailer, an additional foot of cab or tractor length means a reduction of a foot of cargo space, to maintain compliance with length laws. A consequence is the need for more vehicles on the road to carry the same amount of cargo, hence a less efficient transportation system.

Third, there could be increased maintenance costs because of more complex construction and possible higher engine temperatures due to increased back pressure and enclosed structures. Also there would be increased cost of tires if less durable types are required to meet noise specifications.

We are unable to provide specific cost figures for any of these factors. Before gross estimates could be made considerable research on noise reduction techniques and their economic impact would have to be done.

As noise control standards are developed we believe it is appropriate to consider cost-benefit criteria since it is primarily a question of annoyance that we are considering. The public good will not be maximized by insisting on maximum noise reduction at all costs.

As in any economic system where resources are limited, increased effort in one direction generally can be made only at the expense of another. Difficult decisions must be made about the diminishing marginal benefits or satisfaction derived as more resources are devoted to noise reduction.

Passenger Cars

The modern passenger car is relatively quiet because most buyers have indicated this as a preference by their purchase choices. Quietness has a demonstrated appeal for most car buyers.

Quietness has not been the usual criteria in other types of vehicles such as heavy trucks, which are valued primarily for their load carrying efficiency.

V. Uniform National Standards

After all the information and evidence is evaluated, if it is judged that the public interest requires lower noise levels and special effort to control peak noise situations then appropriate national regulations on manufactured products should be enacted and steps taken to insure adequate local control of noise. The regulations should be applied impartially so that all segments of society bear their share of the effort.

Uniform national product noise performance standards would place the cost of noise reduction at its market value by requiring manufacturers

to achieve the standard levels in the most efficient way. Whatever the cost, it will be reflected in the price of the product just as is any other design constraint.

We believe that Federal preemption of new product standards by the issuing authority is essential to orderly mass production processes and interstate commerce. Further, in the case of trucks Federal preemption of noise standards should extend to the operation of vehicles in use as well as to specification of levels for newly manufactured products. Heavy trucks are more often operated near their maximum power output than passenger cars and light trucks. To allow lower local standard operational levels would negate the purpose of Federal preemption.

With the possible exception of tires, which can be treated as a separate entity enteracting with the road surface, vehicle noise regulations should specify total vehicle noise output. For example, we know of no way to rate a muffler by itself in terms of its noise level independent of the specific, entire exhaust system in which it is used.

VI. Compatibility of Standards

In evaluating the evidence and making your recommendations for standards we urge you to consider their relationship to the stringent design constraints already placed on motor vehicles by safety and emissions standards.

As examples: tire safety performance characteristics such as traction and skid resistance may be more important than noise reduction; muffler design changes by the manufacturer to meet lower noise-level performance standards must take into consideration the systems yet to be developed to comply with vehicle emissions standards.

A clear order of national priorities should be established so that more important goals are not sacrificed in pursuit of the lesser.

VII. Enforcement of Regulations

We come now to an aspect of vehicle noise reduction programs that is crucial. It is enforcement. The State of California has had a viable program for a sufficient period of time so that some conclusions can be drawn from their experience.

First, separate regulations for operators and manufacturers, which recognize their capabilities and responsibilities, are necessary. The manufacturer needs a procedure by which he can satisfy himself and the regulatory body that his products comply with the law at the time of sale.

States, on the other hand, or other local agencies, should have the authority to decide the necessary degree of regulation of their citizens as vehicle operators, in terms of prohibiting noisy, abusive operation

of vehicles which otherwise conform to Federal noise performance standards. They also need authority to enforce maintenance responsibilities of the operators. It is for similar reasons that speed laws and vehicle safety maintenance requirements are left to the discretion of states and local communities.

Another obvious observation is that noise standards mean nothing if they are not enforced. In spite of the fact that the California Highway Patrol have made a significant and commendable effort, and have in their judgment made reduction in vehicle noise, a recent CHP study of vehicles in use shows that 10 percent of trucks, 12 percent of automobiles and 75 percent of motorcycles on certain occasions exceed their respective operator noise limits. This is no doubt largely a result of inadequate maintenance of muffler systems, use of inadequate replacement mufflers, bad driving practices, and the fact that many older vehicles, predating the advent of California regulations, are still on the road.

I submit that a reduction in the legal limits on operators or manufacturers will result in no great improvement under these circumstances and, further, that until such time as the great preponderance of vehicles can be constrained to conform to a given standard in use, the value of lowering the standard levels cannot be assessed.

For these reasons we recommend that the development and evaluation of effective enforcement procedures be given high priority in your deliberations. We urge you to call upon the technical expertise available in the Society of Automotive Engineers to assist in this effort.

VIII. Summary and Recommendations

In summary, we have presented an overview of the positions taken by our member companies on some of the significant issues. We have recommended a strategy for reduction of noise annoyance, and have given you our views on the broad major considerations of technology, economics, standards and enforcement.

I will conclude with five recommendations:

A. That, after thorough study of need, uniform national standards be issued, with Federal preemption and consideration of possible conflict or trade-offs involving safety and emissions standards.

B. That model legislation be developed for the guidance of states and local communities.

C. That effective enforcement procedures be developed for state and local use.

D. That a long-range policy of motor vehicle noise reduction be undertaken, taking technological and economic feasibility into account.

E. That substantial research efforts be undertaken addressing the problems of:

: Tire noise

: Technology of noise reduction and comparative economic impact of noise regulations at various levels.

Mr. Chairman, this concludes my remarks.

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INTERNATIONAL HARVESTER COMPANY

PRESENTATION ON

TECHNOLOGY AND ECONOMICS OF NOISE CONTROL

WASHINGTON, D. C.
NOVEMBER 9 - 12, 1971

Presented by:

R. F. Ringham, Vice-President, Engineering

TECHNOLOGY AND ECONOMICS OF NOISE CONTROL

As you know, International Harvester Company has previously presented to EPA Panels information regarding Construction Equipment sound levels, at Atlanta, Georgia, Truck sound levels at Chicago, Illinois, some recommendations regarding enforcement and data on enforcement site calibration possibilities at San Francisco, and Agricultural Equipment sound levels at Denver, Colorado. The primary thrust of these presentations was to provide, as concisely as possible, quantitative data relating to the environmental sound levels (ESL) of the many products of our Company. In all cases we have presented the information in the form of decibels as measured on the "A" scale of a sound level meter (dBA). These measurements were made in all cases at a distance of 50 feet from the working machine and following all applicable recommended practices of the Society of Automotive Engineers (SAE). Where SAE procedures were not available, such as with lawn mowers, the measurements were made on the level terrain at a 50-foot radius from the machine. The highest sound level reading was recorded when the machine was doing its normal job, such as the lawn mower mowing grass. For the purposes of this hearing regarding the broad aspects of "Technology and Economics of Noise Control", we felt that our most appropriate contribution would be to present what we consider tight but attainable goals for the reasonably predictable future.

The future sound level goals by product line which I will be presenting represent the consensus of our sound level measurement and noise control engineers in our various product divisions and our Research Center. The base point for their projections is, of course, the current 1972 model product from which we have made projections for 1975 and 1978. As we noted in our previous presentations on current products, there is a range of values for various kinds of machines within a given product class. There is, in fact, some variation from one machine to another of the same nominal configuration. Feeling that the focal point of noise control is at the loudest of a given sampling, our thinking was addressed to the loudest in each case. As engineers, we would have been delighted to have been

able to derive and present some precise form of cost-effectiveness measure, even as simple as dBA reduction per added dollar of product cost. But we found our basic and collective judgments to be the only workable means, for now, of coming up with projections. They are based on likely technical attainment within reasonable cost impact. At best, their accuracies are probably ± 2 dBA and ± 2 years.

In the following paragraphs our products will be reviewed in a more condensed form than in our previous testimony. They are grouped into broad categories which we feel might be appropriate for consideration for future regulation and enforcement. The means for future sound level improvement have considerable commonality between various products. Nevertheless, each product class is discussed individually for your consideration.

CONSTRUCTION EQUIPMENT

As shown in Table 1, I have chosen to categorize Rubber-Tired Loaders and Scrapers as high silhouette equipment. In these machines the engine, fan, and much of the transmission elements are located rather high above the ground. As a consequence, there is less tendency for ground attentuation of sound before it gets to the observer 50 feet away. Accordingly, these are the machines of the higher sound levels. We have further grouped these machines into two size ranges, namely, over or under 300 HP. The 1972 maximum levels for the large machines run 94 to 97 dBA while the smaller measured in the 85 to 87 range. For both the large and small sizes, our first step improvement to 1975 would consist of fan and exhaust system improvements along with some degree of engine shielding. The next step to 1978, we would expect to achieve by further shielding of the engine compartment, and in some cases further exhaust system improvements and/or possible engine modifications.

Our next category, Crawler Tractors and Loaders, shown in Table 2, is also presented in two groups, with 160 HP being the dividing point. The measures we would expect to take here would be somewhat the same as the preceding. However, with the small machine being at the low 82 dBA level, we consider it more appropriate to spend our efforts in other areas and therefore would not change it for 1975. We would achieve the reduction to 80 dBA in 1978 by improvements in the fan and the engine compartment shielding.

The third category of Construction Equipment is Off-Highway Trucks. These trucks presently have considerable engine compartment shielding inherent in their configuration. We would progressively improve them by adding shielding as well as incorporating improvements in the cooling fan and muffler.

We have combined the light duty machines, such as the small backhoe and loader tractor and the light excavators, into one category as shown in Table 4.

Here, as with the Small Crawler Tractors, we feel that immediate attention is merited elsewhere but we would likely by 1978 incorporate cooling fan and/or shielding improvements, reflecting the knowledge gained in the work on the larger and noisier machines.

HEAVY DUTY ON-ROAD TRUCKS

In this case, we have chosen to group together the Heavy Duty Trucks in one category as shown in Table 5. These would include the long-haul highway trucks, as well as the mixer and dump trucks that support construction activity, and the full range of diesel-powered equipment in between. As we previously testified, these trucks are currently configured to meet local requirements, such as in California and Chicago, of 88 dBA. The trucks already have certain improvements in exhaust mufflers, cooling fans, and in some cases shield or acoustical barriers installed for the purpose of sound attenuation. It will be a difficult job to make the improvements shown in Table 5 for 1975 and 1978. We expect the 1975 improvements to be made by doing further what we have already done. The reduction for 1978 would have to be with some improvements to the engines themselves either by modification or "add-on" devices. The economics of heavy truck operations dictate that as little as possible be done by the brute force of shielding whose weight comes out of payload when gross weight limits are considered. The numbers shown in Table 5 could otherwise be somewhat lower; and, in fact, there are today and will be in the future, many truck configurations of lower sound levels than those shown for the maximum values.

AGRICULTURAL EQUIPMENT

As we noted in our presentations in Denver, there is a wide variety of powered farm equipment, much of it special purpose, and some of it used on a very narrow seasonal pattern. Such is the case of the self-propelled combine type of harvesting machine. We suggest that its 88 to 90 dBA ESL may well be environmentally acceptable when considering the economics and the infrequent exposure, generally well away from urban areas.

Considerable attention has been given to improvements of operator station noise levels in the farm tractor, which have also contributed to the attainment of fairly moderate ESL. As shown in Table 6, we have categorized the farm tractors in two modes of operation. In the tillage mode, the tractor is working its hardest. We would expect that the improvements shown for 1975 would result from continuing improvements in exhaust muffling and cooling fan arrangements. For some tractors, we also expect continuing improvements in transmission noise. The further reduction in 1978 would include considerable shielding of the engine compartment.

In the cultivating, planting, mowing and other modes of operation, where the tractor is less vigorously exercised, we would not expect soon to improve the current level of 82 dBA. We would realize the reduction to 80 dBA in 1978 primarily as a consequence of the improvements made for the tillage operation.

Our Lawn and Garden Tractor levels are displayed in two modes of operation, mowing and snow-blowing (Table 7). We feel greater attention is appropriate to mowing in that there is more frequent use through the summer mowing season. Further, the windows and doors are frequently open and people are engaged in more outdoor activities. The dBA reductions shown are expected to be from progressive improvements made by acoustic treatment of mower housings, shielding or shrouding of engines, and improved exhaust systems. Further

reductions beyond the 74 dBA level shown for 1978, we feel would be achievable only after some breakthrough of technology on large rotary mower design. Achieving the function of both cutting the grass and blowing the cuttings either to the side or into a bag is, within the known state-of-the-art, going to require mower blade tip speeds that make a little noise. We are hopeful of attaining significant improvements in the state-of-the-art, but at this date we do not know how to schedule the invention that is required for this attainment.

With the lawn and garden tractor equipped with a snow blower, you will note we have designated the current level as 81-84 dBA. There is quite some variation in the noise from the snow blower, depending on the density, drifting, etc., of the snow that is to be removed, and therefore the evaluations are much less definitive. We do feel, however, that by 1978 the level can be brought to about 80 dBA. This would be from a combination of the basic tractor improvements previously noted along with acoustic treatment of the snow blower housings and spout.

As shown in Table 8, the current sound level of the Riding Lawn Mower is 72 dBA. As with the lawn and garden tractor, we are looking to continuing improvement by acoustic treatment of the mower housing, the engine exhaust system, and shielding or shrouding of the engine.

We appreciate the opportunity to present these thoughts and recommendations. We also appreciate the efforts of the EPA in conducting these eight hearings on noise abatement and control. Further, the International Harvester Company is most concerned that the control of environmental sound levels be developed as close to a cost-effective basis as we all know how. I feel this is demonstrated by our participation in five of these hearings. We look forward to a continuing and a working relationship with the Office of Noise Abatement and Control, and stand ready to try to provide further information and support as you may require.

TABLE 1

ESL OF HIGH SILHOUETTE CONSTRUCTION EQUIPMENT dB(A)

	1972	1975	1978
LARGE (OVER 300 HP)	94-97	88-90	85
SMALL (UNDER 300 HP)	85-87	84	82

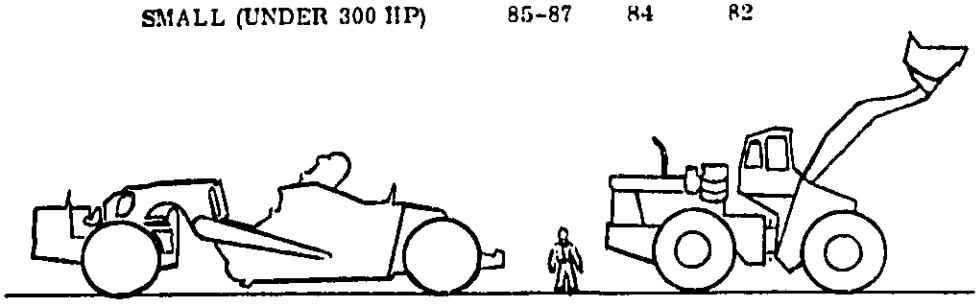


TABLE 2

ESL OF CRAWLER TRACTORS AND LOADERS dB(A)

	1972	1975	1978
LARGE (OVER 160 HP)	88	85	82
SMALL (UNDER 160 HP)	82	82	80

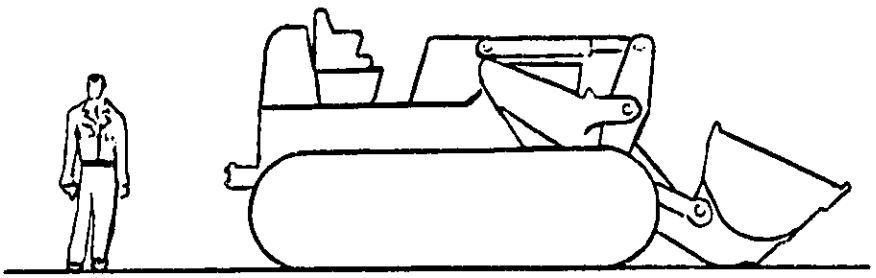


TABLE 3

ESL OF OFF-HIGHWAY TRUCKS

dB(A)

1972	1975	1978
88	86	84

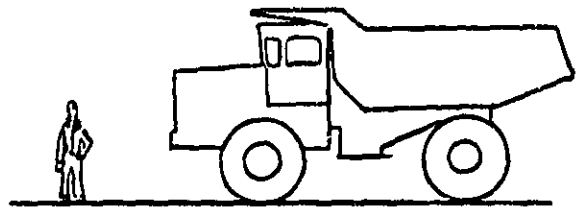


TABLE 4

ESL OF LIGHT CONSTRUCTION EQUIPMENT

dB(A)

1972	1975	1978
85	85	83

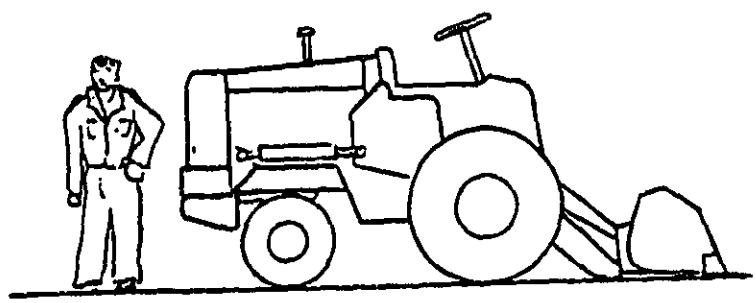


TABLE 5

ESL OF HEAVY DUTY TRUCKS

dB(A)

1972	1975	1978
88	86	84

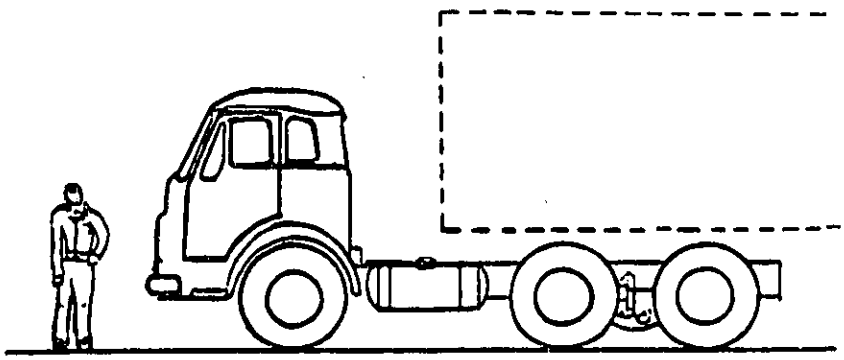


TABLE 6

ESL OF FARM TRACTORS dB(A)

	1972	1975	1978
TILLAGE MODE	88	86	84
PLANTING, MOWING, ETC.	82	82	80

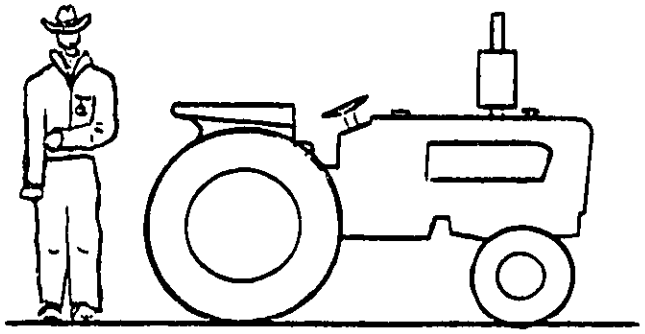


TABLE 7

ESL OF LAWN AND GARDEN TRACTORS dB(A)

	1972	1975	1978
MOWING	78	76	74
SNOW BLOWING	81 - 84	-	about 90

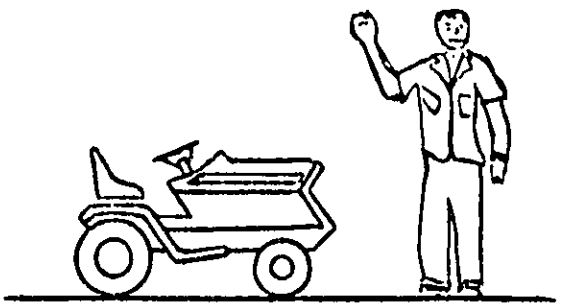
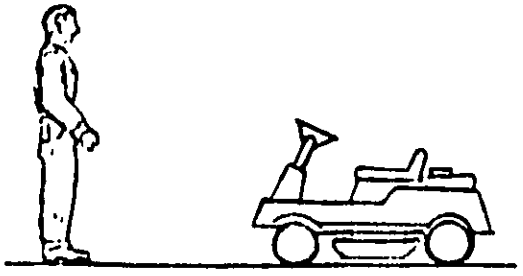


TABLE 8

ESL OF RIDING LAWN MOWERS dB(A)

1972	1975	1978
72	70	68



FARM AND INDUSTRIAL EQUIPMENT INSTITUTE
STATEMENT AT
ENVIRONMENTAL PROTECTION AGENCY'S NATIONAL HEARING
ON NOISE ABATEMENT AND CONTROL
NOVEMBER 9-12, 1971
WASHINGTON, D. C.

Our Institute, referred to as FIEI, is a trade association which was founded in 1894, and its 240 active member companies manufacture and market more than 90% of all farm equipment produced in the United States.

At the hearings held by the Environmental Protection Agency's Office of Noise Abatement and Control in Denver, Colorado, on September 30 and October 1, 1971, FIEI, individual farm equipment manufacturers, technical researchers, a testing agency operating under a state authority and agricultural college researchers and extension personnel submitted views in reqard to the state of the art of noise control progress in association with farm equipment powered by internal combustion engines, and presented recommendations on future activities to optimize noise control progress. The Denver hearings contributed much in that they reported on how a significant noise control progress has evolved with IC powered farm equipment under a voluntary noise standards and noise abatement program.

The reports at Denver provided considerable detail concerning the individual elements and activities of this voluntary system now functioning, and we are pleased to summarize these earlier presentations and place into sharper focus the resources of

Research, Education, independent testing, and the competitive forces which make-up this voluntary system and are available to allocate to agricultural use noise.

To summarize the existing record, it has been shown that in response to agricultural college and industrial research, and reports on noise levels in connection with specific types of IC powered machines, the farm machinery industry supported the joint efforts to establish and publish conscientious and voluntary noise standards as early as 1966. In conjunction with other federal agencies, and voluntary standards setting bodies, the agricultural machinery industry authorized further private research to update the existing knowledge on the state-of-the-art of noise characteristics and abatement. Following the establishment of voluntary noise standards, the farm equipment industry proceeded to develop and produce IC powered farm machinery which incorporated noise abatement technology.

A Nebraska statute authorized and inaugurated agricultural tractor testing in 1920 to provide farmers with definite facts concerning the machines to be sold in that state. Tractor manufacturers wishing to sell in the State of Nebraska must test their products at the University of Nebraska Tractor Test Laboratory under standardized test procedures developed through the combined efforts of the Laboratory, Society of Automotive Engineers (SAE), and the tractor manufacturing industry. The University of Nebraka's College of Agriculture then publishes the results of these tests.

The results are informative to consumers and thus fosters competition among manufacturers. Over the years, a substantial number of technical papers have been published evaluating the state-of the-art of tractor components and tractor progress as reflected by the University of Nebraska test history. The publishing of standardized test data and technical commentary has put in the public domain information useful to maintaining a consistent machinery progress. Consumers, researchers, engineers and manufacturers have benefitted from this unique and long standing reporting activity. It is recorded that specific benefits in mechanical efficiencies, safety and health have been brought about through this long standing procedure.

In 1970, the University of Nebraska expanded its test procedures to include the measurement and reporting of bystander or ambient and operator station sound levels. Two years of published test results, by the University of Nebraska, show bystander noise tends to be within acceptable limits and trending downward. Noise levels measured at the operators station are trending downward and being controlled toward currently acceptable limits. Most recent Nebraska Test Reports show continuing progress in noise abatement. In turn, this information is being placed in the public's hands through normal technical reporting and in industry advertising to the consumer. The result is that the public is voluntarily investing in the new health benefits available to them.

Under the Morrill Act of 1862, the system of Land Grant Colleges and Extention Service was established. This has provided the resources whereby the technical findings of land grant colleges in agricultural research and extension education are made available to all for the benefit of agriculture. This process is at work through the University of Nebraska and other various agricultural colleges and is contributing to the development of noise reduction technology in connection with IC engine-powered machines in agriculture. The system of providing information to both user and manufacturer is doing much to build technical awareness of both problem and solution in the areas important to progress in noise abatement.

In agricultural noise abatement the industry has established a national noise control base through a voluntary control system already in place and functioning. It has utilized a State testing resource which is closely allied to the national agricultural extension system to record technical and health gains and communicate these gains to a nationally oriented manufacturing sector and farmers oriented to state agricultural practices. The agricultural extension system operating at the national, state, and county level is utilized in research, testing, and in consumer follow up.

The industry's establishment of this voluntary noise abatement and control program in conjunction with the use of agricultural

engineering school resources to test and publish has established a competitive base which has served to establish reasonable economic parameters in relation to the substantial recorded progress in noise abatement.

FIEI submits that the record shows how the existing voluntary noise abatement and control system, now functioning, is unique to agriculture. To the best of our knowledge, it does not exist to this same degree in any other Industry. The key elements of the system are:

1. Research capability with a high degree of governmental presence through USDA and the Land Grant Colleges created by the Morrill Act of 1862.

2. Education by the Federal Extension Service, vocational agricultural training, Future Farmer's of America, 4-H, National Safety Council, and those being carried out by the individual companies.

3. Independent testing and reporting of ambient and operator station noise levels by an Internationally recognized Testing Agency of a state sponsored activity at one of the land grant institutions.

4. Competitive forces are at work in the marketplace for quieter agricultural tractors to meet the informed customer

demands and through the individual marketing and advertising programs of various companies in our Industry.

We point with considerable pride and satisfaction to the results already achieved in a short span of time by this viable voluntary system which is quietly at work in agriculture, and urge EPA to charge this unique voluntary system with the responsibility of achieving noise control objectives. We would visualize EPA's contribution to the program as simply the synergism to insure optimum results.