EDITORIAL

Meetings and Symposia

THE increasing interest in eliminating noise as an industrial problem and as a public and private nuisance is borne out by the increase in the number of, and attendance at, meetings and conferences at which the control of noise is the main topic for one or more sessions. Since early October, more than fifty papers on noise and its control have been read at six meetings held in five cities across the country.

The programs for the sessions on noise held at these meetings are carried in the news section, while all of the papers presented at the Fifth National Noise Abatement Symposium form the contents of this issue. Future issues will carry the papers from other meetings, including all of the papers presented at the First West Coast Noise Symposium.

These meetings and symposia serve to acquaint responsible industrial and public officials with a broad fundamental picture and certain specific aspects of the control of noise. Noise is not presented as a menace or a topic resorted to only by publicity-seeking cranks, but is shown to be a physical phenomenon which may cause annoyance or even hearing loss under certain generally defined conditions. The need for more data on the cause of and methods for the prevention of hearing loss are always stressed at these meetings together with examples of how some noise problems in the factory, office, and home have been met.

Local groups interested in sponsoring meetings on noise have frequently run into the problem of original material in this field. The large quantity of material presented during the past five years at the Annual National Noise Abatement Symposium and at other meetings could easily form the basis for many local sessions. Such sessions could be conducted under the guidance of participants in the symposia, highlighted by one or more original papers, and could be concluded by round-table discussions. Such a technique could most easily spread the benefits of the national groups throughout the country.

One Man's Meat

AN examination of the clippings on noise from newspapers throughout the country shows that most people do not like noise. However, the man who has to buy or use a noise-producing device or machine in a profitable operation is hard to convince that it is his machine and not the complainant who is at fault. In many cases, two adamant groups appear before legislative or judicial bodies which, without sufficient time or technical aid, are forced to make decisions which are frequently extremely costly to reverse.

Until the recent development of improved truck mufflers, the operators of the very trucks which supply many cities and towns with a major portion of their food, clothing, and industrial materials were being assailed as maintaining nuisances. Cooperation and understanding on the part of both groups can and has led to the satisfactory solution of this problem in some areas. However, without cooperation and technical assistance in the understanding of operational and acoustical problems, no mutually satisfactory solution can ever be reached by legislation or court action alone.

Definition

NOISE is defined as *unwanted sound,* from which it follows that noise control is the control of unwanted sound. Although mechanical vibration by itself is not noise, it is included within the scope of *NOISE Control* since it takes only a small radiating area coupled with the source of mechanical vibrations to produce large quantities of unwanted sound. We will, however, have to forego entry into the field of electrical noise in electron tube circuits and atmospheric noise or, as it is more commonly known, radio static.

Lewis S. Goodfriend

EDITORIAL

Whether to treat school classrooms as noise sources to be enclosed with large quantities of acoustical materials or to treat them as small auditoriums to contain only that amount of acoustical material which will control the reverberation is a question which has once more become important in the minds of many architects and their acoustical consultants. Most distributors and manufacturers of acoustical materials, backed up by a large group of architects, agree that school officials frequently call for far more material than any of the members of the supply or design groups would dare to recommend. Often where the school administration is sure that classes will be kept small and that discipline is not dependent on noise control the architect and his consultant are allowed to design the rooms to obtain other acoustical properties.

If the classrooms are considered for a moment without walls and ceilings, it will be obvious that the diminution of sound by distance alone will not be sufficient to drop the intelligibility of speech below an adequate value. Addition of the walls and a ceiling of acoustically absorptive material will serve two purposes: to reduce the noise level and to control easily and effectively the speech reverberation time in the room. Auditoriums, music rooms, and lecture halls, on the other hand, should usually be considered as problems in acoustical design, and very often it is the materials supplier who suggests restraints in the use of acoustical materials when these rooms are under consideration.

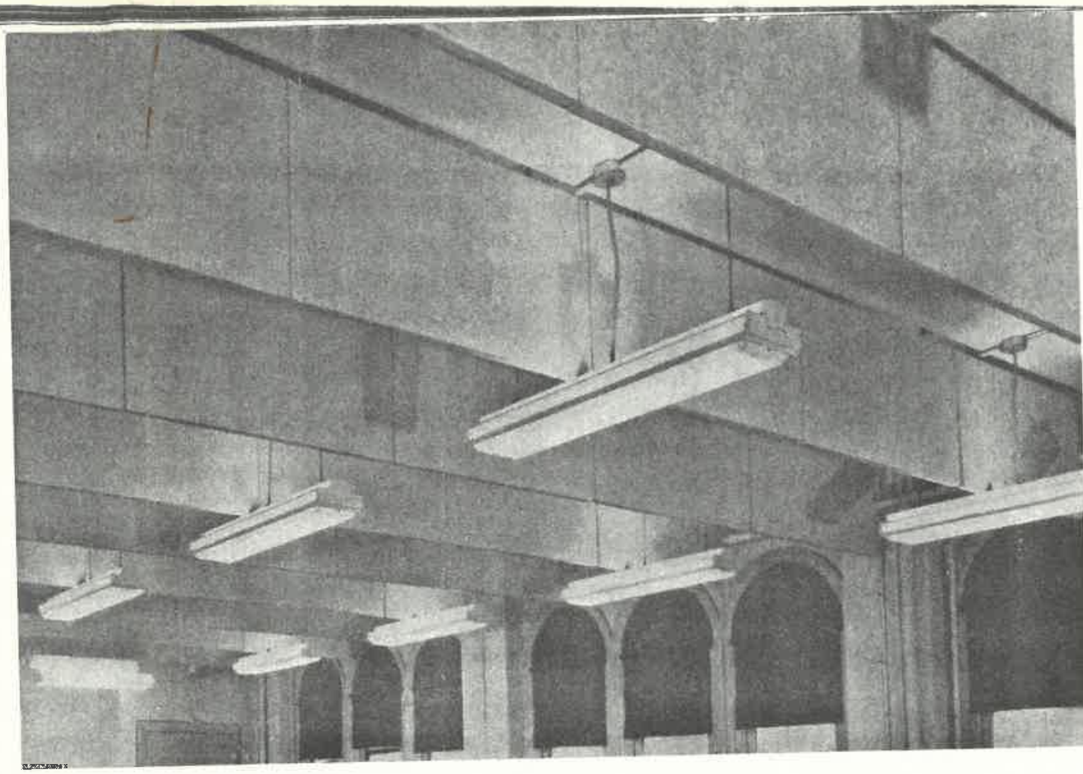
One major problem which arises in teaching is the noise from sources outside the classroom. Where schools must be located in or near business areas or heavily traveled streets, outside noise sources can frequently create noise levels high enough to mask speech completely. Under these conditions, the treated ceiling is a help and an untreated ceiling an unnecessary handicap for the teaching staff. In suburban and rural schools, appropriate siting can certainly make room for discussion of the merits of fully and partially treated classrooms. This is seldom, if ever, true in the urban school.

Auditoriums, music rooms, and lecture halls are all rooms which should usually be considered as problems in acoustical design and should be located in those areas of the school where they will be protected from exterior noise sources and from the noises of toilets, shops, gymnasium, kitchen, and boiler room. Where the appropriate physical isolation can be achieved, the design of the rooms for either optimum sound distribution or, in the case of music rooms, excellence of timbre may proceed without too much further thought to noise control. In these rooms it is often desirable to use none of the conventional acoustical materials and to effect the required sound distribution by an acoustically bright, hard plaster ceiling or, as is often done in music rooms, to treat opposite ends of the room in different manners to provide different acoustical conditions for different types of musical work. Here again economical designs will usually include the conventional acoustical materials where treatment is required.

Shops, cafeterias, kitchens, gymnasiums, and study areas can all benefit from the noise-control features of the conventional acoustical materials when they are applied to the ceiling and in some cases along the wall or furred down where the additional effectiveness of a furred area is indicated.

Returning to the problems of the classroom, it may be pleasanter to teach and to study in an acoustically *bright* or *live* room, but the primary requisites for quiet and discipline must be provided. At the moment it appears that the most economical and architecturally convenient method of meeting these requisites is through the use of conventional acoustical materials as ceiling surfaces.

LEWIS S. GOODFRIEND



functional sound absorbers

IN industrial environments where interior decoration and architectural beauty must often be subordinated to function, the functional sound absorber can be an effective noise-controlling element. Available in a variety of sizes, shapes, and acoustical properties, the functional absorber has been characterized both as the ultimate in noise-reduction equipment and as a waste of industrial safety funds. Somewhere between these two views is the true story.

The industrial noise problem is threefold: Noise causes hearing loss, interferes with communications, and is annoying. The most important effect in the eyes of the Workmen's Compensation Insurance carrier is the hearing-loss problem. To him the reduction of communications may also be a problem where accident prevention is primarily dependent on rapid speech communication. The insurance carrier is little concerned with annoyance. Production and supervision personnel are frequently interested in the ability of workers to communicate easily with one another and with their foremen and others at the supervisory level. It is the inspection department and the office staff who are most responsive to the annoyance values of noise. With these ideas in mind, it is possible to examine the effects of functional absorbers in relation to each part of the industrial noise problem.

It has been found in general that the operators of lathes, single- and multi-spindle drill presses, punch presses, and similar machines receive little or no direct benefit from functional absorbers. The reason is that the sound which reaches the operators' ears directly from the machine is unaffected by any absorbing material placed farther away than the operator. Therefore, if this sound has sufficient intensity to cause hearing loss, it will do so with or without functional absorbers. However, the operators of larger machines such as pulverizers, rotating kilns, mills of various types, and banks of machines may receive the benefits of functional absorbers when the absorbers are used to form a low ceiling over the machine and, as has been done in some cases, used to form an acoustical wall between the operator and the noisy portion of the machine. Some installations have lowered the noise level sufficiently to be considered effective in eliminating the hazard.

Where several machines operating at safe noise levels are located near one or more machines which produce noise levels well in excess of the damage risk level, it is sometimes possible to add sufficient absorption in the form of functional units around and above the noisier units to provide a safe working noise level at the quieter machines. The operators of the machines producing the higher noise levels may then be protected by other means such as ear plugs of an appropriate type, in addition to hoods, covers, and enclosures for the machine.

Supervisory and inspection personnel may often benefit in a similar manner. Since employees in these two categories frequently work at some distance from production machines, it may be possible to achieve large reductions in noise level through the addition of reasonable amounts of absorption in the form of functional absorbers. Here again experience has shown that in certain cases conditions in areas of questionable safety have been improved to a safe state. In other cases, only improvements in communications were made, with hearing damage still possible if personal protection is not used.

At large distances from the source, the effect of functional absorbers can be quite great. For office personnel and shipping and inspection employees located in rooms outside the production area, the reduction may be great enough to drop the machine noise below the background noise in the room. This is not a necessity, but it is always a welcome condition.

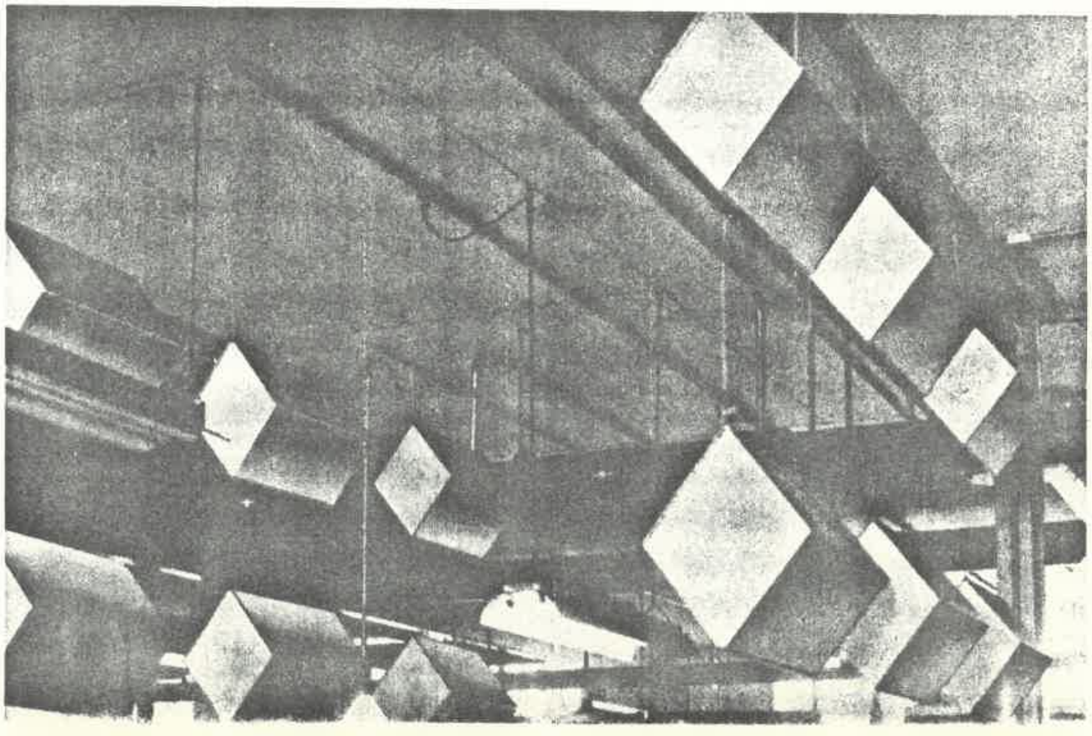
A primary rule in the use of functional sound absorbers is: Check the noise level at the machine operators' ears after the installation of functional absorbers is completed. If it is above an accepted damage risk criterion, then the operators need additional protection. This additional protection may be in the form of machine modifications to reduce noise output, covers and enclosures for the machine, or ear plugs, ear muffs, and helmets designed to provide the maximum of individual protection.

There are some few cases where functional sound absorbers cannot be of any help. All the manufacturers of functional absorbers we know do not want to sell absorbers to these people and will frequently recommend a better approach to problems of this type.

Functional sound absorbers are here to stay. Used with intelligence and care, they can contribute greatly to the control of noise in the industrial community.

LEWIS S. GOODFRIEND

AN EDITORIAL



Whose responsibility is it . . . ?

WHOSE responsibility is it to initiate and follow up on noise control measures in architectural design? This question has been brought to our attention several times in recent months and it deserves an answer. Briefly stated, it is the responsibility of everyone connected with the design, from the owner who commissions the building through the architect and down to all the men employed by both contractor and sub-contractor in constructing and decorating the building. This responsibility often must carry over to the tenant and his employees.

The primary responsibility rests with the architect and his team of engineers. It is they who must recognize site noise problems, sources of noise in mechanical equipment, and sources which the owner will add, and they must take cognizance of the building's use to determine the sound isolation requirements for walls and floors. Acoustical consultants, when employed, can coordinate all of the noise control requirements and eliminate the need for frequent conferences between architect and mechanical engineer in the matter of mechanical noise and noise transmission. However, even the closest cooperation among members of the architect's team is to no avail when noise control measures are circumvented by incorrect installation. It is in the execution that the responsibility falls on the contractors and their men. No supervising architect can be everywhere at once, but it *is* easy to make sure that the men doing the work are aware of the purpose of low sound transmission ducts, walls, and floors. This can insure against having the separate walls of a cavity wall system joined at the bottom by mortar dropped from above. It can also prevent unseen *field changes* which increase the transmission of noise throughout a building.

The complex design problems of modern offices and public buildings often overshadow the noise problems, and the noise problem is complex in itself. To begin with, someone must select the transmitted room-noise levels to be allowed and estimate the levels of the various noise sources, including those designed into the building as part of the mechanical plant and those which the tenants will bring into the building, including office machinery and people. The architect can control directly the location of noisy areas such as shops in a school and locate the music suite, a quiet area, at a safe distance from them. But not even the mechanical engineer can predict the noise levels in a ventilating room five years after construction of a building. The ventilating unit that is delivered by the manufacturer may meet certain noise level criteria when installed, but its noise output in the future will be determined by many factors including maintenance. Have we fully discharged our responsibility when we have specified a unit that is quiet now? It is possible that a safety factor in the form of a slightly larger unit operating at lower velocities, in the case of a fan, might be a wise investment. Also, a lined section of duct with its slight increase in static head for the blower is better installed now than after the ceilings are in and the fan has been selected for the static pressure without duct lining. Other examples involving motors, gear-driven equipment, vibration isolators, and low sound transmission walls for music rooms and offices are numerous.

In all classes of buildings, the owners must assume the responsibility for the elimination of noise control measures under the guise of economy. This is particularly true today when floor space in large offices and public buildings is at a premium. The decreased initial cost or increased income from a building in which wall thickness or room arrangement was sacrificed to obtain a maximum floor area per room or maximum rentable space per floor is often offset by legal expense and the cost of remedial measures. It has been reported that tenants have refused to pay rent where ventilating equipment noise is claimed to be excessive and that school rooms have had to be remodelled to provide the required sound isolation between units. Such cases could have been prevented had proper planning for noise control been carried out without undue emphasis on initial saving.

Much of what has been said for offices and public buildings applies equally well in the design of industrial buildings and homes. However, in industrial buildings the owner-tenant is frequently well aware of the problems of noise and will make every effort to have all the noise reduction measures included within the structure that he can.

In the design of homes the problem is more difficult. The architect must anticipate the owner's desires with regard to noise and must provide all the necessary noise control measures he can without exceeding the buyer's budget. This can lead to many separate problems. Modern homes have a multitude of noise-producing devices built in as permanent equipment. Among these are attic fans, air conditioners, freezers, and rumpus rooms. In home design, selection of equipment and location of rooms can play just as important a part in providing a quiet environment as these factors do in larger structures, but more of the responsibility for planning rests on the architect alone.

In the design of buildings, noise control is everybody's responsibility.

LEWIS S. GOODFRIEND

EDITORIAL

When Dean Vern O. Knudsen of the University of California at Los Angeles, who has been considering the problem of what to do about noise for over thirty years, presented a three-minute contribution to the Acoustical Society's time capsule at its 25th anniversary meeting, he chose as his text, "I Hate Noise." Dean Knudsen has done much to further noise control through his teaching, his public lectures, numerous articles, and his two well-known books on architectural acoustics. Dean Knudsen is not alone in his dislike of noise. However, there are few people who have approached the problem with his knowledge and understanding.

Over a thousand news stories dealing with noise in all its phases have appeared in the public press since the beginning of this year, when NOISE Control first made its appearance. Since the first of June alone, there have been more than fifty newspaper editorials devoted to the subject of noise and the need for its reduction. An examination of these clippings shows a wide variety of noise sources, some of which have been quieted as a result of careful engineering studies and others as a result of either enforcement of existing laws or the passage of new legislation. It appears, from the attention which the subject has received in local governmental bodies and from civic organizations and individuals who have appealed to the authorities or to the press, that everyone joins with Dean Knudsen in hating noise.

A further analysis of these news stories and of a number of the local regulations which have been adopted to cope with noise shows that many of these laws and regulations are overly restrictive, tending, of course, to favor the demands of local residents seeking peace and quiet. Others appear to be almost unenforceable, since they practically require law-enforcement officials to perform complex measurements of the noise and its spectrum. In fact, a number of the reports received by the editor's office bear this out in that the courts have found for the defendant.

It is not enough merely to hate noise, nor is it enough to pass a law against the making of noise. It is imperative that those members of a community who are interested in having a noise abated and those charged with the task of preparing legislation consider the rights of the individual both in the making of noise and in the enjoyment of peaceful surroundings. In drafting legislation for noise control, consideration must be given to the potential enforceability of such laws and to the prior action of the higher courts in dealing with appeals of convictions of violations of earlier statutes, such actions having been reported in the law journals and in the public press, and particularly in the pages of NOISE Control.

Lewis S. Goodfriend

EDITORIAL

Call the Doctor

First-aid measures are helpful, often necessary. But do they substitute for the doctor? The therapist treats the patient, but does he write the prescription? The position of the consultant in the noise reduction field is, or should be, considered in much the same light as that of the specialist in any field. Plant engineers assigned to the solution of noise reduction problems, whether in the manufacturing process or in the resulting product, should have the assistance of a specialist in noise control for a number of reasons, among the strongest of which are (1) cost factor, (2) consultant-management-employee relationship, and (3) experience in a specialized problem area.

In figuring the cost of remedying a noise problem, the time of plant personnel engaged in the actual solving of the problem, charged to overhead and direct costs, and the lost time of personnel who would normally be working in the suspended operation are not the only expenditures to be considered. The cost of equipment and materials consumed in unsuccessful attempts to quiet the noise cannot be overlooked, nor can the compensation claims entered when an apparent solution, consisting of the reduction in level of one or two octave bands, is discovered to be inadequate only upon notification of the filing of hearing-loss claims.

The respect with which management will accept the prescription of an outside engineer, psychologist, or physicist is in striking contrast to the lack of cooperation an employee often finds when assigned to work outside his own department. A consultant can often provide economical solutions to vexing problems which could not be applied by the employees because of management bias. It is easier for an outside man to advise a company official or shop foreman that his approach to noise reduction is not applicable or to overlook the owner's comments concerning a disproven theory. Although it requires considerable tact, the outcome is usually much more satisfactory than it would be if the same discussion had originated with the plant safety engineer.

The experience from which a consultant in noise reduction may draw is perhaps the most obvious argument in his favor. There are a wide variety of fibrous materials used for acoustical work (see article by Samuel Labate in this issue); familiarity with their characteristics is a large contributing factor to the experience of a consultant. In order to make the most effective and economical use of these materials a plant's staff engineer would require considerable time to assemble and interpret the required data, while a consultant would presumably have such data in his files.

The analogy of the problem to the field of medicine is evident. The slogan "Administer first aid and call the doctor" may well be applied to situations where noise control measures are urgently needed. Staff personnel can often find temporary remedial measures, even if it means slowing down production, but the doctor can prescribe the only permanent cure.

For 1956

With this issue we mark the beginning of the second year for NOISE CONTROL. We have included in the first issue of this new year both original papers and articles reprinted with the purpose of reaching those not aware of the noise problem at the time of original publication.

This year two special issues have been planned, one devoted to noise control in automobiles and other vehicles, the other to the control of noise in heating, ventilating, and air-conditioning equipment and installations. Also, we shall continue to bring to our readers material in the noise field presented at major symposia and engineering meetings.

News concerning noise and its control and reviews of books and other publications on or relating to noise shall again be featured, as well as announcements of new products which are useful in the control of noise or are quiet versions of their better-known but noisier prototypes.

LEWIS S. GOODFRIEND

Quieter Automotive Vehicles

Can modern automotive vehicles, with their increasingly powerful engines, be made quiet enough to meet the needs and requirements of the communities through which they travel and for the drivers and passengers who ride in them? To answer this question, NOISE CONTROL asked Editorial Advisor David C. Apps, who has played an important part in the noise reduction work of a large automotive manufacturer and has participated in the many automotive industry noise abatement activities, to assemble a special issue on the subject. We are sure that the excellent results of his efforts will go far toward answering the questions posed by both the public and local governments who have been increasingly troubled by vehicular noise.

The interesting article by Karl M. Richards indicates that legislation alone, even if enforced, is not enough to effect adequate reduction of truck exhaust noise. The wording of some statutes actually permits the operation of a truck with an inadequate muffler as long as it is a muffler. From the information presented in the papers on an industry specification for muffler performance and quiet replacement mufflers, it is clear that adequately quiet mufflers *are* available. Also, there are laws in most states and many cities and towns which *could* be used to control exhaust noise. The problem is how to ensure that the enforcement of the laws *will* result in the use of suitable mufflers.

All of the articles indicate that eventually all trucks, and certainly all cars, on the road will have mufflers meeting the new specification. In the interim, whenever a muffler is replaced, it should be replaced with a quiet one. It is in this area that local and state legislation can be effective. Communities with noise problems arising from truck operations should make full use of the current available knowledge and muffler design data to provide both drivers and owners of noisy-exhaust vehicles with educational material outlining the facts on quiet mufflers. Warnings should be issued indicating that continued operation of the noisy vehicle will result in strong legal action. Continued attention by the automotive industry to the problems of exhaust noise is leading to the elimination of exhaust noise as an engineering problem. It will remain an enforcement problem for some time to come.

The reduction of vehicle noise from sources other than the exhaust is receiving increasing attention. Thus we see, for example, that tire manufacturers are working on the reduction of noise from tires. As pointed out in the paper by Seymour A. Lippmann, the tread pattern is not the only tire noise source, although it may be the tread noise that bothers the people at the roadside. Other noises that may be attributable to the tires can be of annoyance to the passengers. In any case, it is good news that this aspect of vehicular noise is not only under study but appears to be yielding rapidly to the type of activity described in the article.

There are a variety of other noise sources now under investigation in the automotive field about which the public knows little. Modern automobiles and trucks are equipped with intake-air filters which also act as intake silencers. The generator and fan must be silenced and, above all, auxiliary equipment must not make noise. In particular, on trucks carrying perishable goods, the auxiliary-gasoline-engine-driven refrigeration equipment must be quieted. The small two-stroke-cycle gasoline engines must be equipped with efficient mufflers if they are not to be extremely annoying on the road and, particularly, in terminal areas where they must be parked near homes for any length of time. It is also necessary on many types of compressor cooling units to provide a noise-reducing housing for the compressor itself. This is a matter under investigation by the truck manufacturers and operators and the manufacturers of the cooling units.

As in all areas of noise control, the responsibility for quiet motor vehicles lies with everyone associated with the manufacture and operation of the product. The makers of the automobiles, trucks, and engines must make every effort to provide a quiet product in the original equipment; the owners must take cognizance of the significant return on any additional cost which must be paid for quieter vehicles; and the drivers, particularly of trucks, must be made to realize that quietly operated vehicles mean better public relations for themselves, their employers, and the industry.

There is no loss of power or engine efficiency because of the noise reduction, but there is an increase in safety. Tests have shown that inside the cabs of trucks with high exhaust noise levels, the driver is unable to hear the warning signals of bells and sirens on ambulances and fire trucks until he is within two or three seconds of an intersection. Then, it is too late.

In this issue of NOISE CONTROL we present a comprehensive picture of the vehicular noise situation as it exists today. It is to be hoped that the next special issue of NOISE CONTROL on this subject will not have to discuss noise as a problem in vehicular operations, but only in terms of the devices and techniques used to provide quiet vehicles.

LEWIS S. GOODFRIEND

Community Planning and Noise

How can municipal officials prepare laws which will with certainty protect the citizens of their community against noise? There are many differing opinions on the type and wording of laws designed to prevent a man from annoying his neighbor by making what the neighbor considers noise.

NOISE CONTROL is again fortunate to be able to bring to its readers the proceedings of the West Coast Noise Symposium. The meeting, held last December, stressed the theme "Community Noise" and featured papers defining community noise and proposing avenues of approach to its abatement or control by statute.

The papers dealing with community and transportation noise help to delineate the areas of current knowledge and the existing techniques for measuring and rating noise. "City Noise—Los Angeles," by Paul Veneklasen, succeeded so well in relating clearly, through tape recording, the city noises to the city scenes that the author was invited to repeat his talk before the Los Angeles City Council.

It is encouraging to note the hope expressed by the speakers that in the near future the problem of controlling community noise, either through engineering advances or legislation, will be completely resolved.

Unfortunately, in many communities governing organizations are still unable either to enforce existing laws or to write enforceable statutes because of a lack of technical information. It is our hope, as well as that of the symposium sponsors, that these proceedings will bring to the municipal officials concerned appropriate information on what may be done to prepare enforceable laws and what pitfalls may be expected in the process of providing quiet for their communities.

The solutions proposed in these papers are not the final answers. Each city, town, and village has individual needs with regard to laws and statutes. Otherwise, uniform codes in all areas of legislation could be adopted without regard to size or geographic location. As the needs vary, the laws must vary. A residential community within a mile of a proposed high-speed throughway might feel that the zoning regulations of the municipality should protect them from the encroachment of highway noise. On the other hand, residents of a town near a rail-switching terminal might not even notice the noise of a new superhighway.

All this points to the need for understanding and thought in applying the available engineering information to areas of human needs. K. N. Stevens, W. A. Rosenblith, and R. H. Bolt, in their paper "A Community's Reaction to Noise: Can It Be Forecast?" which appeared in the January 1955 issue of NOISE CONTROL, gave us a yardstick with which to measure sources of community noise. The symposium authors give us both reason to apply this information and a warning that it must be applied with care.

Transportation Noise

A major factor in community noise is noise from transportation equipment. Answers to the vehicular noise problems facing conscientious municipal officials have been suggested and tried in a number of communities. In his article in the May issue, Karl Richards discussed some of the obstacles which arise in framing legislation to cope with vehicular noise. In this issue, Donald P. Loye presents another view of the community noise situation and suggests an instrumentation method for assessing the annoyance of vehicular noise which would make use of the relationships among loudness, annoyance, and a sound-level meter reading.

Surveying the papers submitted for publication, reports from the field, and private communications regarding the problem of relating meter readings, loudness, and annoyance, we note the multiplicity of test methods and objectives. None of the tests are comprehensive enough to provide a truly valid basis for relating any one characteristic of a spectrum to the annoyance created in a large group of individuals. Factors which contribute to loudness may not necessarily have any great effect on the annoyance capability, so that much of the data on loudness may be invalid for use in setting annoyance criteria. In relating annoyance criteria to test results, we must ask such questions as whether each of the reporting groups has any bias, whether the vehicles were operating under idling or load conditions, and, if under load, what gear and speed combinations were used. We must also include such elusive factors as the effect of the ambient noise level; the engine speed, and, in turn, the exhaust pulse rate; and the immediate history of the individuals forming the jury or the community.

The studies and surveys made to date have been helpful in setting tentative criteria. Several major research and academic organizations have contributed important data relating spectrum, level, and annoyance, but much still remains to be done. One of the basic requirements for obtaining useful results is the taking of complete data under as wide a variety of conditions as possible, with control over the factors, both acoustical and non-acoustical, which might affect the jury judgment or the vehicle's noise output.

More information might possibly be gained if there were an agency capable of coordinating the activities of the various groups working in the fields of community noise and vehicular noise and of planning and assigning tasks to make the best use of the research facilities available. Such an agency might be found among existing public agencies or governmental bodies, scientific societies, or manufacturing organizations. With coordination, appropriate methods for measuring and regulating the noise of motor transport equipment will be made feasible at the community level.

LEWIS S. GOODFRIEND

LOOKING *for a quiet product?*

More and more products today are being advertised as "quiet," "quietest on the market," "silent-operating"—all dimensionless claims. When questioned, many manufacturers indicate either that no sound measurements were made or that "comparison tests" were used. All claims and statements of this nature are valueless to the architect or engineer working toward a quiet home, school, civic building, office, or factory. Without substantiating technical information, including octave-band power or sound-pressure spectra and the statistical background of the measurements, the owner, architect, or engineer is unable to make an intelligent specification or purchase.

No owner wants a machine, no matter how efficient it is, if when installed in the appropriate location it interferes with speech, prevents sleep, or otherwise conflicts with the normal activities of the area. A particular example is the room air conditioner. For years room air conditioners have been advertised and sold to owners on the basis that in addition to cooling they will operate quietly. In most cases they do not. This situation is rapidly becoming ridiculous.

Equipment today is being specified and bought on a sound engineering basis in all respects but noise. If equipment is noisy after installation, a specialist must be called in and more money spent to alleviate the condition. In many cases nothing can be done to provide the quieting necessary to meet the commonly accepted background noise criterion for the space under consideration.

The outlook is not completely black, however. A few manufacturers have measured the sound-pressure levels of their products under specific conditions and either calculated them for reference conditions or deduced the sound-power levels from the measurements and the room conditions. Several trade associations have promoted the use of a uniform method of measurement and specification of the noise output of equipment manufactured by their members. Notable among these is the Industrial Unit Heater Association, which in January 1955 published *Bulletin 13, Sound Measurement Test Code for Unit Heaters.* The code specifies the manner of measurement, the calculations to be performed, and the manner of statement of the rating classification of the product. Although the method specified results in a single-class rating rather than a sound-power or power level characteristic, the rating is translatable into a loudness range in sones. The manufacturer should have available to the architect or designer from his files the actual sound-pressure level readings corresponding to the ratings and data on the measuring stations and room conditions.

At least one business machine manufacturer has measured the sound-power output of his products. Although not rating the products publicly, one large department store and one merchandising organization check products for noise in their own laboratories in an effort to provide quiet products for their customers.

The availability of modern measuring equipment and the ease with which reasonably accurate measurements can be made in spaces set up for noise measurement (or out of doors in quiet locations) put this data within the reach of even a small manufacturing concern. Not enough has been done to date, however, to stimulate manufacturers to set up measuring facilities and to publish the sound-level or noise characteristics of their products.

As a first step in this direction, NOISE CONTROL will publish a list of manufacturers of all types of equipment, including household appliances, who have noise measurement data available. Such data must include either octave-band power levels or octave-band sound-pressure levels, location of the measuring stations, and room absorption or room factor. This data should be provided for stock models of all types of units manufactured. To be listed, a manufacturer should supply sample copies of actual data to the editor along with a description of the test procedure used. Since the listing will not in any way be an endorsement, but merely a list of sources of technical data for designers and specification writers, there is little likelihood that the list will be abused. Those engineers and architects who avail themselves of the data and who specify a given product on the basis of its noise performance can always include proof-of-performance requirements in the specifications.

In supplying the data, manufacturers should also benefit as sources of noise and possible means for their suppression become evident.

The matter of standard methods of measurement is under consideration by a committee of the American Standards Association. When the needs of various industries become clearer, standard methods of measurement and specification can be promulgated. In the meantime, NOISE CONTROL hopes, by means of the proposed list, to aid in the establishment and use of an intelligent and efficient procedure for choosing or specifying appropriately quiet equipment.

LEWIS S. GOODFRIEND

Who Pays the Bill?

An architect who accepts a commission for a building may not see the need for consulting an acoustical expert until the work is well under way. Often it is only when faced with materials selection problems and questions related to the placement of mechanical components in spaces where they may be potential noise sources, but where they must go for architectural reasons that the architect calls the acoustical engineer.

By this time the architect has already made his contract with the client, and very often the possibility of an acoustical consultant's fee has not been considered. Too often, in the experience of those with whom we have talked, the architect must pay the acoustical engineer out of his own pocket. Where the profit margin is narrow and where there are other services and overhead competing for the architect's dollar, a limit may be placed on the fee for acoustical services, and this sometimes leads to a situation in which the materials or equipment supplier or the mechanical engineer is called upon to make noise control recommendations. It is not wise to have the acoustical and noise control features of a structure handled by several different people who may apply different criteria to the same problem.

The success which has been achieved on a large number of projects, where problems in noise and architectural acoustics do not exist, attests to the impressive results of teamwork between architect and engineer. Many a client who has been forced to call in an acoustical engineer to solve a noise problem after a building is occupied could have enjoyed successful initial results had the project been analyzed for acoustics and noise by an acoustical engineer during the design phase.

This is not an easy argument to present to architect or client because the engineer cannot show a distinct saving in terms of present materials cost. Any claim on the part of an acoustical engineer today that he can save a client the amount of his fee on the cost of materials is specious. It just cannot be done. The only asset which the acoustical engineer has to offer is service based on training and experience and a regard for ethics.

The acoustical engineer can help the architect provide a building suited to the purposes for which it is intended, with adequate sound isolation and ideal acoustical environments for each space inside and outside the enclosure. With knowledge, experience, and good judgment, he can provide satisfactory noise reduction and good interior acoustical conditions with materials in keeping with the architect's esthetic approach. To insist on an elaborate design where conventional architectural acoustical materials are desired by the architect and are adequate for the acoustical purpose is not in the province of the acoustical engineer. On the other hand, he must be prepared to develop, if necessary, measures for the control of noise and the acoustical environment which will make use of materials and finishes which the architect requires in his design, provided the architect and client are prepared to face the cost of such special designs.

The client should be impressed with the problems he will face if the acoustics are "taken as they come" or if the acoustical engineer is called in after plans are completed and ready to go out for bid and he is asked to "check them over for acoustics." It is very difficult at this point for an acoustical consultant to tell an architect or his client that it would be less costly to relocate the rooms than to have to erect tricky sound-isolation walls between rooms later (between a mechanical equipment room and the principal's office, for example).

Architects and engineering firms can protect themselves, their suppliers, their consultants, and their clients if they state explicitly in their contracts that a separate acoustical engineering firm will handle the acoustical design at a specified cost. An explicit fee charged to the client is the best possible way to free the architect of the cost limitation, which is in reality a *quality* limitation on the acoustical engineering phase of his work.

Modern living has brought with it many new high-powered noise sources which call for specialized engineering treatment. A client does not expect his architect to design the steel or plan the mechanical phases of his project. Today, with the increased complexity of acoustical problems, the specialized services of the acoustical engineer can very seldom be considered optional. It should be obvious to a client made aware of this situation that an explicit fee for the acoustical engineer is the only means of assuring a structure which will provide the optimum acoustical environment.

LEWIS S. GOODFRIEND

Symposium Papers

This issue of NOISE CONTROL contains the fourteen papers presented at the seventh annual National Noise Abatement Symposium at the Hotel Sherman in Chicago on October 11th and 12th, 1956. All were invited papers given by men whose experience and knowledge gives them an insight into the particular subjects discussed.

Some of the papers present material which is not new to the readers of NOISE CONTROL. The symposium committee, in selecting speakers, took into consideration the fact that there has been in the past a small individual repeat attendance: companies tend to choose different representatives each year. Also, since NOISE CONTROL's readership is constantly expanding, it was felt that the repetition of certain basic information and standard application techniques, even though familiar to some readers, would provide an excellent background for the many new subscribers.

The realization on the part of the symposium committee of the importance of a widespread understanding of the fundamental engineering facts of noise control resulted in a number of talks on basic subjects and some new information, application data, and evaluated results. Much of the material discussed in former symposia is presented again in a refreshing and interesting way, with new examples and illustrations.

Although some readers may feel that some papers are not sufficiently detailed technically, we trust that the majority will find in these proceedings not only a fresh approach to some conventional problems, but readily applied techniques which may be put to use by those not acquainted with the theory of acoustics as well as by the practicing acoustical engineer.

City Noise

Studies of some of the actual sources of city noise show a wide variety of major contributors and an interesting time distribution pattern. New York (away from the entertainment area), in common with many other cities, is quiet during a portion of the night. The environment is suitable for work, play, or sleep, the quiet being broken only by the passing cab, bus, or truck. But just before dawn a rapid and significant change is effected. Delivery trucks move in and around both residential areas and business districts. The noise of tires, exhaust, and unloading raises the noise level well above the ambient at just the time when people are most wakeful and find return to slumber almost impossible.

This type of community noise problem is difficult to control by legislation. Deliveries must be made. Early bus schedules must be maintained. Taxis must pick up and deliver their fares without restriction of locale. Nonetheless, there are answers: good vehicle and highway maintenance, quiet operation, cooperation. It takes driver education as well as good public relations to keep trucks and buses, even those equipped with good mufflers, from being an annoyance during early morning hours. Gunning the engine, poor engine timing, and poor route or stop selection may all be responsible for making even a well-equipped bus or truck a noise nuisance. Suppression of horn blowing is only a first step. Traffic and noise code enforcement, as has been pointed out previously on this page, is difficult. Continuous driver education campaigns supplemented by direct contact with fleet owners, bus company officials, drivers, and individual truck and cab owners can be effective. Funds for a staff consisting of an engineer and a public relations expert-interviewer-lecturer could probably be provided from the saving in cost of inconclusive legal actions which only lead to bitterness and often no noise reduction.

Remember the facts:

1. Tire tread noise can be minimized by trial and selection.
2. Effective mufflers are available.
3. The correct mufflers do not cause power losses.
4. Traffic control patterns and bus stop locations can affect truck and bus starting noise.
5. Correct bus and truck operation minimizes noise.
6. Good vehicle and highway maintenance minimizes noise.

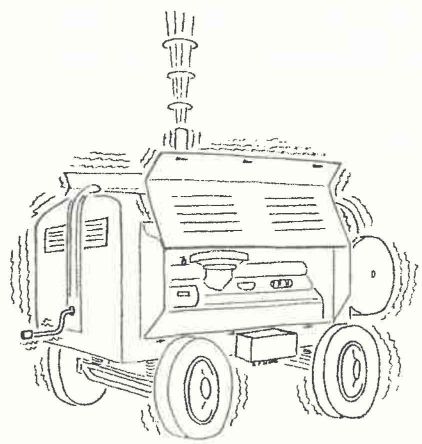
LEWIS S. GOODFRIEND

Quiet That Machine!

Machinery makes noise. Most machinery manufacturers will agree with this statement. In fact, some manufacturers and even some users believe there is a corollary: machinery *must* be noisy! In recent months we have had an opportunity to view many machines, from small printing presses to diesel railroad engines. Some produced the din usually associated with machinery and so often accepted as usual. However, others (some of each type) were not noisy!

It is true that some types of machines, in particular machines such as the punch press and the surface grinder, do not at the moment appear susceptible to noise reduction. There appears to be little reason, however, why machines such as diesel engines, air compressors, air and electric motors, and materials handling equipment cannot be quieted.

The initial quieting cost should not always be considered the determining factor. Witness the improvement in sales appeal of automobiles with panel damping in the form of body undercoat and door treatment; the increase in life of large machines properly mounted on vibration isolators; and the reduction in building maintenance when vibrating pipes are isolated from walls and pumps by means of flexible hangers and connections and snubbers. A quiet machine can often be an improved machine, in which noise reduction has been achieved by the introduction of better materials handling technique, greater accuracy, higher speed, reduced product breakage, all for little or no increase in cost.



Why don't all manufacturers take advantage of these machine modifications to gain the benefits cited? There are many answers to this question, most of which are associated with an unwillingness on the part of both manufacturer and user to vary from the tried and proven method. Manufacturers may worry about user acceptance of an unconventional machine modification, even if the new performance specifications indicate an improvement over earlier models. Questions may arise on the part of the user such as "Will it last as long as earlier models?"; "Who else has bought one?" (Am I a guinea pig?); "Has it been life-tested?" Avoiding such changes may mean that current sales will continue at an even level—unless, of course, competition takes the initiative in noise reduction.

The approach to noise reduction in machinery is seldom a purely acoustical problem. In fact, most quieting techniques for machinery consist of mechanical engineering methods with acoustical objectives. For example, in a machine tool the acoustical objective may be to reduce vibration forces transmitted from a rotating machine element to a large-area panel or base, thus reducing the acoustical radiating surface. To meet this objective two approaches are immediately evident. The simpler is to provide mechanical isolation between the radiating surface and the source of the vibration forces. However, improving balance of the rotating element may reduce bearing wear in addition to improving the operational characteristics of the machine, in which case isolation of the panel will probably no longer be required.

The substitution of quieter assembly techniques for current noisy methods is another illustration of an acoustical problem solved by mechanical engineering. Fastening by spinning or by metal clips and retainers instead of rivets are purely mechanical solutions to noise problems. In many instances such substitutions have led to speedier product assembly and to better product maintenance. It should be noted that machines used for spinning and punching holes for special fasteners must be quieter than the riveter if improvement is to be made.

Many air-operated machines and air motors exhaust directly to the atmosphere, although their size, shape, and cost would readily qualify them for treatment with effective, inexpensive mufflers.

The difference between a safe shop and a hazard may be the ability to communicate in an emergency, but a moving crane operated by a noisy air motor cannot be stopped by the man who cannot hear the warning.

Design and plant personnel can solve many of these problems if management orders a noise reduction program put into effect. Sometimes the acoustical expert can help start the program on the right track, but the shortage of acoustical experts should not be permitted to be an excuse for noisy machines. Machines make noise—but they do not have to!

LEWIS S. GOODFRIEND

Jet Noise—Fact or Fantasy?

THROUGH a haze of statements issued by aircraft company officials, airport personnel, jet-engine manufacturers, and newspaper reporters emerges a most confusing picture of jet-engine noise and its effects on people. Some statements leave the reader with the impression that there is no real problem in quieting jet engines, that few people are annoyed by the noise around airports, and that we'll all have to get used to it anyway. Other pictures drawn in news reports and by otherwise responsible manufacturing and airport authorities convey the idea that jet noise is a danger to the community, that Air Force personnel are becoming hard of hearing at a rapid rate, or that jet aircraft cannot operate in this country without noise suppressors.

What are the facts?

The facts may be stated briefly; the engineering data required to back them up would fill volumes.

Jet engines make noise. They make more noise when they provide more thrust. Thus, a heavily loaded jet aircraft on take-off will make more noise than an almost empty craft which is landing.

Empty or partially loaded jet planes flown around the country on demonstration flights, with the noise being read on sound-level meters in the hands of men experienced in newspaper reporting but with no knowledge of sound prove nothing.

The banning of a jet aircraft by the Port of New York Authority means only that the particular craft banned is too noisy at present. It does not mean that operational craft of the same type when delivered for use will not be as quiet or quieter than present-day reciprocating-engine-driven craft.

The clearance of the French Caravelle plane for trial flights from Idlewild (New York International Airport) does not mean that the Authority is lifting the ban for other jets. The noise characteristics under operational conditions will be studied for each jet aircraft before it is permitted to land in New York, and permission will be granted only if its noise output is less than that of presently operating piston-engine aircraft.

Finally, Air Force personnel are not becoming hard of hearing at a rapidly growing rate. The Air Force has an intensive hearing conservation program in effect, and records show no increase in the number of discharges due to loss of hearing since the introduction of jet engines on Air Force craft.

There is little need for all this confusion regarding jet-engine noise and public reaction. Publicity stunts and misleading decibel measurements reported by men who are probably excellent reporters but who are admittedly not acoustical experts can only heighten ill will toward airline operators when noise-producing jet aircraft begin operating in their home towns.

The other side of the picture is no better. Scare stories about how noisy it will be if jets operate from the local airport may well prevent even test flights in communities where jets could operate without annoyance because of a combination of satisfactory runway layout, sufficient distance from nearby populated areas, and operational procedures which permit take-offs and landings with noise levels held to predetermined standards.

Responsible people in both business and government look forward to the introduction of jet aircraft in commercial aviation with great appreciation of the benefits to be derived therefrom. A realistic attitude on the part of the press and public will help prevent long legal battles and bitter arguments over the right of jets to land at given airports. Jets, trucks, industrial plants, air-conditioning equipment—none of these should be allowed to become noise nuisances. The jet aircraft's noise-producing capabilities, however, can be learned only through operational flights. If jets cannot meet the standards set by the community, then ban them. But wait until they are operational.

Now is the time to set the criteria for their use. As they become operational they can be compared to the criteria and approved or banned. This is a job for airport operators, acoustical engineers, and lawmakers. It must be done soon, or much of the misinformation now directed to the public will become so firmly rooted that any reasonable solution to the problem will have to await the outcome of litigation, expensive time-consuming litigation.

Noise and Consideration

With the arrival of summer, people throughout the country are leaving the windows of their homes open to the summer breezes—and, unfortunately, to the summer noises. Even well-enforced ordinances cannot prevent the inconsiderate person from blowing his car horn, buzzing the neighbors' homes in a light plane, or playing records at a high sound level after midnight. These and many other noise annoyances can readily be prevented by considerate action. Remember! What is music to your ears may be only noise to your neighbor!

LEWIS S. GOODFRIEND

Cities VS TRUCK NOISE

Truck noise, that familiar sound across the nation, creeping into every corner of the community, the insidious robber of sleep and creator of daytime disturbances, is the target for new restrictive measures being proposed, prepared, and promulgated in cities throughout the country. Cincinnati, Ohio; Covington, Kentucky; Houston, Texas; and Memphis, Tennessee are taking the lead in this direction.

Laws are being drawn up on the basis of sound-level meter readings and jury ratings of annoyance. Several will be patterned after the Milwaukee law now in effect.

Why there has been so much activity in this area in the last few months is not clear. Most new trucks meet the 125-sone truck noise design limit approved on March 1, 1954 by the AMA Motor Truck Committee. Quiet replacement mufflers, however, (as noted in the article by David C. Apps beginning on page 34 of this issue) are not gaining the wide acceptance anticipated for them. Restrictive local laws are the result of this lack of good sense and cooperation on the part of the trucking industry.

Truckers hesitate to use quiet mufflers apparently because of the mistaken notion that quiet units are more expensive to operate and maintain. Until truck fleet owners, individual owners, drivers, and maintenance personnel realize that higher operating costs brought about through fines, delays for muffler checks, and increased regulation of truck routes can be avoided only by buying and installing premium-priced, high-quality, quiet mufflers, communities will harrass the truckers. Law enforcement officers will continue to use every opportunity to issue summonses for even the slightest infraction of local ordinances, as they have in communities along the route of the New England Thruway. In this case, trucks diverted from the thruway by construction detours and forced to use routes passing through towns have demonstrated an obvious lack of muffling, and many communities are responding by having local police set up truck stops for inspection of various safety and loading requirements.

We do not sanction harrassment of any particular group. On the other hand, we do agree with those city executives and members of the community who feel that a truck route should not be a source of noise. Many communities throughout the country have cooperated with truckers in various ways, switching traffic lights, for example, from their usual signal pattern to a flashing yellow signal at night in order to minimize truck stops and at the same time lessen gear changing and engine racing as trucks pass through town. It is time that truck and fleet owners assume the responsibility that is theirs by taking every measure necessary to remove truck noise from the community scene.

Quiet Products

On page 70 of this issue are listed the names of three manufacturers who noise-rate their products and can supply acoustical data for engineering the product into its surroundings. These concerns have supplied NOISE CONTROL with information on methods used to make the measurements and have forwarded samples of the data to the office of the Editor.

It is hoped that other manufacturers who can supply sound output and spectrum information will join these three and take advantage of the free listing in NOISE CONTROL. This includes truck muffler manufacturers.

LEWIS S. GOODFRIEND

NOISE IN BUILDINGS

THE public press is replete with short items concerning complaints originating from noise annoyance within buildings. In most of these cases, the only solution lies in individual reprimand or, when the issue is a more serious one, in adjudication. In many cases the normal activities of the individual are curtailed not because of the nature of the activities themselves, but because of an inherent fault in the building in which they are carried out.

No committees are set up by city councils to set noise levels in the home or to specify the sound-transmission loss through the walls of multiple dwellings, offices, and public buildings. Yet the undesirable effects of noise in the home and the office unquestionably warrant the establishment of specifications to determine the acoustical properties of the walls, floors, and partitions of buildings in which people live and work.

It is particularly important in the case of multiple dwellings, apartment houses, hotels, motels—any building in which people must sleep. Theoretically, we sleep to regain strength and energy to face the next day's work and its problems refreshed and cheerful. Actually, the reverse is often the case. Families are too often exposed to all the noises of the neighborhood as they filter under the doors, through the closed windows and the visual barriers of wall, floor, and ceiling. The most unfortunate aspect of this situation is that it is, in most cases, accepted as standard.

Several European countries hold a different viewpoint; they have written tight specifications for the sound isolation which must be provided by the building elements of apartment houses and other dwellings.

Our building codes and health laws forbid the connection of improper plumbing equipment in order to prevent contamination of our water supply. They prohibit the improper connection of electrical equipment to power lines in order to prevent fires from destroying lives and property. They include many specifications for the purpose of avoiding building hazards—unsafe stairs, fire traps, collapse. All these provisions have as their aim the protection of the individual. It is not illogical to reason that in these days of high-speed living leading to headaches, tensions, and the consumption of hundreds of millions of aspirin tablets and tranquilizing pills, the individual needs protection from noise annoyance. It should not be a luxury to find quiet and relative relief from noise, and it should not be necessary to curtail the recreational activities of others to find it, since both relaxation and recreation have therapeutic value. The provision of more adequate soundproofing in apartments, hotels, in all multiple dwellings is a reasonable solution.

It is not abnormal for a baby to want to play with his toys on the apartment floor. Nor can the man downstairs, just home from a night's work in an industrial plant, be blamed for wanting his rest. Bickering between families, sometimes ending in lawsuits, is not the solution to the problem. The problem was built into the building.

There is little or no reason today why *quiet* apartments, hotels, and multiple dwellings cannot be designed with high-transmission-loss doors, windows, and partitions. Besides requiring good construction practices, buildings so designed will always have premium market value.

"Soundproofing" existing buildings is not the answer. Good noise control design *is*—where each element of a building is designed to provide a maximum of sound isolation. Good noise control in dwellings requires careful planning and efficient construction supervision. Most important, however, good noise control in dwellings should be regulated from the very beginning. Sound-transmission loss specifications should be part of every building code, and the work of establishing these specifications should begin *now*. Each day that passes sees the design, construction, completion of buildings unsatisfactory from a noise control standpoint.

It is the old editorial ending—"We must plan now!"

But that, in reality, is half the answer to all noise control design.

LEWIS S. GOODFRIEND

EDITORIAL

Technology ⟶ Application

The Lag

Considerable time, money, and research are being devoted to the problems of noise control where they occur in industry, aviation, surface transportation, architecture, consumer products, and the community. Practical scientific and engineering methods and devices are now available to scientists and engineers working on acoustical problems in these areas to provide required reductions in noise level. However, we are experiencing the inevitable lag between development and application.

We are standing on the threshold of a time of widespread application of theory to the practical, everyday elements of man's acoustical environment. How long we must wait at the threshold will be decided by the public as well as the scientist and engineer.

The Objective

We know the goals.

- We want noise controlled.
- We want industrial machines to be designed or enclosed so that they do not cause annoyance to the occupants of the buildings in which they are located or to the neighbors, interfere with communications, or lead to industrial hearing loss.
- We want quiet surface transportation vehicles. We want them to make no more noise at the nearest residence than a modern automobile.
- We want aircraft noise held to a minimum. We want political leaders and planners to recognize that airport and community planning are integral.
- We want buildings designed to keep outside noise out and inside noise in and to insure that noise generators are isolated from spaces where quiet is desired or required and that the number of mechanical noise sources is kept to a minimum.
- We want our communities to be quiet, whether they are urban, suburban, or rural.

What this really means is that we want the people responsible for the generation of noise, either through the design, manufacture, or use of noisy devices, to be more considerate of their fellow human beings. The technology has advanced sufficiently to permit major improvement.

The Interim

During the next five, ten, or fifteen years some of the knowledge now available will certainly diffuse from the laboratory to the designer, architect, production line, and politician. What steps can be taken in the interim to speed the information along and to encourage action?

With so much emphasis in the headlines on credit, defense, missiles, and satellites, those responsible for noise control may lose sight of the continued public need for a better acoustical environment. The answer is clear. The public can and should be apprised of the facts regarding noise and the available measures for its control. Newspapers and the technical press should spread the word that noise can be controlled and that the actuating force is public pressure.

It should be stressed that expert engineering is required to quiet almost all the annoying, interfering, or hazardous (to hearing) noises. The public, industrial management, and political leaders should not settle for self-styled experts. True, anyone who can read can learn how to copy someone else's solution to a noise problem. However, it takes experience seldom gained in any other line of scientific work to tackle and solve new noise problems or to solve the same problem in a different environment.

Finally, everyone connected with noise abatement efforts must be made aware that it often requires a large initial investment to rid a product, factory, or community of noise. This investment is often weighed against an owner's, purchaser's, or taxpayer's demand for economy, and the noise reduction work may not be begun until a crisis develops. To overcome this kind of resistance, it is necessary only to compare the cost of remedying the present situation with the cost of remedying the situation as it will be in the future. Typical problems that could have been solved inexpensively a few years ago and which now require considerably greater expenditure include gas-engine-operated lawn mowers, built-in garbage disposal units, central home air heating and conditioning units, vacuum cleaners, many modern but noisy factories, monumental but noisy civic buildings, and rural and suburban communities with severe or critical transportation noise situations.

The interim measure of public education, leading to intelligent planning and action, will help bridge the gap between technology and application and will hasten the day when man's acoustical environment can be considered to be not only acceptable, but conducive to better living.

LEWIS S. GOODFRIEND

EDITORIAL

STANDARDS FOR STANDARDS SAKE?

The recent publication of ASTM E 90-66 T, LABORATORY MEASUREMENT OF AIRBORNE SOUND TRANSMISSION LOSS OF BUILDING PARTITIONS, leads us to examine the purpose and quality of measurement and test standards. This particular measurement method appears to cover, as well as the present state of the art will permit, the appropriate test procedure for the laboratory measurement of sound transmission loss between two carefully constructed laboratory spaces. However, associated with the standard is a proposed method of rating partitions, the sound transmission class which on first glance looks like its predecessor included with the E 90-61 T method. However, when checked against speech articulation A1 values for a partition based on the rating contour, the new sound transmission class value will always give a partition a lower AI (more privacy) than the actual measured data on the partition will yield. In addition the STC values, in general, will be one to three decibels higher than those obtained with the STC determined using the E 90-61 T method of of computation. It appears that the ASTM committee E6 has not only modified the testing method to bring it up to date, they have handed to manufacturers one to three dB greater values for the same old partitions, and handed to the architect some STC numbers that are no longer related to the realities which the building designer requires. We can only hope that ASTM Committee E6 will reconsider the method of computing the STC and go back to the 1961 method modified for use with one-third octave bands. There is too much money at stake when designing for sound isolation to arbitrarily and unnecessarily change rating methods. It is hard enough to design for quiet and privacy without having someone changing the length of our yardstick.

The broader problem that has appeared with respect to standards in the areas of sound and vibration is that we are not dealing with a single industry, research specialty, or product type. In acoustics today, the areas of industry, research, and products which are affected by simple changes in test procedures, definitions, and measurement methods are numerous and diverse. They may have different requirements and for reasons of history or tradition use different terminology. When new standards are written solely by the acoustical community, we often tend to overlook the specialized requirements of the industrial and commercial user of such standards.

Better coordination is needed between the standards writing groups and the probable users. This is not always easy since the potential users may not be aware of the writing activity or the possible effect on them of a proposed new standard. Nonetheless, it is the responsibility of any standards body to obtain comments from each technical area that may be affected by the standard being written. It is true that writing and revising standards is a time-consuming task, but a little bit of haste after four or five years of writing and revision could vitiate the entire work of the writing standards body.

We look forward to an era of more useful and better coordinated standards that will meet not only the needs of the acoustical expert, but will serve the entire scientific, engineering, and industrial communities.

Lewis S. Goodfriend

EDITORIAL

THE WRONG ROAD TO COMMUNITY NOISE REGULATION

During the past five years there has been a rapid increase in the number of municipalities that have adopted some type of noise performance code as part of a zoning regulation or nuisance statute. The basic idea is excellent. That is, if the allowable octave band levels are set, then the regulation can be enforced. However, there are many pitfalls in this approach that often make the regulations useless, completely unenforceable, and therefore unable to stand up in court. One fundamental problem with all such codes is that to be reasonable, they should bear some relationship to the existing background spectrum within the municipality or within each zone. Other problems include the difficulty of adjusting the regulation to preclude pure tones, beats, sounds of unusual character, and intermittent sounds.

With respect to intermittent sounds, the problem is so difficult that two different firms, actively working on noise regulations, may have almost diametrically opposite methods for taking them into account. One group allows such sounds to occur at higher levels if they occur for only a small fraction of each hour. The second organization permits almost no increase in level for intermittent sounds. The logic in each approach is very attractive, and each is probably correct for some situations. Possibly both approaches are wrong for some situations.

Another set of problems, not yet adequately solved, relates to the locations at which the measurements for code compliance must be made. If the measurements are to be made at a plant lot line, then they can be extremely restrictive for an industry located in the center of an industrial zone while, at the same time, much too liberal for a noisy concern at the edge of the zone. Similarly, at the nearest residential zone boundary, measurement of the plant noise becomes an almost impossible task because of intermittent traffic noise, except possibly during the early morning hours. This problem is especially vexing when the author of the code intends that the plant noise be less than the early morning background. It is also very difficult to pinpoint the source when measuring at the zone boundary. The offending noise may not even arise within the plant under study, but may have its origin in a different plant or even outside the industrial zone.

Similar problems occur with local nuisance statutes. When the regulation limits the noise level at the lot line, it may not be very effective in preventing neighbors from annoying each other with air-conditioning equipment, power mowers, and home workshop equipment.

Perhaps there is no simple pattern that fits every community with respect to zoning and nuisance noise control. S)V will shortly take a look at some of the existing regulations and the avenues for developing more effective regulations.

Lewis S. Goodfriend

THE QUIET ROOM AIR-CONDITIONER–HOW SOON?

Although the public and various governmental bodies at several levels appear to be concerned about the achievement of quiet in our communities and in our homes and privacy in multiple dwellings, the same level of interest does not appear to exist with respect to machines—this includes those ranging from home appliances up to giant construction machines. Specifically, much effort has been expended on making residential air-conditioning equipment *acceptable.* Discussions with a number of men in the manufacturing area have always led to the answer that quiet units have been offered to builders of multiple dwellings, hotels, dormitories and offices, but the owners, designers, or supervising authorities will not accept the increased price usually estimated at an additional 25-to-35 percent.

The trouble with this argument is that owners and architects acting for owners, seldom have the opportunity to determine in advance what the real price differential will be. This is one of the idiosyncrasies of the building and construction business. The job may be specified as Brand "A" but when it is bid by the plumbing or heating subcontractor he may figure his price on a noisier, less expensive unit. When the wrangling is over it turns out that the job will be delayed by waiting for the quiet units, or the Brand "X" units offered as equal are not equal when installed; but then it is too late. We have seen this on project after project. Only where the owner can specify the unit by name and number (not usually permitted on public projects or governmentally supported ones) is he likely to even approach what he wants.

The problem is two-fold. First, as already mentioned, is the archaic practice used to obtain bids in the construction industry. Second, there have been no real engineering achievements in the field of unit air-conditioner quieting since the end of World War II when these units became very popular for private residential use. We dabble at adding a bit of glass fiber or foamed plastic here and there. In a given machine, the mechanical engineering department provides a slightly quieter fan, but there is no giant step in quieting technique, not even a small but explicit innovation. There are many obstacles to obtaining quiet air, all well substantiated by theoretical proofs. The proofs say that moving air makes noise. Also, compressors used in such unitary equipment generate both noise and vibration which are radiated by the case as noise. But these arguments only really apply to the room air-conditioner as we know it today.

Isn't it possible that a unit air-conditioner of the future might, like a steam radiator of an earlier era, sit quietly (albeit inefficiently) in the corner or under the window and function silently or almost so with just a little creak and a sigh once in a while. It might just turn out that the job can be done not only quietly but for about the same price. We recall an earlier air moving-propulsion system that without mufflers was unpalatable until its bigger, quieter brother was devised. We refer to the pure and bypass jet engines. Neither is quiet, but the simultaneous gain in both noise reduction and in thrust was considered impossible until F. B. Greatrex showed that it could be done. The need, the market for quieter unitary air-conditioners is here. Where is the product to meet the need?

Lewis S. Goodfriend

EDITORIAL

SOMETHING NEW IN SHOCK AND VIBRATION ISOLATION?

As we look over the latest batch of literature from the shock and vibration control equipment manufacturers, we wonder whether there is not a better approach. There are many questions that as yet seem to have been answered only cursorily without any real thought. It is so easy to take vibration isolator theory and specify the characteristics of an ideal shock or vibration isolator which will meet whatever architectural, industrial, or aerospace requirement is at hand. The next step is to make the allowances and adjustments for practical isolator design and there is the required specification. Every manufacturer in the isolator business has models to fill every need. But if that is the case, why do isolated components fail in aerospace equipment and why do building owners have to provide extra isolation for ventilating machinery on the penthouse above prime office space.

Part of the answer to these questions lies in our inability, in the aerospace case, to predict exactly how much shock and vibration our isolated unit will withstand before failure. For the architectural case it is the inverse. We do not know how much or what kind of vibration forces will show up at the base of any given ventilating or air-conditioning machine.

The real question posed here with respect to vibration and shock isolation methods is: Are we on the right track? There have been some unusual achievements during the past few years in all areas of engineering. The entire concept of semiconductor devices was revolutionized by the transistor and the field of power control by the development of the silicon controlled rectifier. Yet we are still using the same basic hardware for mechanical vibration isolation, the resilient support providing either shock reduction, or vibration control above some particular frequency, usually higher than we can readily tolerate. Some highly specialized systems using pneumatic or hydraulic servo loops have been developed, but this is not close to a universal answer.

There have been several promising starts in the direction of improved equipment needing less isolation or generating less vibration. These include the damped-structure electro-mechanical assembly which is less sensitive to vibration, and the precision built mechanical equipment for air conditioning systems. This latter class of equipment is now coming into vogue along with the total energy systems that have as their basis an aircraft type gas-turbine engine. These approaches must still rely on the old-fashioned mechanical resilient isolator for adequate operation. No, there is still something missing. Once we find the answer to this problem, then the problem of ride control in both passenger and freight vehicles may seem easier to approach too. Until we find a better shock and vibration isolation technique, we cannot afford to be complacent.

Lewis S. Goodfriend

EDITORIAL

PNdB— APPLICATION AND MISAPPLICATION

There has been some recent activity in congress to set or to give the Federal Aviation Agency the power to set an upper limit on aircraft noise measured around airports. It appears that the limit will be stated in PNdB, the perceived noise level. There is great technical and political danger in this course and it might be of considerable value for members of congress and the regulatory agencies to review the history and original purpose of PNdB and the reasons for regulating aircraft noise.

Perceived noise level, PNdB, was developed by Karl Kryter for the purpose of "Scaling Human Reaction to the Sound From Aircraft" as so aptly expressed in the title of his 1959 paper. In particular PNdB was developed as a basis for prediction of the human reaction to jet aircraft noise and to permit certain decisions with respect to operation of various jet aircraft at airports surrounded by communities not earlier subjected to jet aircraft noise. Later Kryter and his associates found that certain additional allowances or adjustments had to be included for duration of exposure, and the presence of pure tones in the broadband noise spectra of jet aircraft sounds.

Using the PNdB scheme, it appears that one can get quite reasonable correlation between noise exposure computed in PNdB and annoyance. This is good and we believe that this is a good and useful application for PNdB. Recently, however, the armed services and the FAA have made use of PNdB in another form. To the computed PNdB they have added still further adjustments for day and night exposure, the number of exposures per day, and other factors. The result is called the Composite Noise Rating (CNR) and it too is in PNdB. The predicted PNdB are given in 5 PNdB intervals and the adjustments are in 5 PNdB steps. Now how does anyone tell whether the PNdB of some regulation refers to a CNR type of PNdB or the old fashioned kind computed directly from the spectrum of a real aircraft on test flights under full load conditions.

It would have been so much easier to continue using the letter identifications for the CNR ratings developed by Rosenblith and Stevens and published in 1952 and in several texts and handbooks thereafter.

PNdB has also been applied to non-aircraft noises by several writers and researchers without any apparent attempt to verify or validate their use. Single number ratings are dangerous to use because they instill more confidence than is justified in a multidimensional situation and they can hide critical influences which will only be apparent on examination of the complete sound spectrum. There are several other indices which may produce closer correlation with human reaction to the particular noises in question. This is not an investigation to be undertaken lightly using a few laboratory colleagues and graduate students for test subjects.

One final area of misapplication of PNdB is in enforcement. No one can, at this time, predict with any degree of accuracy the spectrum of a new generation of aircraft engines. If these engines have radically different spectra from those now in use, who can guarantee that PNdB will correctly predict the human reaction to the new noise. Furthermore no scheme that places the upper limit close to the normal operational, flight-profile noise level is a reasonable enforcement means. Currently, there are no instruments available to monitor noise and read directly in PNdB. Even if there were, how can readings be taken everywhere in a community at once.

The answer to the enforcement problem may be to reexamine the aircraft takeoff and flight noise vs time profiles and to approve aircraft for use at given airports on the basis of this data, keeping in mind the now available statistics on community noise and aircraft operations.

The idea of Perceived Noise Level when correctly applied is a useful tool. When misapplied, playing with PNdB can be a costly game.

Lewis S. Goodfriend

EDITORIAL

PENDING LEGISLATION

We hear a lot today about an informed citizenry. Among the items about which engineers working in the field of sound and vibration should be informed are various matters dealing with the control of sound and vibration that come before congress, the state legislature and one's own local municipal governing body and those in its neighboring communities.

Two current examples of legislation now being considered in Washington will have a major effect on our own areas of interest. The first is Congressman Theodore R. Kupferman's bill (HR 2819) to establish an Office of Noise Control in the Surgeon General's Office in the Department of Health, Education and Welfare. The second item now being examined is the assignment of the task of setting maximum sound limits for aircraft noise and sonic boom to the Secretary of Transportation. The bill, introduced by Senator Magnuson, (S. 707), would empower the Secretary of Transportation to,

> "(b) In any action to amend, modify, suspend, or revoke a certificate wherein violation of aircraft noise or sonic boom standards, rules, or regulations is at issue, the certificate holder shall have the same notice and appeal rights as are contained in section 609, and in any appeal to the National Transportation Safety Board, the Board may amend, modify, or reverse the Secretary's order if it finds that safety in air commerce or air transportation and the public interest do not require the affirmation of the Secretary's order."

Looking first at Representative Kupferman's bill, it is clear that this is a step in the right direction only if the proposed Office of Noise Control can establish some kind of effective program. We do not believe that the funding of research programs at universities and both private and government operated research organizations throughout the country will produce a useful result at present. Basically there is a shortage of research people in industry, throughout the universities, and in private research organizations at the present time. Providing funds for more research will only aggravate the shortage. Our suggestion is that funds be made available for scholarships and grants to provide for adequate undergraduate and graduate study in acoustics and the establishment of course programs in applied acoustics and mechanical vibration encompassing both the theoretical and practical aspects. Presently available personnel in industry research and at the universities could provide adequate faculty for the teaching program. In a few years there should be enough people in the graduate programs to carry on with an expanded undergraduate program and to begin expanded research activities in sound and vibration at all of the institutions and organizations capable of providing the administrative responsibility for them.

With respect to the bill introduced by Senator Magnuson, we can only hope that the FAA armed with the authority to act in the matter will in fact act to set some kind of realistic controls over aviation noise. We are not sure, as last month's editorial indicated, that PNdB levels are the correct tool for regulation. However, we understand that the FAA will hold hearings on *proposed rulemaking* whenever they start any action on noise level control. This is the time when each of us as a private citizen or as a representative of an interested organization can appear before the FAA and state our views in the case. There currently are many interested members of both houses of congress who will be monitoring the hearings. The combination of public hearings and interest on the part of the members of congress should assure that the public interest is served.

To keep informed on legislative matters related to our profession such as the two noted above, we need only call the local office of our congressman or those of our State senators. Local matters and State legislation can also be followed by checking regularly with the town clerk and local office of the members of the legislature. Each of these officials is usually happy to speak to technically trained people interested in the pending legislation. It is not important which side you are on as long as you are aware of the pending legislation and made your views and the basis for them known to those who have to make the decisions on them in our legislative chambers.

Lewis S. Goodfriend

RESEARCH AND PUBLICATION

There are three facets of research in vibration and airborne sound that continue to puzzle us year after year. The first relates to the subject areas selected for research. Second is the apparent lack of support for basic research among acoustical products companies. The third facet concerns publication of poorly done research and its corollary, poorly documented papers that may or may not report significant information.

Our observations indicate that very little basic research is being done either at universities or in industrial concerns that make and sell acoustical products such as mufflers, ceiling tile, building components, vibration reduction systems, and shock suppression systems, to name a few. There is a lot of cut-and-try experimentation, but this can hardly be dignified by the name of experimental research. In addition, a large volume of application engineering is assigned to corporate research laboratories. This misses the mark, too. It simply is not research.

Turning to academic research, we find many "research" projects supported by Federal grants. There are also numbers of published papers alleged to be reports of research. Some of these are clearly partial fulfillment of the requirements for an advanced degree. Others look like staff members' efforts to survive the "publish or perish" phenomenon. We should not overlook the publication of progress reports which are interesting since they usually deal with no progress. This leaves a few genuine research papers. But, where is work of the stature of that produced by Harvey Fletcher, W. P. Mason, or P. M. Morse and R. H. Bolt? Our present climate of Federally funded university "research" and product development industrial "research" must be re-oriented to once again produce work of such depth and quality. For example, little theoretical information of value has been published on the use of reverberation rooms since the 1944 paper by Morse and Bolt. It is even more appalling that many authors use such rooms for transmission loss, sound absorption, and sound power measurements that are not only of questionable validity but are theoretically indefensible.

A review of references or obviously omitted references is also illuminating. One category easily detected this way is the "new look at an old subject" which was preceded by identical papers in another related field. Lack of a reference to earlier work indicates to us that the author really did not go through the literature. Another category contains what might be termed the "company references only" paper. Here the author lists only those papers published by his colleagues or predecessors in the company or institution. Typically, where a colleague has referred to Rayleigh in a 1930 paper, we find not the original source, but the "in house" reference. Of course, there is no regard to the fact that such "in house" publications are virtually inaccessible. A second class in this category is the "author references only" paper. Here we find a list of the author's prior work often referring to topics more fully covered in other material. In some cases, indeed many, references to the author's own work are well justified, but basic references should be repeated.

Disquieting conclusions present themselves after our review of current published work and projects in acoustical research:

☐ Problem solving, not basic research, appears to receive the most attention and money in industrial and university research facilities.

☐ Published work is often accompanied by inadequate references. Careful literature search no longer appears to be one of the basic precepts for modern acoustical research in spite of the fact that the use of adequate reference material, and the documentation of such use, is of great value. It assists a reader in orienting himself, reduces further research on the subject, and simplifies analysis and discussion of the paper itself.

Lewis S. Goodfriend

SV August 1967

EDITORIAL
THE MEANING OF MEASUREMENTS

We have read the report several times and have examined the curves in great detail. We are now convinced that the one-inch thick report weighing two pounds resting on the Editor's desk tells the reader little more than the title of the project and the hopes of its authors. Why? Possibly another look at the report will tell us.

The report presents the results of vibration and sound measurements on small motor-blower units within a small reverberant room. It describes the size, shape and location of the room; the tests to be performed, and illustrates the results in a number (too many) of charts.

In looking at the results we note that all of the acoustical measurements made with the blower in the room have a rising high frequency spectrum. This contradicts our own knowledge that the spectrum should be falling for the test specimen. The curves of the background noise, without the test specimen running, show high frequency background noise levels far below those of the blower. We determined that if the sound level meter used for the measurements was on an incorrect setting while measuring a noise with a rapidly falling spectrum, the attached analyzer would be reading the internal noise level of the meter itself. Therefore, the analyzer could not show the actual levels of the sound to be measured.

The next trouble spot encountered in the report came when we looked at the background noise levels in the room—they had a rather flat spectrum rising slightly at the low frequency end. The instrument manufacturer's specifications verified that in some octave bands, room "noise levels" were identical to the internal instrument noise for the combined sound level meter-octave band analyzer being used.

Next we looked at the vibration levels measured on the floor of the room, at the base of the blower, and on the unisolated blower frame. The change in spectrum from one location to the other did not agree at all with the isolators used for the blower support. Again, equipment specifications assisted in solving the inconsistency. Once the accelerometer was moved from the frame to either of the isolated positions, the electrical signal caused by the acoustic noise output of the blower was greater than the vibration induced output. The change in spectrum shape occurs because of the difference between acoustic output and vibration output of the blower and the differences in the sensitivity of the accelerometer to acoustic and vibration excitation.

Data recorded for the acoustical output of the motor-blower assembly covered octave bands from 31.5 to 8000 c/s (center frequency). The room, however, had no dimension larger than 15 ft. Under these conditions there are so few modes within the room that the data in the 31.5 or even the 63 c/s band could not be valid. If this were not enough, we also found a similar fan in our file of old spectra which has a pure tone in the 31.5 c/s band at a frequency far removed from any room mode. This means that the level of the pure tone, measured in the reverberation room, is completely unrelated to the actual sound output of the blower. Later along in the report we did find a mention of the pure tone, but no comment on the possible error introduced by the method of measurement.

More questions than answers were provided by the text, and so abandoning it, we turned to the charts for solutions. We were again foiled; the charts certainly contained some of the necessary information, but without spending at least as much time as the author, we could not perform any meaningful cross checks. The charts were in four different sizes, with no combination that could be overlaid. The scales varied from one set to another and the reference acceleration level was omitted.

Of course, there are fundamental questions about design approval of a product on the basis of testing only the production prototype and, maybe, one or two production units. Certainly, a major influence here is the cost of sound and vibration measurements on one sample which may be as high as the entire production quality control program on electrical and aerodynamic properties. But, testing one or two units leads to some questionable statistical, and ethical, results.

Conclusions are usually a joy to read since for the most part they are brief, optimistic, and exude confidence. Still, our final judgment on this report must be negative in spite of the carefully performed tests and the volume of data reduction and presentation. The report was of little value to the reader and the work of little value to the firm that subsidized it.

How does this happen? It can happen because the organization needing the information has no one on the staff who can really interpret the data or design the experiment, and because competent use of electronic instruments is no protection from non-electronic difficulties that occur. The above cited report is hypothetical, but all of the examples were taken from recent reports that have passed across the Editor's desk.

Lewis S. Goodfriend

SHORT COURSE TO OBLIVION

Around Labor Day, the mail always brings numerous circulars advertising short courses and refresher courses on a wide variety of subjects related to sound and vibration. The phenomenon repeats itself in the spring and again just before school closes for the summer. What is the magic that a short course can work? We found it hard enough to grasp many concepts and place them in proper perspective during a full school semester, and even today, we wonder if we could master mechanical impedance concepts in one semester much less in the space of one or two weeks. Possibly, some one has developed new teaching methods that make subjects such as this clear in only a few days and can delineate the various subtleties with such ease and lucidity that they can be absorbed by every student. But, who is to teach us how to learn this fast. Most of those grasping at the short courses need the background and drill that only several weeks of step-by-step progress and review can allow. Just spraying the class with facts, methods, and equations is not going to really teach an individual any basic information or leave people with any useful tools.

If the short course isn't the answer, is there an answer to the question, Where can a man get some good courses in sound and vibration or acoustics generally? As we see it, anyone who wants to get down to fundamentals in sound and vibration has many avenues open. None really provide quick capsule training, but the long term benefits of the long route will be obvious to the seriously interested individual. Among the subjects with which the sound and vibration specialist should be familiar are mechanics, aerodynamics, basic electronics, instrumentation, applied experimental psychology, human physiology, physical acoustics, and for the well rounded senior engineering staff man, a knowledge of architectural acoustics, statistical methods, and materials technology.

The length and breadth of the listing of subjects important to the man seriously involved with sound and vibration is considerably longer than this, but this is a good start. It is also the probable reason that there are so few people working in the field. Most of us do quite well in the engineering world with capability in only two or three of these subjects. Why bother with more? The answer is the same one as why climb mountains or why make a trip to the moon.

To start the trip to a broader acoustical knowledge, it seems to us that a good basic college course in acoustics as taught in the physics department of many universities is essential. It is in courses such as these, with no attempt at application, that we first find out what causes sound to radiate, how it propagates and what it does when it meets an obstacle. Even if you have had the course fifteen years ago, it is likely to be a better refresher than any one week broad brush job. The next course we would choose is a basic electronic instrumentation course. It may require a semester of basic electronics first, but that's good anyway, because when we were in school, the transistor wasn't around and the beam deflection tubes had not yet been invented. Then, take a couple of courses in phychology. Some are more interesting than others, but one should be on experimental psychology. If you read up on physiology of the nervous system, the ear, and the mechanism of speech production, you may be able to skip the course on physiology.

At this point you may really know something about the fundamentals of sound and vibration.

Now, how about the *practical aspects* of the subject? That's a question that the short course candidate always asks, but if you have been taking the full semester courses, you will find that the practical stuff is in the literature and even in those musty old books in the library by, Lindsay, Den Hartog, Timoshenko, and Morse. It turns out that if you find out how to read what is printed, the practical answers are there too.

It may just be that the long course not only teaches the subject but at the same time lets us think about what is being taught and in that context allows the student to see the areas of applications and the interrelationships between the various parameters that go to make up a noise control program.

It is too late to register for the fall semester, but if we work fast, we can still get the catalogs in time to pick the right course and register for the spring semester. Let's see, Physics Department, Night Division, Acoustics I, Monday. . . . .

Lewis S. Goodfriend

THE USEFULNESS OF WORDS

This will be a short item. After reviewing several large reports and a number of smaller ones, we are impressed by the present trend to substitute words for planning, logic, results, and conclusions. Also, the use of excessive numbers of illustrations to replace a careful description of a device or system is a waste of the reader's time. Because we are in a technical field, we seem to feel that we have to make everything we write sound technical. The reports that I have had to read only reinforce my long-held thesis that engineers need to learn how to express themselves using English and not just to learn the language with its basic rules for syntax and grammar. One of the fascinating aspects of the reports we have read is that they all meet the tests for good grammar and syntax. But, they just don't communicate information very well.

Specialists in sound and vibration, it seems to me, have a special obligation to write clearly. Our area of interest is clouded with highly technical terminology about a group of subjects that almost any layman can characterize completely in colorful language. Almost every report involving acoustics in air, solids, or fluids starts off with a dissertation on decibels, then on the propagation of sound in the medium, and after twenty or thirty pages, gets into the heart of the matter. Why can't we assume that our readers either know about decibels and the fundamentals of sound propagation or never will, and get into the heart of the matter—the study covered by the project or program. The knowledgeable reader will be able to recall the information needed to deal with decibels and propagation, and the lay reader will fare no worse for not having the too complex explanation.

We have often heard the complaint from technical specialists that outlines are difficult to write, and it's easier to start by assembling the text. From some of the manuscripts that we have reviewed and papers we have read, we are convinced that a good paper, report, or article can only be constructed by following the same rules that everyone else who writes has to follow. The fact that it is hard to prepare an outline is usually an indication that the author's ideas are still disorganized in his own mind. Piling words one on another with no clear plan for the manuscript usually results in a verbal maze in which the reader soon becomes bored. The continued stringing together of words in the place of planning, logic, results, and conclusions can produce a fat report from which the reader may infer that some activity has taken place but can never be sure.

If we want our work to receive support within our own companies, from government agencies, and from the public, we had better learn how to communicate with the people who make up the company, the agency, and the public. Sound and vibration are topics receiving more and more attention from every quarter, and none of us would believe how quickly a private company report could end up as the key document in a congressional hearing on noise, vibration, or the "environment". If we can't communicate well with each other, we will never make it with the public and congress.

Good technical writing should be clear, concise, and natural. We would like to see more of it.

Lewis S. Goodfriend

EDITORIAL

EVALUATING THE EFFECTS OF SOUND ON PEOPLE

How does sound affect people? This is a simple question, and it is one that is being asked with increasing regularity of engineers and scientists in the field of acoustics. Unfortunately, this is the same question that the engineers and scientists have been asking themselves for a long time, and for which meaningful answers have only started to appear during the last few years. It is with this in mind that **S)V** will continue to publish original material on the subject, reviews of the status of the commonly used techniques, and descriptions or discussions of equipment for direct indication of the various ratings.

In the October issue of our **S)V OBSERVER** took a look at the highly complex Zwicker method and one manufacturer's beautiful machine for direct evaluation of a sound in terms of its loudness. In this issue, we are taking a look at the old single number rating: the A-weighted Sound Level. There are many reasons why the use of the A-weighted level either alone or in conjunction with the C-weighted level is so attractive. First, it appears to have a fairly high correlation with subjective response in terms of both loudness and annoyance. Now J. H. Botsford has shown that it can be used to predict the hearing hazard presented by almost any industrial working environment. In a paper by J. K. Brasch, in the December issue, he examines the correlation between the A-weighted sound levels and other measures of loudness evaluation for high-speed highway noise.

One might justifiably ask why has the A-weighted sound level, which has been available for so many years, not been a successful measure of loudness or annoyance to date. We believe that there are at least two fundamental reasons. Both reasons that the A-weighting takes on a new appeal lie in improvements in the sound level meters available for making the measurements.

The advent of semiconductor technology spurred the development of lightweight precision electronic equipment. With such equipment available, the electrical circuit which comprises the A-weighting network for any given instrument could be designed to provide the exact attenuation characteristic specified by the standard within a few tenths of a decibel. In turn, small microphone cartridges with their low-level output could be used effectively. It was unfortunate that those who drafted the existing standard for Sound Level Meters (USASI S 1.4—1961) found it necessary to permit such wide tolerances at low and high frequencies where the need for precision is most critical. Otherwise, we might have had the present level of work a few years earlier. However, older microphones were large and had poor low and high frequency response characteristics. The result was that the older sound level meters were very likely to give considerable misinformation since one could not be sure whether a high A-weighted reading resulted because of a large frequency component or a moderate high frequency signal. With the precision sound level meters available today and the improvements even in the general purpose sound level meters, the A-weighted readings are closer to the truth than ever before. At this point in time, the computed and measured A-weighted levels are in excellent agreement.

The second reason that the A-weighted levels are receiving more attention is that the equipment required to make the measurements has become reasonable in terms of size and weight. Even with the largest of the sound level meters available in the 1950's it was a tiring task to make many measurements covering a large area. In the light of these reasons, new attention should be given to the A-weighted sound level either alone or in conjunction with the C-weighted level for purposes of rating or evaluating noise environments.

We are not suggesting that the A-weighted Sound Level be used for any other purpose than rating or rank-ordering an environment. For purposes of research, design and remediation, it is still imperative that the engineer and scientist have available octave- or one-third-octave band information and detailed evaluation in terms of loudness or jury ratings. What we do recommend is that the simplest appropriate rating scheme be used for each particular task involved in evaluating the effects of sound on people.

Lewis S. Goodfriend

EDITORIAL

IN THE PUBLIC INTEREST?

When will the airline industry and the FAA stop deluding themselves that they are acting in the public interest where matters of aircraft noise are involved? The recent withdrawal of the airport operators' group and withdrawal of financial support by the Airline Pilots Association from the National Aircraft Noise Abatement Council will be reported in detail in the **S)V Observer** in a future issue. These actions highlight the public dissatisfaction with the airport noise problem. We were present several years ago when an airline spokesman told a congressional hearing that if the public wanted air transportation, they would have to live with the noise. Although reports reaching us during the past year have indicated a moderation of this stand, the situation will not improve perceptively until the airlines and the airframe and engine manufacturers consider the public interest. And, we don't mean just the flying public.

There are many aspects of this problem. These include design goals, research costs, rate structure, tax relief, routes, airport location and land use, as well as Federal regulation of aircraft noise.

One of the most critical matters related to any program for noise abatement and regulation is the goal sought. All of the work to date appears to be based on the idea that we should set the maximum allowable aircraft noise levels at the maximum tolerance levels of a majority of the airport neighbors. In our view this goal is fundamentally wrong for two reasons. First, it now appears that the majority of the neighbors surrounding an airport are not essentially representative of the group which finds the noise objectionable. In some situations as few as 1% and usually no more than 20% of the airport neighbors will become identified with any action to obtain relief from aircraft or any other noise in the neighborhood of the noise source. The question now arises as to whether one thousand people must suffer what to them may be extremely disturbing noise levels just because their neighbors have different thresholds of response, indifference, or pleasant associations with aircraft noise.

The second error in the current approach to this problem is based on the idea that there is a level of tolerance or acceptability that exists just below the level at which the sound is unacceptable. This notion arises from the early design of the PNdB scale. The perceived noise method was originally designed to compare the noise levels of pure jet aircraft with those of piston aircraft at a major metropolitan airport. Since the original proposal for a noisiness or perceived noise rating scheme, the method has been revised and refined several times. It does not and cannot give an absolute rating of acceptance or tolerance. No completely objective study of subjective response of individuals and groups within a community has been carried out, to date. If such a study was available, it might be far more heartening than those in the aviation industry fear. Other areas of human response, not laboratory studies, but true behavioral analyses indicate that in some areas man's response above threshold is one of no tolerance and total unacceptabitiy. Two examples are the response to flicker in the peripheral visual field even in the presence of high-level illumination of the central area, and the response to the odors of the mercaptors (skunk for example). It may turn out that for a fairly well fixed segment of the population, the audibility of aircraft noise at levels that interfere with speech communication in the home, telephone use, or the audition of reproduced entertainment sound signals is unacceptable. Some reduction in acceptability may also result from apprehension or from the visual effects on television reception.

Why is it that we are such a great nation for product surveys, test marketing, radio-television interview programs, but we haven't put any non-government money into research of this nature. When the airline industry realizes that it will have a much easier time convincing the non-flying public to fly if they aren't angry with airports, airlines, and aircraft, they might be willing to budget the same volume of money that goes into advertising for research into both the behavioral and noise control aspects of the problem.

If the FAA maintains a position of requiring a mandate from congress for every action it considers controversial, we will have inadequacies in many areas including safety and noise. However, we are convinced that they must be bold and far-sighted if they are to promote aviation effectively. They are not only housekeepers and regulators for the aviation industry, they are also responsible for guiding the industry on an exciting new course that will keep the industry profitable and growing.

Now is the time to reassess the needs of the nation in terms of aircraft noise research and to chart a new course that really represents the public interest.

Lewis S. Goodfriend

EDITORIAL

SOUND AND VIBRATION

Our name, **sound and vibration,** is not just a title, it is an acknowledgment of the fact that sound and vibration are the same phenomenon, only the media are different. The facts that we can hear solid-borne vibration if we have placed our head in contact with a vibrating rod, and that the walls of a building shake and in turn rattle the glassware or china in response to low frequency air-borne signals, testify to the truth of our belief. Since this is true, why do we see so little attention to the environment for vibration testing facilities, and so little attention on the part of acoustical designers to the vibration response of commercial, residential and office buildings to air-borne signals.

The acoustical conditions that exist in many vibration testing facilities require that test personnel wear hearing protective devices. Although hearing protection may be required, appropriate noise control measures can limit the maximum levels at locations away from the actual shaker itself. Also, the problem of annoying noise levels in adjacent spaces would be considerably reduced. We find it hard to believe that management and design personnel will not provide adequate budget for appropriate noise control for such spaces. Considering the value of the equipment that goes into the test facility and the care with which it is selected, there should be no reason that any shaker room should not have adequate interior acoustical control materials and sound isolation facilities including suitable gasketed doors and muffler equipped ventilation. Whether the noise control equipment is fabricated in the company shop, installed by an outside contractor or purchased from a responsible manufacturer of noise control equipment, such measures should be considered as basic a part of any vibration test facility as the shaker itself.

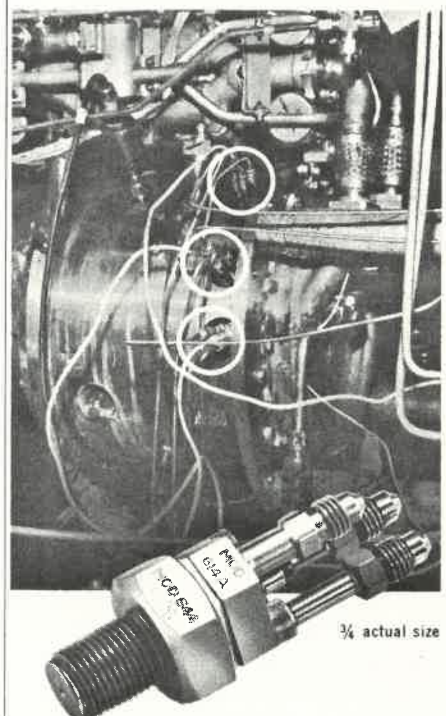
There are several "noise-induced" vibration effects that are seldom given full credit as the causes of complaint in areas near local industries. Basically, all of these problems are related to the ability of low frequency acoustical signals at moderate levels to cause large amplitude responses in building structures. Typical structures run in size from private residences to aircraft hangars. The problem is clearly shown in the effect of low overpressure sonic booms, which although they may do no visible damage, certainly cause dynamic forces to occur in the structure and can cause secondary sounds such as rattling windows.

It is well known among blasting experts that many quarry blasts that are only slightly audible are capable of structural damage while the noise of a time-delay blast will rattle the china and glassware but will cause no structural damage.

Other sources that produce continuous low frequency signals that result in shaking residential structures and some commercial buildings are railroad car shakers, industrial furnaces, and diesel-engine low-pass-filter mufflers. Since the neighbors often complain of "dangerous vibrations" from these sources, the municipal, health, and engineering officials charged with evaluating the situation or enforcing local laws can and often are misled. The problem is compounded when vibration experts can't find enough earth-borne vibration near the source to measure.

We believe that sound and vibration must always be evaluated as one phenomenon.

Lewis S. Goodfriend



EDITORIAL

THE MISSING TOOLS

We have looked at quite a few new equipment packages and test facilities lately, and we find the same omissions—no oscilloscope and no headphones. We wonder why. We do like all of those sophisticated systems with their rows and rows of controls, dials, and meters, but how can you tell that they are analyzing the desired signal and not that of the local AM broadcasting station. In some cases only the headphones can indicate that the signal is the acoustic response of an accelerometer and not the acceleration of the device under test. With the oscilloscope and earphones at the console or in the equipment package, man—the operator, whether technician, engineer, or scientist—can make himself a part of the measuring system. The quickest way to locate hum in a system is through the use of these two tools. Excessive clipping of noise is obvious on an oscilloscope screen as are unbalanced clipping, phase shift, and ringing. Headphones can also be used to check for low-level leakage between channels where the leakage test signal is of the same order of magnitude as the noise.

This is not to suggest that oscilloscopes be used for signal readout. They are good for readout, especially with 16mm or 35mm automatic framing cameras or Polaroid cameras. However, the simplest three-inch, 450 kc, DC coupled 'scope is an essential operating tool and is as important as screwdriver, flashlight, and chart paper. More sophisticated oscilloscopes with dual-channel, split-screen, single-sweep, 5 Mc capability and a delay line are also available for on-line monitoring. Even four-input, split-screen units can be economical monitoring devices. The storage display and large screen oscilloscopes also offer useful features in the sound and vibration measuring system. Actually, the modern oscilloscope with internal calibration can serve as an adequate readout in many applications. It can be used to examine accelerometer output for machine vibration studies, and it readily shows fundamental and harmonic excitation of various machines elements. It can often free more complex devices—counters, digital voltmeters, frequency meters, graphic recorders—for use elsewhere in the measuring system.

As we have indicated before in these columns, much misinformation is inadvertantly reported as data. A good oscilloscope connected to appropriate points in the system and used regularly should improve the chances of collecting the data and not the noise or crosstalk.

HERTZ

Although we look with sadness on the almost universal acquiescence to proponents of Hertz in the publication field, we feel that common sense calls for S)V to use Hz some time in the near future. As cps is slowly interred, we bow our heads and shed a bitter tear. For purely political reasons, a clear easy-to-visualize term is replaced by a name not associated in this hemisphere with the unit it designates. Here is Gresham's Law of Scientific Terminology at work.

Lewis S. Goodfriend

EDITORIAL

INFORMATION VS. SPECIFICATION

In a competitive economy, there will always be a range of products designed to perform the same nominal task, each having different performance characteristics. It is up to the manufacturers to meet the needs of their market, or they will not survive. However, it is also true in our present economy, that the designer, or an architect, or the future owner or user of the end-use system, selects a given component or product to meet a specific need on the basis of available performance information, or on the basis of cost. Under unusual circumstances, a product may be selected on the basis of the known quality and the integrity of the manufacturer. Considering these circumstances, it is unusual that so little performance information is included in the performance specifications for most products. This applies to architectural products as well as items for consumer and business office end use.

Motors for vacuum cleaners are noisy and the blower is noisier. A similar pair of items for a computer are equally unsuitable from the user point of view. An architect's mechanical-engineering consultant specifying a fan or pump is faced with the problem that no manufacturer can tell how much noise or vibration to expect at the fan-room floor.

It is true that several engineering and trade groups have specified the method of rating the ducted sound output of fans, but this is only a small fraction of the whole problem.

The manufacturers of vibration isolators have prepared tables for the selection of vibration isolators for architectural use, and will provide the physical design data on their isolators. But, where is the information on the source of vibration?

The architect, mechanical consultant, or product designer can specify that a component meet certain rigid vibration and sound output requirements, but these will not be realistic unless there is information from the manufacturer on the actual product itself. In some industries there has been discussion between manufacturer and purchaser. But, even under these circumstances, the data are often taken under conditions that do not readily permit an application to the end-use conditions.

It is at this point that we should stop talking about specifications and talk about product information and technical services to the purchaser.

The computers that have done so much to speed work in the accounting, engineering, and data processing fields are far noisier than they need to be. Household products from the vacuum cleaner on up through the home air-conditioning plant are sources of continual complaint to their manufacturers. We are all aware of the problems of industrial noise in the community and within the industrial plant itself. Much of the noise in each of these situations could be greatly reduced by the application of product information supplied by the parts manufacturer to the product manufacturer. The information could then be used to design the noise and vibration control elements on a realistic basis.

The "use" requirements should dictate both the isolation needed or available and the allowable sound and vibration output of a component in a specified test fixture. The measurements may be made using accepted standard procedures or fixtures if they are suitable. But, a fan or motor bolted to a sheet metal or die-cast housing does not perform in any way like the same unit mounted on spring isolators supported by a seismic mass. It is true that the product designer might try to calculate the output under the use conditions from laboratory measurements made using the seismic mass; but anyone who has tried it will know of the gap between theory and application to real products for which mathematical models are difficult to construct. It is possible to measure the mechanical impedance of the product at the appropriate point and estimate what the component will do when attached at this point, but that is only the beginning. More information is really needed. To be sure that the measured mechanical impedance is not out at three or four sigma, a program for measurement of the mechanical impedance must be carried out and the statistical limits studied to learn what combinations of components will be acoustically or dynamically unacceptable. At this point, most design programs run out of time and dollars.

The answer seems to us to lie in a better approach to the specification, sale, and purchase of components and products that generate noise or vibration. Notwithstanding the tremendous impetus provided by military and aerospace research, our commercial application of the knowledge developed has been small. There is still a great gap between information on which to base specifications and the needs of the specifier.

Lewis S. Goodfriend

(Our Authors—cont'd from p. 4)
tioning industry. He is a member of the Acoustical Society of America, American Society of Heating Air-Conditioning and Refrigerating Engineers, American Institute of Electrical Engineers, and the Research Advisory Committee on Noise in Buildings.

Mr. Blazier has published and presented a number of papers in his field and holds degrees from the University of Kansas.

Hoover

Techniques for the control of noise in air handling systems are covered by **Robert M. Hoover** in this issue (see "Air Distribution Noise Control in Critical Auditoriums," page 16).

Mr. Hoover is engaged in noise control in industry and transportation, in product development, and in building acoustics at Bolt Beranek & Newman Inc., Cambridge, Mass. His projects have included noise control design for compressor installations and large industrial fans, community noise problems resulting from plant noise, commercial and military aircraft noise studies, and quieting of military and commercial air-conditioning units and industrial machinery. In the field of building acoustics, Mr. Hoover has worked on the design of measures for controlling both structure-borne and airborne noise resulting from mechanical and electrical equipment in office buildings, concert halls, and research facilities.

Prior to joining BB&N, Mr. Hoover was employed at the Ordnance Research Laboratory, Pennsylvania State University. He worked on the development and calibration of underwater sound transducers, measurement of sound propagation in the ocean, and studies of the magnetostrictive properties of materials.

Mr. Hoover has presented and published numerous papers on noise control and is a member of the Acoustical Society of America. He holds a BS degree from the University of Maine and an MS degree from Pennsylvania State University.

EDITORIAL

ENDING THE AIRPORT NOISE PROBLEM

Recent discussions with respect to the evaluation of noise in communities near airports have led us to conclude that the airport noise problems will continue to plague cities throughout the nation until congress shows its willingness to support the Federal Aviation Administration when this agency acts to prevent acoustical disaster. Private conversations with government officials and consultants or employees for major cities have convinced us that the FAA knows how to control the problems near airports through realistic land-use planning. However, until they have some means of enforcing their recommendations, they cannot really improve the situation.

The notion that certifying aircraft to be no noisier than a far too high PNdB value is only a gesture. The real effectiveness of the FAA can come only when it can refuse to provide any services to an airport operating agency which has not complied with their rules for land-use planning around the airport. We say "rules" rather than "recommendations" since we believe that these present recommendations must be made into rules. However, the enforcement of these rules must be above political control so that no mayor, no city council member, no member of congress can appeal to the Secretary of Transportation and have the rules suspended. Also, the real estate interests must be made aware that if they refuse to cooperate, they will jeopardize the local economy. Even if they cannot be prosecuted for, or enjoined from building housing developments or apartment complexes too close to airports, real estate sales and the local economy could suffer if the commercial air transport industry moved operations out of the airport. No major or feeder airline with aircraft costing from one-to-several million dollars each will risk flying into an airport not equipped with the latest FAA navigational aids and an FAA operated control tower except in the lowest traffic density areas. Without these controls, the FAA is powerless to direct the control of aircraft noise in the vicinity of airports.

We believe that the Congress must enact the appropriate supporting legislation that will arm the FAA with the legal authority to refuse to provide equipment, money, and controllers to those airports that are not adequately protected against residential land use in the areas that the FAA designates as unsuitable for residential use. With such legislation covering the entire country, there can be no problem of one county vying with another for the airport serving the area on the basis of lower costs and easier rules for land use planning. The FAA, the Departments of Health, Education, and Welfare and the Interior are all powerless to control land use planning around airports without the additional legislation that we are recommending be passed by congress. How long must the public wait for their elected representatives to protect this area of the public interest?

Lewis S. Goodfriend

TERMINOLOGY, DEFINITIONS, and USAGE

There is a popular game in the field of sound and vibration. We are sure Parkinson has a precedent for it, but basically it is the generation of a new name, symbol or "standard" curve or contour that someone has found convenient. It may not be accepted outside of his own laboratory, nor needed anywhere for that matter. For example, we begin to find the N curve available on some sound level meters and filter sets. At first glance we would have expected these to be Zwicker's community noise contours which are labeled N contours. We were wrong. They are the 40 PNdB equal "annoyance" curve. Since the equal annoyance contour and the Zwicker contour are rather different in shape, considerable confusion can result.

Standards committees move slowly, and justifiably so. However, when they do act they should provide a document that is readable prose and one that is applicable in the 1970's. We have been encouraged by recent ASTM and USASI documents. We would now like to see USASI bring its standard Acoustical Terminology S1.1 up to date. Many of the definitions in S1.1 are stilted, excessively formal, or not according to present usage. We particularly deprecate the definition of the *decibel*.

> "The decibel is one-tenth of a bel. Thus the decibel is a unit of level when the base of the logarithm is the tenth root of ten, and the quantities concerned are proportional to power."

In fact, the decibel is not a unit since a unit is a division of a linear scale. It is a division on a logarithmic scale. It may not be easy to find simple English prose to state what the decibel is, but let's try.

Similarly, the term *sound pressure* in the standard is defined as:

> "The sound pressure at a point is the total instantaneous pressure at that point . . ."

This is not generally the use to which the unmodified term *sound pressure* is put. To most users of the term with whom I have talked, whose papers I have read, or to whose paper I have referred in the scientific literature, the unmodified term means the rms sound pressure. When we want to talk about the instantaneous value we use that particular modifier. We may even have to add other modifiers to sound pressure to make clear an intended use not anticipated in the standard terminology, but we can in general make clear our meaning by explicitly defining the word in the particular paper.

We are pleased to note the trend away from the use of three letter symbols for sound pressure level (now accepted as L_p) and sound power level (now accepted as L_W). Here again the main subject is the level. The subscript tells us that the level is computed from a sound pressure or a sound power reference. In the absence of a stated reference, common usage tells us to choose 0.0002 microbar for the pressure reference and 1×10^{-12} watt (one picowatt) as the reference for sound power. The trend is a good one and we trust that this is a good omen. With vigilance on the part of all in the field of sound and vibration, and inputs to the committee members from our own technical societies from each of us, we may be able to make the standards of the 1970's easily read useful documents. This is particularly important for those to whom our field is a peripheral area as well as for the acoustical expert. It might even improve communication between those working in sound and vibration and our fellow men. They in turn might even try to communicate with us.

Lewis S. Goodfriend

MORE ON STANDARDS

There is a standard for specifying and identifying frequency bands and band limits.

No one would ever know it to look at the literature and manufacturers' catalogs, but it is true. USASI S1.6 specifies the preferred band center frequencies, the method of numbering bands linearly on a logarithmic scale in accordance with their center frequencies. It also provides for bands outside the range of the table in the standard. Why IEEE in revising or reprinting the old AIEE 85 standard, "Airborne Noise Measurements on Rotating Electrical Machinery" still used octave band numbers starting with the one centered at 125 Hz as Band 1 is not clear. Most air conditioning equipment manufacturers have called Band 1 the band from 20 to 75 Hz in the old commercial octave bands. At the present time, AMCA uses "1" to designate the band centered at 63 Hz.

It is difficult to believe that there is an USASI standard relating to frequency bands at all, but there are in fact two USASI standards that deal with frequency bands. USASI S1.6 already noted and S1.11-1966 which is concerned with octave, half-octave and one-third octave filters. These two standards provide a simple clear method of specifying the center frequencies of the bands used and of numbering the bands if some number other than the center frequency is desired. The bands and their numbers in accordance with these standards permit easy adaptation to computer programming, and provide a simple system with no ambiguity. The system permits numbering bands down to very low frequencies for use on low-frequency vibration work and on up into the ultrasonic (RF too if you really insist) region. Why must the band numbers start with "1" for the lowest band in our particular experiment.

We have consistently urged the use of existing standards unless they are outdated. In that case anyone who substitutes another method, procedure, or practice for one specified in an existing standard should notify the appropriate standards body (USASI, ASTM, IEEE, Acoustical Society, IES) and advise the secretary or chairman of the standards committee of the need for revisions to the standard. It is true that on several occasions in the past, suggestions for revisions have gone unheeded. To help forestall such problems, S)V will publish appropriate paragraphs from your correspondence or your entire letter if you wish whenever you call on the standards organizations for revisions. You can also submit letters to the editor for publication, and can submit papers, short or long, to suggest the need for new or revised standards or to comment on existing standards. We also suggest that whenever you call for a revision, you have an outline of the revisions needed. We also hope that you will be willing to serve on the committee to prepare the revised standard.

Standards are of value only so long as they are used. There are many appropriate and useful standards available. Use them. They not only tell you how to do the job in an accepted way, they really form the basis for the language of engineering and science. Without them we could not communicate at all. Using only the few we find handy, limits our ability to communicate and may even garble the message. There is one word of caution. Don't substitute a standard in place of thought. To those writing standards, I caution you to consider both theory and practice. Standards which permit precise measurements on low cost items at great expense may fall rapidly into disuse. And one final word, there are not enough symbols and signs to avoid duplications in an area of engineering as broad as sound and vibration. Convention, usage, and convenience may mean more to the practical use of a symbol or standard abbreviation than avoiding its repetition in some other area of the field. How much confusion results from using S for electrical susceptance, acoustical area, and thermodynamic entropy? If possible ambiguity appears in a particular written document, care in writing or the use of subscripts can resolve the ambiguity.

Lewis S. Goodfriend

EDITORIAL

THE ENGINEER IN THE ECONOMY

Where will we all go if peace returns, and we are once again faced with a peacetime economy. Will we head for boom and bust under a mad wave of loose credit selling, or will we all be so tightly documented by the computers of the cashless society that we can never buy anything that we can't afford? And, why should we ask these questions in a technical publication anyhow? The reason really goes to the heart of the question, "Will we all be here at the same (or similar) desks next year or the year after" We may not be out selling apples as happened even to engineers during the depression of the 30's, but we had all better take a good hard look at where the economy is going now. When peace gets here and the defense spending shifts, cutbacks come through, and aerospace research is slow to pick up, whose fault will it be if a lot of us are out on the street?

The picture is slowly taking shape throughout the research and industrial areas, and it looks like a problem similar to the post-Korean period. There may be no explicit recession for the soft goods sections of the economy, but those engineers and scientists who have been hard at work in federally financed or military-oriented privately funded research may find that their skill is not needed in the present slot and no jobs available in the private sector at the same pay scale. The private sector does not demand zero defects. In fact, the possibility of designing modular equipment for the private sector is getting popular. It makes service easier and places few real restrictions on design. However, the results can be as shoddy as ever.

Where will people skilled in sound and vibration work fit within a totally consumer-products oriented economy? On the basis of a few tours through department stores and toy stores throughout the East, it is obvious that there are many innovations still waiting to be made in consumer products. Toys are especially vulnerable to bad design. Manufacturers of consumer products are still unaware of the readily available techniques and materials to provide better products and quieter vibration-free products at the same or only slightly higher costs. Now is the time for the military-oriented and aerospace-test personnel to plan their futures. It is true that many of the aerospace companies will continue to supply services and equipment to the space program and the civilian economy in a post-Vietnam period. But, it is playing Russian roulette to think that your own company will still be able to continue without changes.

We are convinced that the civilian economy can absorb a large number of people from the military and aerospace-oriented sound and vibration field, and that companies manufacturing consumer products can become profitable customers of the firms now supplying services and products to the military and aerospace industries. The reorientation plans must be made now and continuously updated. All of the talent, experience and equipment now in use in the space and defense programs must not lie idle when peace comes.

There are many problems to solve in vibration and noise control, air and water pollution control, transportation, housing, and sociology. The same effort devoted to these areas for the military and aerospace programs is now needed to keep our nation healthy and whole. Have you made your personal plans or set up a plan for your company?

Lewis S. Goodfriend

LOW-QUALITY CONSUMER PRODUCTS

There was this new "quiet" vacuum cleaner bought to replace the aging relic that failed to pull any more vacuum, only when it was plugged in, no quiet at all. Even making due allowances for the larger motor and the low-cost impact plastic case, it was unbelievable that a consumers' rating organization and the manufacturer both thought that this was a quiet machine.

How about the new bicycle for the family's oldest child that comes in assorted pieces with inadequate instructions so that you have to guess at what goes where. Then there is the case of the new television set that just doesn't work correctly. The dealer is too busy to really try to find the trouble. That is, if he is really technically qualified to look for it, and he has his money. (If you paid cash or if you financed it, the dealer has no more interest in you, the set, or your complaint.) The bank or finance company is unsympathetic and the owner has to live with the defects. Change the machine, it's a car, a washer, it's a snow blower, a lawn mower, a fully automated kitchen range . . . The list is endless.

What astonishes us is that almost nobody cares. Yes, the President cares and so does Betty Furness, and just possibly the sales manager of the company that made the product or maybe it's the president of the company. True, a letter on your firm's letterhead addressed to the company official may reach him. It just may. Then again, it may not.

But let's stop a minute. We have the one nagging question to ask. Do you care? As we have traversed the aisles of many discount houses throughout the country looking at the wares and considering the quality of available merchandise, we are struck by the fact that we are a nation of bargain hunters. Some of us, with the full knowledge that we may be getting a "lemon" will buy a costly item on "special sale" and live to regret it. On the other hand there is no necessity for reputable manufacturers or merchandisers to pander to persons with these tastes. Cynicism and hypocrisy have brought about much of the problem leading to turned-off and tuned out young-people.

What it boils down to is that our economy is no longer based on true needs being met in the marketplace by competing manufacturers and marketers who offer a range of products in varying price categories to meet varying needs. We are told that all of the products are superb, we need them even if we can't use them or as one radio commercial puts it "What can *you* say when all your friends start discussing . . ." There is no longer any integrity in the marketplace. At least none is visible. Were it not for the Federal Trade Commission, The Surgeon General's Office, and so many other regulatory bodies that it's hard to keep up with their rules, we could all make a fast dollar.

This does relate to sound and vibration. The economics of manufacture and sale of products in an expanding economy should produce a good profit for everyone. However, price increases do not seem to keep up with costs. At least, that's what I'm told by my manufacturing and marketing friends. The only way to make ends meet is to cut something out of the product or find a less expensive way to make the same product or an even better one. Now, this is where people working in our area can really contribute to their company's competitive position. Since the sound and vibration engineer must look at a product with an open mind and from every point of view, he may even be able to see where product improvement, ease of manufacture and a quiet result can all be accomplished within the budget.

The excuse for low-quality consumer products is usually a mixture of greed, ignorance, and resistance to change. Those of us outside of design, production and sales should make every effort to contribute our best to make our company's consumer products high-quality, low-cost consumer products instead of vice versa.

Lewis S. Goodfriend

LOOKING FORWARD, STEPPING BACKWARD

The Acoustical Society of America announced the results of its Council Committee on Reorganization of the Society at the annual business meeting of the society in May. The report of the committee proposes some changes in the by-laws. The basic recommendations of the committee and the proposed changes were read to those few members of the society who took the trouble to attend the society's business meeting. There were in fact less than 50 of the Acoustical Society's more than 4,000 members present. Thus very few members are yet aware of the proposals. What are the proposals?

The Committee recommended that each year, the members would elect a President Elect, a Vice President Elect and six members of the executive council at large. Thus the Executive Council of the society would consist of the president, vice president, president elect, vice president elect, and the six councilmen at large. The Treasurer, the Secretary, and the Editor in Chief would be elected by the Executive Council for a period greater than one year. The Technical Council would remain unchanged but would be presided over by the vice president elect. The secretary would not only be elected for a period of more than one year, he would be a full time employee of the society.

Considering the fact that the present structure has existed for a very long time and the needs of a scientific society, especially this one, have changed considerably in recent years, the committee has recommended what appear to us to be relatively insignificant changes. But they are dangerous changes in terms of the goals of a scientific society. Why the committee felt that the members of the Executive Council could be better informed about the qualifications of a member for treasurer, secretary, or editor is difficult to fathom. We are convinced that further insulating the three officers with the greatest continuing responsibility from the members to whom they are responsible is a dangerous step in the self destruction of the society. When the members of the executive council feel that they have special wisdom or special access to knowledge of a man's capability, they are taking from the members the right to structure their society in the manner they desire and with persons that they trust to carry out their best interests. These best interests may in some cases not coincide with the views of the executive council. We have seen scientific and technical societies become less effective instruments of science and technology by just this type of restructuring of the executive chain.

There is nothing wrong with the society having a paid Executive Director reporting to the Executive Committee of the Executive Council, but the society's secretary, treasurer, and editor should, in fact must, serve at the pleasure of the members. Paid officials can be selected by the elected officers.

If the Acoustical Society has problems getting members to attend business meetings and to participate in the nomination of and selection of candidates for office, then the timing of the meeting, the nature of its agenda, and the possible need for regional representation might be in order, not dimunition of the members control of the selection of men whose judgment and actions are critical to the society's well being.

The Acoustical Society of America has done well by its members in many areas and less well in others. Among its achievements are its publications, in particular the Journal with its papers, references to contemporary literature, patents, and other back-of-the-book matter. The Society's meetings are well attended and are truly scientific in a day when many society meetings are more social or sales oriented. Its educational activities are slowly becoming effective in orienting more young people toward acoustics and providing information for school use.

If restructuring is needed, it is in the areas of committee objectives and society goals. Until the Acoustical Society assumes the responsibility for providing information and guidance to the public through committee reports, more intensive standards activities (through ASTM and USASI joint activities), and through the use of information publications such as newsletters or a society activities publication, it will not be fulfilling its proper role. It is through such internal information publications that the problem of acquainting members with candidates for office can be solved, and interest of members in the society's business can be maintained. The Journal must not be relied upon for this purpose. It is often read months after the need for communication between the officers and the members has passed. IEEE has a whole hierarchy of information publications down to Section Newsletters and Group Newsletters, both very useful. The AIHA has a Newsletter that carries much important business information that allows the members to work effectively to carry out the aims of the association which incidentally has a much smaller membership than the Acoustical Society.

The executive council of the Acoustical Society should itself reexamine the purpose and goals of the society for the last quarter of the twentieth century and plan to take giant strides.

Lewis S. Goodfriend

EDITORIAL

POOR LAW VS NO LAW

We have recently been appraised of the proposal of the United States Department of Labor to issue rules under the terms of the Walsh-Healey Act affecting the maximum sound levels in industrial environments. The Walsh-Healey Act covers work performed under contracts involving $10,000 or more. Today, this leave out few contracts. The proposed rule will be subject to public hearings on November 6, 1968. What is the proposal? It would limit the noise level in a working environment to 85 dBA (decibels, A-weighted). Furthermore, it would require that hearing protection equipment would be mandatory if the levels exceeded 85 dBA. A set of tables is provided that would account for intermittent exposure to different environments. In an earlier effort to protect those working in noisy industrial environments, the American Council of Government Industrial Hygienists (ACGIH) proposed a set of "threshold limit values", but pegged the level at 92 dBA or, using the average of the levels in the 500, 100, and 2000 Hz octave bands, sets 85 dB as the maximum.

Who is correct? The answer depends on how much protection is to be offered to what percentage of the working population. If the protection offered by the Department of Labor's proposed rule is for 90% of the exposed population in a 40 year working lifetime, then it is an excessively restrictive regulation. On the other hand, the ACGIH Proposal may result in protecting less than 90% of the exposed population during a working lifetime less than 10 years. The federal proposal does not account for the presence of pure tones, while the ACGIH proposal includes a 5 dB adjustment for pure tones, a change of limits for daily exposures less than one hour and a limit for impact noise.

Another piece of noise regulation that has become law is the California vehicular noise regulation. Here the combination of maximum A-weighted level, measuring distance, and requirement for operation at full throttle, combine to reject current Cadillacs while passing some trucks that have unpleasant low frequency signals that can shake the walls of houses near a highway.

The members of the various state legislatures, the administrators in the department of labor, and the government industrial hygienists are not to be too severly criticized for having trouble writing perfect laws to cover hearing protection or automotive noise. Most engineers do not appear to be able to communicate effectively with lawyers and legislators. We can talk about general cases and we can specify a sound field or spectrum in detail. What we have not been able to do is to relate the sound field or the spectrum to human response except in very broad statistical terms. Also, there are many engineers who over generalize. The lawmaker carries this one step further when he makes rules that must apply across the board to every case and, just because the engineer did not foresee the special cases, does not relieve the unhappy industrialist or the rejected Cadillac owner of the obligation to conform or suffer the penalty.

This column has often pleaded for thoughtful engineering and effective communication. These three new instances clearly show where some of our failures lie. We are now faced with the prospect of poor laws which will be hard to change. We should prefer to see no law, but it is already too late. Even if the Department of Labor's proposed rules are modified or the ACGIH threshold limit values are accepted, we will have given many in the federal service, legislators, and industrialists a stronger case against any future action. In fact, some industry voices are already arguing against any regulation. We agree, but for a very different reason.

Lewis S. Goodfriend

EDITORIAL

THE FAA TASK

The 90th Congress, when it enacted Public Law 90-411 (HR 3400 and S 707) assigned to the Federal Aviation Administration the task of certifying aircraft for noise. There are many steps in carrying out this task beginning with issuance by FAA of a notice of proposed rule-making. A recent FAA report indicates that the FAA choice for the method to evaluate aircraft noise for certification will probably be EPNL, effective perceived noise level. The report presents the history of the development of EPNL, a critical evaluation of its validity, computation procedures, and examples of use. The report is a thorough and objective study of the subject. It includes discussions of the completeness and exactness of the EPNL method. However, to its author and to us the EPNL appears to be an effective starting point for evaluating aircraft noise in 1969. There is little doubt that new tests would show new numbers, but this is probably as much a result of test method as of the computational method used to arrive at the noise rating.

We have heard of some unhappiness within the aviation industry over the possibility of the FAA's adoption of EPNL as its rating method. We are also well aware that such a method might rate engines of equal thrust but different noise character several dB apart. However, except for the work by Little and his colleagues, most of the subjective effects work has been supported directly by FAA, NASA, and the military services.

Since EPNL is currently the most effective index of subjective response and does correlate well with subjective response, let's use it. Had the engine and airframe manufacturers, and the airlines presented any more meaningful data, we would want to see the rule-making delayed. This is not the case.

On the basis of what we have seen to date, we fully support the FAA. Let's get the rules on the books and see that they're met. If the aviation industry can show that the method really is poorer than another or can develop and validate another more accurate one, the FAA is prepared to revise and update its rules. From here, it appears that the aviation industry is just looking for another short breather without really planning an all-out joint effort to develop, statistically describe, and validate a method of relating aircraft noise to human response.

Lewis S. Goodfriend

EDITORIAL

MAN TO THE MOON

The manned flight of Apollo 8 to the moon and back is one of this country's great achievements. As modestly pointed out by Colonel Frank Borman from the deck of the aircraft carrier Yorktown upon his return, the success of the circumlunar flight was the result of a joint effort by many people all over the country. There is little doubt as to the magnitude of the feat performed by our three scientist-astronauts. We are also delighted that the shock and vibration control systems that were involved in the launch system, the engines, the control system, the service module, and the Apollo 8 command capsule itself performed as designed. With so many possible means of vibration excitation, the provision of appropriate vibration environments for all of the operating equipment and for the astronauts themselves shows the painstaking study, design and testing in the area of shock and vibration that have gone into this project. It is true that a complex design organization can and did carry out the design task. But, we did have past failures, relays operated when their components resonated or connectors loosened in flight. Some aircraft problems have been traced to inadequate shock and vibration control. The Apollo 8 and some earlier flights have shown that we can have failure-free space missions.

The giant share of the credit for the job belongs to Borman, Lovell and Anders. But, without the thorough job done by the designers and builders of the equipment, there would have been failure. This country has learned much from the successful completion of this mission. Most of what the public sees and hears will concern the moon, its nature and the challenge of future space flight.

We can learn much about reliability, environmental control and the optimum organizational structure for equipment design and even for consumer goods from the development programs that led to the successful completion of this achievement in space. If we do less, we are being less than fair with the astronauts who made the trip, and with the people of the country who have paid and will continue to pay the bills to continue the program.

We, as scientists and engineers working in the areas of shock and vibration, have a particular responsibility to see that the knowledge gained in the design and testing of space-flight-system components is correctly and widely applied in all sections of the economy. It may be that a few technical papers are in order, but the really wide dissemination of the kind of information acquired here will be by individual contact, by transfers of employees with the knowledge from one company or division to another, and by the continued application of the same approach by the individual organizations involved as they approach new problems in both aerospace and earthborne systems.

S)V salutes Astronauts Borman, Lovell and Anders, the NASA team that has done such a superb job on the Apollo program and the engineering, testing and manufacturing organizations involved . . . including each person who contributed to the successful trip to the moon and back.

Lewis S. Goodfriend

EDITORIAL

FEDERAL REGULATION OF INDUSTRIAL NOISE

There is a new regulation on industrial noise. It is a federal regulation, and it is readily enforced, almost effortlessly. The new regulation is the Department of Labor's revision to the Safety and Health Standards for Federal Supply Contracts. Under the Walsh-Healey Public Contracts Act, it is required ". . . that contracts entered into by any agency for the manufacture or furnishing of materials, supplies, articles, and equipment in any amount exceeding $10,000 must contain . . . a stipulation that no part of such contract will be performed . . . in any plants, factories, buildings, or surroundings or under working conditions which are unsanitary or hazardous or dangerous to the health and safety of employees engaged in the performance of said contract." The revisions to the safety and health standards include a new regulation on noise which S)V will publish shortly. This new regulation was the subject of public hearings on November 6, 7, and 8, 1968 and were further revised and published in the Federal Register on January 17, 1969. They become effective in 30 days. In other words, they became effective on January 27, 1969.

Basically, the new regulation is the same as was noted in this column in the November issue of S)V, a limit of 85 dB, A-weighted, in the working environment. A temporary relief was granted in the final version. Until January 1, 1971 the limiting level may be 92 dB, A-weighted, if programs of both hearing conservation and plant noise reduction are instituted. Appropriate methods of measurement are specified and a method to accommodate intermittent noise is included.

It is our understanding that considerable negative commentary was received by the Department of Labor at the hearings. However, the rule has been issued, and notices sent to all interested parties. The impact is tremendous. It will of course provide a forceful impetus for increased sales in the sound and vibration control fields. However, the costs to industry can be staggering. In fact, even the manufacturing concerns in the noise and vibration equipment field can be hard hit by the new rules. In fact, some small industries may find it difficult to stay in business and meet these requirements. It is surprising how many concerns, small and large, do business under the Walsh-Healey Act.

Being realistic, however, we believe that this had to come. We are a nation turning to pollution control, cleaning up the air and waters of our country. We have also become an audio-visually oriented nation. To lose ones hearing is no longer the mark of the sage old timer in the forge shop; it is a major social impairment. We are in favor of noise control and hearing conservation in industry, but we are not sure that this is the best way. Nonetheless, since it is now law, let us try to live with it. If it does not work, or if it causes too great an economic dislocation, then hearing conservation and noise control in industry will have to be implemented in some other manner. One fact stands out on the positive side, those who conform with the law can expect to have reduced workman's compensation rates. It may turn out that the law will be industry's boon not bane.

We will be watching with interest.

Lewis S. Goodfriend

SOUND AND VIBRATION AND ARCHITECTURAL ACOUSTICS

The job of S)V is to keep its readers informed on subjects within our field. For the past two years we have published a wide variety of articles touching on subjects ranging from mechanical impedance to the human response to noise. Articles on noise have predominated. We have only touched architectural acoustics. We have given much more space to noise and noise measurement and its effects on people. This is the area where there has been the greatest public—and engineering—interest. There are of course, a large number of readers who work and have interests in the vibration measurement and control area. However, everyone in the aerospace and automotive industries have had both financial support and quantities of technical information almost too large to handle during the past decade. Not so with noise. It was not until last year's conference on "Noise as a Public Health Hazard" that it became really apparent that the public, industry and the Federal Government could agree on the urgency of the problem. Since then an accelerated public and political effort have resulted in greater support for all kinds of work in noise research and noise control efforts.

S)V can serve its readers best by bringing to them information on what is happening, where it is published, and by publishing the latest state of the art as well as historical and tutorial material in the fields we cover. When we have new techniques, applications of unusual materials and equipment and time-saving tricks for either sound or vibration we publish the material. The real problem is to not publish and republish the same old technical jargon and detailed analyses that belong in our sister journals of the scientific societies.

We shall during the coming year publish more articles on vibration and a few on architectural acoustics. We do not propose to publish case history articles in this area. Every building requires special approaches to its problems. However, these are usually handled by the application of the basic knowlelge of architectural acoustics and of mechanical engineering along with a feeling for architectural materials and an understanding of architecture. The practice of architecture appears, from here, to be an amalgam of art, engineering, business and economics. Application of acoustical knowledge to building design without an understanding of architecture is dangerous. S)V will, therefore, present those articles on architectural acoustics that delineate the state of the art and the existing problems and then discuss approaches to or solutions for these problems. We shall continue to present the best and latest technical information that we can find on vibration—in all its aspects—and noise and man's response to it. We may not be able to balance the content of every issue, but over the year we shall not neglect any area.

TIME EXTENSION ON FEDERAL NOISE REGULATION

Secretary of Labor George P. Shultz has delayed the effective date of the proposed regulations on noise that were the subject of this column last month.

The new date for the proposed provisions of the Walsh Healey Public Contracts Act to become effective is May 17. Secretary Shultz stated that the delay does not reflect an evaluation of the merits of the proposal but is necessary to afford him the time to study a complex regulation he may have to administer. The delay should give a large number of industrial managers an opportunity to get a better grasp of the problems they will face in noise reduction. However, the two year trial period with the upper limit set at 92 dB, A-weighted, should give both industry and the Department of Labor a chance to evaluate the realities involved. It may be that by 1972 a different final level or a different measuring technique may be in order. As we stated before control is inevitable. The real problem is how do we achieve it economically?

Lewis S. Goodfriend

EDITORIAL

STANDARD BY FIAT

The United States scientific, engineering and business communities have prided themselves on their ability to interact sufficiently and effectively to produce the many voluntary standards required to test materials, grade or rate products and calibrate instruments of many types. Often the armed forces have adopted special requirements for their own purposes and sometimes major portions are adapted for civilian use. The reverse also takes place. Usually there is interaction between the governmental agency concerned and the private groups having knowledge and interest in the field.

With the publication of HUD TS-24, "A Guide to Air-borne, Impact, and Structure-borne Noise-Control in Multifamily Dwellings," the National Bureau of Standards, working with the Department of Housing and Urban Development, has chosen to publish a method for measuring the sound isolation provided by floor-ceiling structures in response to floor impacts generated by a "standard tapping machine." Since such a standard procedure for the United States has been under consideration by a task group of ASTM Committee C-20, we wonder why the senior author of the NBS-DHUD report, who incidentally heads the task group of ASTM's Committee C-20, publishes such a procedure before it has been approved by ASTM. It has been our understanding that the purpose of the task group–Committee, chain is to provide adequate study and review of proposed standard methods and procedures. One is led to believe that the lack of publication or approval of a proposed standard is indication that negative votes or inadequate substantiation to resolve negative votes has hindered progress of the standard at task group or committee level.

There are a number of published and private studies which we have seen that would indicate that the tapping machine does not adequately rank order floor-ceiling structures. In fact, some information published by T. Mariner indicates that two structures that are judged widely different by other schemes test alike using the tapping machine, and floors judged about the same subjectively may differ greatly in terms of the tapping machine test. We shall not enter this controversy. We should, however, like to ask whether the NBS-DHUD document is an appropriate vehicle to force upon the building industry the preferred method of a standards committee chairman. We cannot agree that ". . . the problem exists now and until better schemes are developed and proven, we must of necessity use those methods presently available, which indeed have been reasonably successful in Europe and elsewhere for a number of years." In fact, information from Europe seems to confirm our earlier suspicions that when European builders copied American lightweight-building techniques, their rating schemes would give them wrong answers. What worked well for heavy masonry buildings does not work well for lightweight systems.

It is sad that what is otherwise an excellent publication should be used to force an unsubstantiated, controversial test procedure on the U. S. building industry. Had the authors chosen to rank order to the best of their ability a series of floor ceiling constructions as they do plumbing connections and vent stacks, it might limit construction flexibility to a small degree, but it would not commit millions of dollars to the use of floor-ceiling systems of questionable impact isolating capability tested by a method incapable of resolving human acceptability over a wide range of nominal rating values. We do not know what course of action ASTM Committee C-20 will take nor can we guess the reaction of the ASTM executives, but certainly standards forced upon the building industry by a government agency, and in particular the National Bureau of Standards, will not generate confidence and trust in that agency. On the brighter side, one cannot accuse the bureau in question of dragging its feet.

Lewis S. Goodfriend

EDITORIAL

MISSED OPPORTUNITIES

Once again a handful of college graduates from this year's class will have completed their formal academic training without any but the slightest acquaintance with the field of acoustics. Even fewer will have had any exposure to the realities in the practical world of sound and vibration. Not all of these graduates with acoustical training, meager as it may be, will enter the field of sound and vibration. Others with no training, only an enthusiasm for some phase of work in our field, will find it attractive enough to forego the lures of fields such as computer applications, large-scale integrated electronics, and lasers.

We have pointed out some aspects of this problem before, but it stands out so much more clearly this year at commencement time. We have participated in and taken note of close to a dozen seminars, scientific society meetings, and government agency sponsored meetings on the subject of noise. Many of these sessions were or will be at the most basic engineering level. They are efforts to acquaint non-acoustical personnel with fundamental ideas in the area of sound and vibration—origin, transmission, effects, and control. Many of the participants have or will ask why isn't the basic material taught more widely in colleges and universities. This is a question that we find difficult to answer.

The Acoustical Society of America has taken note of this situation also, and through its committee structure is making an effort to have more college programs in acoustics. However, the classic problem arises: in what department do the acoustics courses belong? Because acoustics is a multi-disciplinary field with strong elements in psychology, physics, electrical engineering, architecture and mechanics, it is difficult to assign the responsibility to one department. To coordinate a course program in acoustics appears to be a difficult task. In the past it has usually been one department head who, being interested in the widest areas of acoustics, has taken the responsibility for seeing that all aspects of the field were covered for students in all of the departments that might find it of interest. This is, of course, a hap-hazard manner in which to plan an academic program. However, it has been effective. It really proves that those of us in the field must develop the comprehensive course plan of study for those who should study acoustics. Also, some of us may have to devote some of our time to teaching those courses at local universities where we have the credentials to do so. If we do not offer to serve as instructors or adjunct professors, or such other faculty assignments as are appropriate, we cannot continue to complain that no one is teaching the subject.

The answer as seen from here is: participate, help plan the course structure, help to line up suitable course material in the psychology, physics, and engineering departments, and then help to teach one or more of the courses. We can ill afford to continue complaining about the shortage of qualified personnel, nor should those working in less interesting fields be denied the opportunity to study and work in what we know is the most fascinating and rewarding area of science and engineering.

Lewis S. Goodfriend

EDITORIAL

WALSH-HEALEY — THE POSITIVE ASPECTS

It is no longer news that Secretary of Labor, George Shultz, has approved the changes in the Walsh-Healey Public Contracts Act that require that noise in workplaces of firms doing business with the government must be reduced to 90 dB, A-weighted, or lower. It also provides that where this is not done, a hearing conservation program must be effected. On the basis of all available information, this should provide a high level of protection throughout the working life of today's industrial employee. However, the true impact of the Walsh-Healey regulations is not obvious from either the new rule itself or the nominal protection it offers from permanent noise-induced hearing loss. There are numerous indirect benefits to both industries and their employees.

* One of the most unusual by-products of the effort to comply with the Walsh-Healey rules has been reported to me by several consultants. This is the improvement in production equipment efficiency after maintenance steps taken simultaneously with, and as, noise reduction measures. For example, cash savings can be attributed to shutting off compressed air and steam in plants where unused air and steam lines in and around machines had been vented to the atmosphere usually inadvertently, but always accompanied by noise levels above the 90 dB(A) limit.

* Pre-employment audiograms will become routine in large numbers of industries as a requirement of a hearing conservation program. They will have two-fold benefits. They will sort out those prospective and new employees whose hearing has been affected by prior noise exposure, thus fixing the responsibility for the prior loss. They will also spot those new employees whose hearing has been affected by non-employment related noise exposure such as recreational gunfire or military-service noise exposures or disease. These employees can be referred to their own physician for follow-up before a more serious condition results.

* A continuing audiometric program should also spot those employees whose hearing is being damaged by continued exposure to high levels of recreational noise including gunfire and discotheques.

* Improvements in communication at work stations reduce fatigue and improve safety conditions. One cannot say that efficiency is improved, but there are some indications that improved production may result because of the ease of communication.

* Search for quieter production methods can lead to quicker, less costly or more effective manufacturing techniques. In other terms, the noise control program can stimulate improvement in production methods.

There is another area where the changes in the Walsh-Healey Act will generate profits. This is in the sound and vibration control products field. Here the effective marketing of equipment and products should result in a sharp upswing in sales for those companies selling hearing protection equipment, mufflers, and vibration control and damping products. Also, those firms that make quieter production machines can take advantage of the leverage created by the changes in the rules.

We do have a few words of caution. We believe in fairness on all sides. There appears to have been some effort by a few sales offices to apply scare techniques in the sale of quieting and hearing protection gear. In particular, we are appalled by the reports reaching us that some salesmen are telling prospective customers that they need new, better-isolating audiometric booths to make measurements based on the recently adopted ISO hearing thresholds. This, of course, is not true for industrial audiometric purposes. All of the laws and methods of computing compensation for hearing loss now appear to be compatible with the ISO threshold levels. The only people who need better rooms are the scientists who study threshold values. For compensation purposes, the actual values of the sound pressure levels at the ear that correspond to the old AMA values for which a given percentage of hearing loss exists have not changed. Thus, there is no need in industrial audiometry to measure anything better than we formerly measured. It is imperative for clinical and research work in otology and audiology that the background levels within the test space be lowered, but not for industrial purposes. We do believe that there are ample opportunities to sell products and equipment without stretching this point.

Thus, there turn out to be many positive aspects for industry, the employee, and the noise control product manufacturer in the addition of these new rules to the Walsh-Healey Act.

Lewis S. Goodfriend

BAD SOUND

It continues to amaze us that in a day of such great scientific and social advances and with the increasing interest in high quality home and commercial audio entertainment systems, the public has inflicted on it such poor sound quality where it is most important. Airports, rail terminals, and public meetings, are notable for the poor sound quality and low speech intelligibility provided by what should be optimized information transmission systems. The goal is communication.

Although S)V is not and does not intend to become a sound system or communication publication, we are cognizant of the responsibility of airport operators, railroads and civic officials as well as their engineers and architects to provide appropriate sound communication systems. All too often all that is provided is a sound distribution system which emits unintelligible squawks. There is no shortage of knowledge in this field and the right equipment is also readily available at prices that compare favorably with the unsuccessful equipment often installed.

There is an even sadder note. Even where the appropriate equipment has been selected and installed, lack of proper operation or appropriate maintenance has resulted in failure of critical items to perform well if at all.

This is no problem that can be solved by writing tight specifications, developing industry standards or by setting national standards. There appear to be many separate causes.

- ☐ First is the selection and purchase of inferior and inappropriate equipment as cited earlier.
- ☐ Next is the incorrect installation of adequate equipment.
- ☐ Incorrect operation of adequate equipment including destruction of loudspeakers by either mechanical or electrical accidents.
- ☐ Inadequate or incorrect maintenance.

We have grown tired of trying to hear announcements of our flight at numerous airports. We are saddened by governmental meetings in public session where only those in the front row can hear the eminent men of our country at these supposedly public meetings or hearings (and then only if the "sound system" is turned off). And who ever knows from the platform announcement where the diner is on the express train to New York.

There is no easy cure for this situation. As indicated earlier, standards or specifications alone will do little. The real answer appears to us to lie in education of all of the people involved with the design, construction, ownership, and maintenance of these public facilities. They must learn that quality sound can be obtained, where the money is best spent in terms of equipment quality, and what kind of preventive maintenance is required to protect the investment in such equipment and the facility it serves.

Where owner, designer, installer and the operators of such facilities have taken the pains to either learn or apply the facts, the results are spectacular. Let's make them all that way from now on. Each of us in the sound and vibration field can influence the designs whenever we serve on any of the boards, or design groups, or as part owner of local airport or civic facilities.

Lewis S. Goodfriend

TRANSPORTATION VERSUS ENVIRONMENT

There is little doubt that this nation depends on its transportation system to move people and goods economically from one place to another at reasonable costs. Over the years the public has seen a vast network of highways cover the nation with concrete, fumes, and noise with economic need as their justification. Also, the growth of air travel has not been without its attendant concrete, fumes, and noise, similarly justified by economic need, "the price of progress." All too often the rights of way for highways have been selected on the basis of acquisition costs, hypothetical cost benefit ratios, and political expediency. Airports, too, appear to be located or expanded without regard to the communities in which they are located, but on the basis of a hypothetical economic potential, not the existing need of the community in which they are located. The development of our transportation systems parallels similar developments in industry and utilities which have resulted in many of our pollution problems. All too often pollution control has been neglected because of its cost and the possible effect on profit.

With both private and industrial pollution now subject to federal control and with federal programs on noise and its abatement now in the study stage, we believe that the deleterious effects of transportation on the environment also may soon be controlled. This will not only include control of crankcase and exhaust emissions, but control of the selection of highway rights of way and site selection for air terminals. The first signs of such an enlightened program were given when Secretary of Transportation John Volpe ruled against the controversial riverfront Interstate Highway section in New Orleans' historic French Quarter. His decision included both the elevated and the grade level versions of the "urgently needed" proposed highway. The Secretary also plans to consider environmental factors and the desires of local residents in the planning of new transportation facilities. Toward this end he has a new Office of Environment and Urban Systems headed by Assistant Secretary James D. Braman, former mayor of Seattle. Although Braman's role appears to be related to highways and mass transit, we hope that he will also find time to look at some of the opportunistically planned regional airports.

There are real problems in the selection of rights of way for highways, and sites and layouts for airports. However, we have too often noted that the beneficiaries of the alleged benefits to be derived from a new highway section are not the neighbors of the new or expanded highway, but the transportation industry, the shippers, and receivers of goods in distant cities and travellers who cannot even get off the highway to shop or stop in the surrounding communities. As for airports, similar logic has been used in support of new or expanded facilities. Too often, there is a real need for safer facilities, but without expanded operations they are not economical for the airport operator. The result is that the expanded commercial operations needed to cover costs affect the environment of the community without much benefit to the community.

The actions of Secretary Volpe along with those of the Department of Health, Education and Welfare, and Department of Labor on the control of pollution and noise are exciting steps toward preserving what is left of our environment and possibly reversing the almost irreversible damage that has occurred to date.

Lewis S. Goodfriend

EDITORIAL

BANDS—NARROW AND WIDE

The presentation of acoustical, and even some vibration data in terms of octave- or fractional octave-band levels is commonplace today. With the advent of modern real-time analyzers, correlators, and stable narrow-band sharp-rolloff wave analyzers, we question the continued dominance of the octave and fractional octave-band data presentations. Furthermore, the increasing use of A-weighted sound levels to evaluate environments for a wide variety of purposes appears to further weaken the position now occupied by the relatively wide-band analyzers.

A look into the past shows that prior to World War II, the wave analyzer and the sound level meter, the vacuum tube voltmeter, and the oscilloscope were the tools with which most investigators examined noise and vibration signals. The early wave analyzers were large, electrically not-too-stable instruments that had to be swept mechanically, and very slowly at that, across the frequency spectrum. The sound level meter with its electrical weightings might have achieved early success except for the fact that microphones could not be made stable and uniform at low frequencies, and the A-weighted readings from different instruments gave widely varying readings if strong low frequency signals were present. This problem carried over until the early 1960's.

The vacuum-tube-voltmeter became a preferred instrument around many electronic and acoustical laboratories just prior to, and following WW-II. However, it lacked the weighting characteristics of the sound level meter, and thus could only provide an overall or unweighted reading. It was not easy to calibrate or adjust in terms of acoustical level, and many models were troubled by internal noise.

The oscilloscope was great for showing the complex waveform, but the only easy way to find the signal's spectral content was to do a Fourier analysis or to set up a bank of filters. Since the digital computer had not been developed and the fast Fourier transform did not yet exist, band filters looked good for use with both voltmeter and oscilloscope. During WW-II, the octave and fractional octave band filter became the most popular tools for evaluating acoustical environments. It was so easy to take a few quick readings, one in each band, and the broad-brush data appeared adequate for purposes of describing noise exposure of aviators, navy engine-room personnel, and similar noise environments within military and industrial establishments.

Today, we know that we can get adequate environmental exposure data using the A- and C-weighted levels from a precision sound level meter. Where detailed engineering information is desired, a narrow band analysis using a wave analyzer is certainly more appropriate. The computer controlled real-time analyzer using one-third octave bands appears to offer some interesting answers. It can compute many subjective indicators. However, for many applications the need is not for subjective information, which can be fairly well established by A-weighted sound levels, but for the nature of the source in a complex signal. Under these circumstances, the wave analyzer mated with a graphic level or an X-Y recorder provides the needed information. The modern wave analyzer is equipped with several bandwidths and commends itself highly to today's analysis tasks.

Two other modern instruments have also shown great promise in evaluating noise signals, locating sources of noise, and finding coherent signals that may be annoying, but almost impossible to measure with band analyzers. These are the correlator and the signal averager. The modern correlator computes the auto- or cross-correlation function of signals and yields information about their sources and other time-dependent characteristics. The averager can pick coherent signals out of noise. Again, the nature of the source can readily be defined once the signal is clearly seen. These are not by any means all of the tricks available from the typical instrument either. Many interact directly with small computers which process the data and can control the test program.

We believe that it is time for the technical and scientific societies to review the standard methods of measuring and reporting data and to consider whether the octave band has not had its day.

Lewis S. Goodfriend

PROGRESS IN SOUND ISOLATION

Where are the great strides in acoustical control in building design and construction? The innovations introduced into the design of office and residential buildings all seem intended to reduce cost without increasing any benefits to the occupants. In particular, new methods of heavy construction, installation of mechanical and electrical systems, and new finishes have all helped to hold the line on construction cost in our present inflationary period. Because there has been a shortage of both housing and office space across the country, people seeking apartments and offices accept what they can find in a seller's market. They are being forced to accept a substandard product. The lack of privacy, the intrusive noise of ones neighbors, and the inability to escape from noise of other family members are problems as serious or worse today than they were three years ago at the time of the inception of S)V.

The hoped-for research by major institutions, by federal agencies and by private industry has not materialized. We know that research is going on, but little, if any, involves the fundamental theory of the transmission of sound through building structures and the assembled building system. In fact, we are still limited to elementary mass law and coincidence theory in predicting the performance of only the partition. So-called field testing has not been supported by the appropriate theoretical analysis that might show where the sound comes from and where it goes to in a real building.

We are delighted to see innovation in building design and construction. However, it is time the building and construction industry bought some insurance. The public has found interested listeners at city, state, and federal levels. Today's politicians are sensitive to problems of national public concern and "noise pollution" and acoustical privacy are among these problems. Again, we must point out that where industry and the professions do not meet the needs of the public, federal legislation is much more likely than ever before. With the scientific tools available to the building industry and the new technologies and equipment available to researchers in architectural acoustics, there is no logical reason for the lack of improvement in privacy and noise control.

Lewis S. Goodfriend

EDITORIAL

RESEARCH RESPONSIBILITY

Where is all the research on sound and vibration taking place? As we talk to engineers and scientists, review the mail for the past few months, and read the pages of the technical press, we find it difficult to answer the question. From the amount of material published on the control of noise and machinery vibration it looks as if there is almost no activity at all in these areas. On the other hand, we have talked to a few people who are doing very interesting work in one or two specialized areas. We also know from discussions with instrument manufacturers that they are supplying equipment to people engaged in research in these areas. Possibly the real reason that the research effort is not visible is that there are many small projects within numerous organizations and when these projects are finished, the organization goes back to solving problems in its basic product area.

There are, of course, some areas of noise and vibration work that are reported in articles or scientific papers dealing with industrial hygiene, psycho-acoustics, physiological acoustics, and in areas such as mechanical impedance, instruments, and aero-acoustics. However, the real problem, as has been indicated in the past, is that noise is a negative commodity. It is not like the color, size, weight, and utility of a product which the manufacturer seeks to improve in a product, it is an unwanted byproduct that must be eliminated. The cost for noise control reduces or removes this unwanted effect. Also, there are few communities that feel compelled to finance research on noise and its effects on their citizens. Thus we see little improvement in the noise research picture from a review of what is happening in the private sector.

The federally supported activity however, continues to grow to meet the needs and demands of an aroused public and a responsive government. We believe that the effort is necessary, but as we have said before, why, in a country based on private capital, must the federal government step in and finance so much of the nation's noise pollution control research.

Part of the problem on product noise control has been the desire of the manufacturers to provide consumer items that sound strong and effective. Whoever heard a quiet hand saw or chain saw? Furthermore, the dishwasher and the clothes washer and dryer let the user know what they are doing by the noise they make. We'll go along with that idea, but what we don't understand is why they have to do it with such a high noise level. Can't a little of that positive product development and product research go into making a "quiet but powerful" sound?

It is also interesting to note that a sizeable amount of research and funds, have gone into studying the noise of, and quieting, aircraft engines. It is interesting because the problem has become one of critical proportions. With the newly published FAA limits for certification of air-carrier jet aircraft, the need for more work becomes mandatory. We need one of those much sought after "breakthroughs." In passing, we must commend NASA, the FAA, and those in industry who have been working on the various quiet engine programs. However, there is still room for novelty, ingenuity, innovation, greatness. Research takes many forms, it is carried out in many different kinds of organizations, but it must be initiated, supported, and funded, privately as well as publicly.

Lewis S. Goodfriend

STATE OF THE ART

As the first few days of the 1970's slip noisily by, we wondered again since we have all of this modern hardware and instrumentation backed by superb analytical research and computational tools, why isn't it quieter. We also wonder why it should still cost so much to buy the quiet that we have been able to achieve. It is interesting, as we begin the new decade, to stop and see where we have been and what we have achieved.

The largest strides in the fields of sound and vibration have taken place in the area of instrumentation, and test equipment. We can expose equipment of almost any size to acoustical and vibration signals of almost any waveform and measure the result with extreme precision. In the areas of equipment and community noise it is possible to obtain a wide variety of "pictures" of the noise generated by the equipment or to which the community is exposed. Among the new or modernized instruments to become readily available in the past decade are the signal averager, the correlator, the stable wave analyzer, spectral density analyzers, phase plotters, pocket-size precision sound-level meters, miniature accelerometers with minimal cross-axis sensitivity, and road simulators for simulating input forces to automotive vehicles. Also the marriage of modern, small digital computers to acoustical and vibration instruments has opened the door to comprehensive studies of the distribution of levels and spectral energy of numerous sounds. The new high contrast sound spectrograph and the many rapid spectrum-display devices including the so-called real-time analyzers have speeded the analysis and evaluation of noise signals.

In the hardware and materials fields there were few innovations. Among those that did appear were the application of lead to the cross-talk problem in modern office and school buildings, the advent of optimized damping compounds, the introduction of practical "air-spring" vibration isolators, the rating of ventilating mufflers on a "dynamic" basis. New, resilient, residential partition construction systems were designed and marketed providing higher TL test figures. Similarly new floor-ceiling systems were developed to provide good impact rating numbers. Many existing products were tested and their sound ratings published in catalogs. Some manufacturers of vibration isolation systems for industrial and ventilating equipment have modernized their lines and can now provide high deflection steel springs which are stable and not flanked by their mountings. However, few *new* products reached the marketplace during the decade.

In the standards and regulatory areas, there were a number of standards of real interest to be approved by ASTM or ANSI (ex USASI, ex ASA) these included the sound level meter standard S1.4, the ASTM E90-66T and C423-66 on sound transmission loss and sound absorption respectively.

In terms of new laws, California and New York adopted motor-vehicle sound-level limits, the Federal Aviation Administration set noise level limits for the certification of new aircraft, and the Department of Labor issued its well known amendment to the Walsh-Healey Public Contracts Act limiting the exposure of industrial workers to levels below 90 dB(A-weighted) or equivalent. The attempt of the town of Hempstead, N. Y. To enjoin operations at John F. Kennedy International Airport failed, while lawsuits against several airport operators including Tampa and Jacksonville, Florida, on the basis of inverse condemnation, were won by the neighbors. A judge in Morristown, N. J. ruled that ground operations of business jets had to be quieted. He also ruled that night time business-jet operations could be curtailed between selected hours. Thus there has been small but important progress through standardization and regulation to provide some voluntary and some imposed standards for noise measurement and control.

It is in the area of human response to sound and vibration that much work has taken place and few applicable results have appeared. The scientific journals have published research papers on psychological acoustics but putting the answers to work has been difficult. Kryter and Pearsons did much to refine the applicability of perceived noise levels to both aircraft and non-aircraft sounds. Gales, Botsford, and R. W. Young brought the effectiveness of the A-weighted sound level as an indicator of acceptability of noise into prominence. Webster updated speech interference level (PSIL) and reviewed its applicability. Many other authors have contributed to the problem of noisiness, acceptability, and comfort. Some new work was done on ride characteristics and comfort, but no definitive work was published. Toward the end of the decade considerable attention was given to the sociological factors influencing acceptability of aircraft noise, but again no definitive publication appeared.

From here, it looks like we had a lot of fun modernizing or designing a wide range of electronic devices using semiconductors. They are fun to play with too, but we really have not applied ourselves to solving our problems with them. Possibly one reason that we have few new items in terms of hardware and materials is that nobody wants or needs new ones at this time. What we probably need more is better designed equipment making use of those techniques and components that can yield a quiet production line machine or home appliance. More standards are in the "mill" along with new state and federal regulations that just didn't get approved or enacted. The major failure of the past decade in our field appears to be in the bioacoustics area. We have been unable to even settle on the semantics we should use or what constitutes a suitable human. It may just be that our major shortcoming of the 1960's was that we oversimplified our experiments to such a degree that no matter what answer we obtained, it was the wrong answer to the real problem. We learn from our mistakes and I trust that we shall not repeat those of the past decade in the next. Good luck.

Lewis S. Goodfriend

IS SILENCE THE GOAL?

A careful reader of the present persuasive arguments for noise abatement might be led to believe that the ultimate goal for a national noise control program is silence. A perusal of the technical literature on the subject provides little in the way of guidelines. Once the noise levels have been reduced to a point where speech communications are feasible over a reasonable distance we are left to our own devices to determine what an ideal noise environment might be.

It is true, there are tables of A-weighted sound levels, the NC contours, and the out-of-doors composite noise rating. However, these are based on acceptability or tolerance criteria. We find that these criteria are often useful as a basis for design, providing the designer makes some value judgments of his own. In fact we are convinced that criteria can be established for all types of occupied spaces using currently available information and some information on the proposed use of the space. These are not just criteria for acceptability as some widely publicized noise abatement experts claim. They appear to many researchers as the optimum acoustical environments for the existing context.

We are looking at residential environments that are generally below NC-35. This might be in the range of 40 to 42 dB (A-weighted). Even in the quiet suburban-rural communities, interior noise levels are in a range close to 30 dB (A-weighted).

It has been suggested that the introduction of masking noise in residences near airports would make the aircraft noise intrusion more palatable by reducing the change in loudness from the artificial background to the level of the intrusion rather than starting from some lower ambient level. We subscribe to this so long as the masking noise levels are not so high as to be annoying or intrusive themselves. To us, this means that they will have to stay below the NC-35 contour. But this is often eight to 10 dB higher than can be found in the residences near major airports. We believe that it can reduce the impact of the aircraft noise intrusion.

The method is really quite well known, and has been used for many years in offices and public buildings where privacy and freedom from certain types of intrusive office noise is required. On occasion, it has been called, "acoustic perfume." The anology is not bad. We can remember the rose water added to the circus ventilation system as the elephants entered. Just as in the acoustical case, too much perfume can be more noxious than not enough.

The physiological and psychological research that is needed to delineate the envelope of the optimum environment is only now beginning. Based on what we know about acceptability, speech interference, and detection of signals in the presence of masking, a modest amount of masking noise can be used to reduce the annoyance caused by many types of intrusive noises. As for hazard to hearing from the artificially induced masking, we shall only point out that birds, summer insects, and the nearby ocean generate levels that exceed the NC-35 contour. Who shall argue that this is an unhealthy environment?

Lewis S. Goodfriend

EDITORIAL

RATIONAL PURCHASE SPECIFICATIONS

During the past few months we have seen some purchase specifications and purchase orders that have a new twist. This is a requirement that the product "meet the noise requirements of the Walsh-Healey Public Contracts Act" and it is usually rubber stamped across the middle of the purchase order. Such purchase orders and specifications show two aspects of the problems of this field. First they show that manufacturers and processors are responding to the Walsh-Healey act regulations, Second, they show that there is widespread misunderstanding of the principles of noise generation and control.

For many years the manufacturers of air-conditioning fans and industrial blowers have provided sound power information to purchasers of their equipment. With this information, and any simple noise control text, including some excellent ones provided by sound measuring equipment manufacturers, purchasers could estimate the sound levels to be expected under their particular installation conditions. This method places the responsibility for obtaining the appropriate final environment on the purchaser. It is the purchaser who can add mufflers, plenums or enclosed work spaces within his plant. Also, it is the purchaser alone who governs the working conditions in his plant.

To demand that the manufacturer of a fan, pump, engine, generator or machine tool meet a sound-pressure-level specification in an unspecified acoustical environment is neither sensible nor economical.

The most effective means of obtaining suitable acoustical environments is through the use of an analysis of the needs and the output of the noise sources and then the design of a suitable noise control system. Such a system may include mufflers or plenums purchased from the same manufacturer as the noisy equipment or fabricated elsewhere. However, the equipment manufacturer will be bidding on the production machinery as a specific item. The noise control equipment will be called out specifically, and every offeror will know exactly what he is bidding on. The purchaser also will know where his money is going. From discussions with some fan manufacturers, the cost of meeting unrealistic "shotgun" type noise specifications is passed along to the purchaser, and the safety factors always run the cost up over the prices for a fan equipped with mufflers specified by pressure drop and attenuation.

It seems to us that purchasers of industrial equipment would find it advantageous to examine some of the recent literature on noise measurement, the current ANSI standards, and possibly to attend one of the growing number of noise seminars. Above all we recommend consultation with the equipment supplier. Sometimes changing the basic item purchased to a slightly different model may either reduce the noise at the source or may make the noise easier to quiet using conventional commercially available prefabricated mufflers.

The use of that rubber stamped legend may seem like the easy way out, but from here it looks like the most costly way too.

Lewis S. Goodfriend

EDITORIAL

THE QUALITY OF LIFE

As we began to piece together the ideas for this month's Editorial, it became increasingly difficult to select the title. An alternative title might have been Cost vs. Benefit. The basic idea concerns the environmental goals which we seek for the present moment and for years to come.

There is a popular engineering game called cost-benefit analysis. The object is to evaluate the projected results of a given engineering project in terms of its cost to the various segments of society including industry, commerce, users and the non-user public and the benefits both direct and indirect to these same segments of society. As an engineering tool it has many interesting aspects. However, as we have reviewed the analyses presented to us over the past few years we note that convention, lack of adequate data, poor assumptions and outright bias have all but eliminated the usefulness of cost-benefit analysis in many projects.

On major highway route alignment studies, opposing experts at hearings can make irrefutable cases for and against the proposed alignment and all the alternatives. Evaluations that use the acoustical impact as part of the cost-benefit picture can show similar disparity.

We are not declared conservationists, but we do believe that the environment as it is now constituted is a precious, if already a somewhat tarnished, treasure to be cherished and preserved and possibly nursed back to a healthier state. Even if we cannot restore it once more to its initial state, a condition that we really cannot define, we should set our goals in terms of the long term quality of life which we seek as a nation in the world community.

We must be realistic in terms of natures own pollution forces, and in terms of the cost to go beyond the minimum goal of just holding our own. If we apply the cost-benefit analysis scheme to the reduction of noise or any other pollution mechanism, we must decide on a whole series of environmental quality levels of increasing freedom from pollution that we can use for goals in a step by step program. Then we must decide whose benefit is pre-eminent. Usually the public comes out on the short end. But here, we must face certain realities. Long term studies in case after case of pollution reveal that the tolerable limits may be lower than the accepted values of this year or last year. In fact, the tolerable limits or "threshold limit values" used by industrial hygienists keep decreasing in many areas as more long term studies show that detrimental effects are caused in human tissue by exposure even to very low quantities of pollutants. If we don't know what the tolerable value is, there are several choices. We can accept any quantity since we have no proof of exactly where the limit should be. We can guess at a value using our best engineering judgment or we can set zero as the acceptable environmental level.

If we value human life and the quality of life as we have come to expect it then we must choose conservative threshold limit values and protect the public even if the cost is higher than the cold hard facts that cost-benefit analysis might indicate. The quality of life is a concept that is difficult to justify in terms of profit and loss statements and the responsibilities of directors to the stockholders in is narrowest sense. Yet, the stockholders and directors too are among the citizens whose lives are at stake. It is time to stop the blind application of economic justification for all kinds of pollution and in particular noise. The stresses on humans from the total environmental exposure in daily life is unknown, and lack of "factual" proof is no cause for lowering the standards.

Lewis S. Goodfriend

EDITORIAL

THE PRICE OF WAITING

Leading professionals and staff personnel working in the field of sound and vibration throughout industry, government and the academic world are being called upon to provide guidance in the setting of levels for all kinds of rules, regulations, and standards. However, little real help is available. We know how to measure noise and we can present our measurements in many forms. We also know how to prepare statutes and put restrictions on sound levels into these statutes. Unfortunately, nobody really can, on a scientific basis, prove that any one set of levels is more appropriate than another. We do know some good ranges of levels to use and we do know the probable limits of acceptability and tolerance. What we still don't know is what noise really does to people.

Two years ago the Department of Health, Education and Welfare through the U.S. Public Health Service and with the American Speech and Hearing Association held a meeting on Noise as a Public Health Hazard. Last year the Department of Transportation held a meeting on Transportation Noise. Both meetings developed the same picture, major features of which include:

☐ Adequate and appropriate physical measurements of noise can be made.

☐ Noise data can be processed in many ways to produce whatever statistics may be needed.

☐ The response of people under laboratory conditions to different levels and kinds of noise has been determined for a wide variety of individually controlled parameters.

☐ The ability of noise to interfere with speech has been defined as a function of level and spectrum.

☐ The relationship between noise exposure and hearing loss has been determined.

☐ The effect of adding or varying several stimuli simultaneously, such as level, spectrum shape, pure tones, frequency of occurance, duration of individual intrusions, and crest factor is unknown.

☐ Effects on sleep are not known except for a few isolated physiological parameters.

☐ Associative factors such as those related to prior exposures and fear have not been investigated.

On the basis of the pictures drawn, regulatory agencies and lawmakers can point to the confused situation, and can use this as the basis for picking almost any numbers that they *feel* are right. Such numbers are within the range of acceptability for the population considered, but nonetheless, may be inappropirate. It is true that funds are available and research is taking place, but we have waited too long. Yesterday's answers are inadequate and tomorrow's answers cannot solve today's problems. Selection of appropriate noise exposure criteria for various rules and regulations cannot be made rationally. The result is that current regulations and rules are being written on a *good judgement* or *best guess* basis.

We trust that future research will be directed toward examining the multiple stimulus situation both in the laboratory and in field situations. We must also look at people in a sociological context. We cannot state the price of having waited so long to examine the responses to multidimensional stimuli but it is obviously high.

Lewis S. Goodfriend

Editorial

The Significance of Sound Levels

The ubiquitous decibel has become familiar to almost everyone. It is associated with noise in the minds of the public, public officials and members of our legislative bodies. What the numbers mean appears to be little understood by the people who use the word decibel. This appears to have come about because of the wide public interest in noise, and to a certain extent because the interest in high fidelity sound or reproduction of sound has been unaccompanied by interest in the derivation or meaning of the term. There has also been a proliferation of sound measuring devices covering the range from the computer-based real-time analyzer on down to a thirty dollar "sound-level meter" offered for sale by mail. In the middle of the range is the group of well known sound level meters costing about $400.

For purposes of determining the sound-pressure level at a given point in a room or out of doors, it is necessary to have a device which will tell the user what the sound-pressure is at that point. If the sound-pressure is not a continuous, smooth, slowly-varying function of time, the meter pointer, on any hand held meter, should vary. Recording devices can be used which will plot or print the A-weighted sound-levels as a function of time on a chart recorder or a strip chart printer. Several problems become apparent as soon as level recorders and real-time analyzers are used. Among these are defining the "sound level" for a time varying signal. Several approaches can be used. Two methods often used are to make some assumptions about the statistics of the sound level or to "average by eye." When the only instrumentation available is a sound level meter, then averaging by eye over a few seconds' period and noting the reading is probably the easiest answer. However, this tells nothing about the maximum level experienced and provides no information about the temporal patterns.

The more sophisticated instruments also introduce more sophisticated problems. Among these are maintenance. Data are useless if analyzed by a computer controlled system that looks like it's doing the right job, but in fact is not processing correctly. Really the same problem exists for the simplest equipment. How many people read an uncalibrated, hand held sound level meter and are then convinced that they know the sound level? Furthermore, the low-cost sound level meters and the non-sound level meters may be useful in seeing "how bad a situation is," but confusing their reading with fact will be dangerous.

Another typical problem with some of the new systems is that some analyzers use analog filtering, analog detection of the signal and analog averaging, others use digital processing throughout, while still other analyzers use hybrid systems. Each system is capable of producing different results when analyzing the same tape recording of community noise. In some cases the differences may amount to two or three decibels. When such differences become a matter of legal importance or proof of compliance, it is important to understand the significance of the numbers.

We are convinced that the increasing number of regulations and statutes limiting sound levels will be difficult to enforce unless the personnel assigned to enforcement agencies use only well maintained instruments of the highest quality and understand the significance of the readings.

Lewis S. Goodfriend
Editor

8 on Reader Service Card →

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Editorial

Applied Acoustics

It seems appropriate for this issue on applied acoustics to review some of the areas where applied acoustics might improve the noise and vibration environment of man.

There are those who say that noise as an accompaniment of a clothes washer or dryer is essential in order to let the user know what is happening. Further, it is claimed that quiet vacuum cleaners, mixers and mowers will not sell because they do not *sound* powerful. We have said before that the technology is available today to not only quiet these noise sources, but to give them a quiet but powerful sound. For those machines that currently signal their stage of activity with noise or its cessation, chimes, bells and easily designed electronically generated auditory signals would readily do the job. As far as cost is concerned, quiet machines seldom seem to cost more than noisy ones. It does take some effort to do the engineering and it does require some changes in design or production, but the actual bill of materials may not change at all. If a firm doesn't know what to do and doesn't want to make the effort, then it is easy to justify the neglect of noise and vibration reduction on a "cost accounting" basis. Another truth is that it *can* cost a lot of money to re-engineer the product so that it is quiet. However, with suitable assistance from competent consultants and noise control product suppliers, the added engineering and hardware costs are often undiscernible when retooling for a new model.

Transportation noise is now receiving considerable attention. Much work has been done by automotive manufacturers to determine the major noise sources, to develop standards for measurement and test through the SAE committees, and to reduce the noise output of the worst sources. Here again, not quieting two major sources, truck engine exhausts and retread tires, is considered to be economically desirable. The owners and drivers view mufflers as power reducers. There is no doubt that the weight of a good, efficient muffler does reduce the gross load weight, but this is not usually a problem. If the truck has any muffler, a good one does not add very much *additional* weight. As to efficiency, the loss in efficiency is in general unmeasurable. The real complaint comes from the drivers who don't hear that "powerful" sound as they "gun" the engine. Maybe it is necessary to provide the driver with an acoustical signal all his own to give him the feeling of surging power as he wheels his rig along the road and up hills where the thrill of that powerful sound is needed to give confidence or satisfy his ego, but can't this be a sound tailored for the driver? As for the retread tires that make so much noise as the trucks move along turnpikes and freeways across the country, there is little reason that they must have the old "vacuum cup" patterns except for the alleged cost to buy new tire molds. We wonder how many times the cost of existing dies has been written off. The knowledge is available today to provide suitable tread designs that will be considerably quieter than existing tread patterns, and a non-acoustical incentive such as a special tax for old treads, a fine for excessive tread noise, or tax write-offs for new quiet-tread tire molds might also be an example of applied acoustics.

In passing, we should note that progress has been shown in rapid transit systems where the use of acoustical materials in stations and tunnels, resilient track fasteners, and welded rails have yielded measurable improvements.

As the economy recovers from the recent down-turn, all segments of industry and commerce should take advantage of the sound and vibration technology so clearly outlined by the directories of products and systems in the July and August issues of S)V and make their products and services quieter, and in turn, more attractive to the buying public. They should also, as they retool, modernize and grow, use products and systems that will allow the expanded plant facilities to be environmentally compatible.

Applied acoustics is an empty term until the application is effected in terms of a salable product or an environmental control system. We are not convinced that it is either too costly or difficult to eliminate or reduce the noise and vibration in some of our worst environmental situations.

Lewis S. Goodfriend
Editor

Editorial

The Bandwagon

The intense national interest in environmental issues has focused attention on noise as a health hazard at high levels and as a social ill at lower levels. The Federal government has moved on several fronts to control noise. The Department of Labor's changes in the Walsh-Healey Public Contracts Act typifies the interest and action at the Federal level. The massive action against the supersonic transport in the United States and the strong division with the Congress on funding the SST program is another index of the importance placed on noise pollution control. Under these circumstances, it is not surprising that several engineering and scientific societies have now found that noise is an important part of their responsibility. Superficially this appears to be a good situation, but careful analysis leads to some interesting questions.

- Is enough new material being developed to warrant sessions and symposia on aircraft noise, machinery noise, and industrial hearing conservation at six to 10 national society meetings each year?
- When will the universities offer courses that will help train or retrain aerospace environmental engineers to work in the area of industrial and community noise problems?
- What are the scientific and engineering societies going to do to enhance the capabilities of their members in the areas where the problems exist?
- Is the only major source of funding concerning the behavioral aspects of noise going to be the Federal government?

We can see the need for meetings for the exchange of technical information, but we question whether there are enough qualified people in the sound and vibration field to meet the needs for industry, commerce, and government. The key word in the last sentence is "qualified." We have reviewed over 100 resumes and friends in the consulting field have received over 200 in reply to advertisements for acoustical engineers. Too many of the respondents have capabilities in only one narrow segment of our multi-discipline field and have obviously not paid much attention to the warnings voiced by many, including S)V, that lean days would eventually catch up with the aerospace industries.

Engineers moving out of the aerospace field have and will continue to find that the needs in the industrial, commercial, and government areas are for people with a broad range of capabilities in sound and vibration. These include the physics of sound, machine design, architectural acoustics, fundamentals of psychoacoustics, physiology of hearing, elementary sociology, musical acoustics, electronic instrument technology, and aerodynamic fundamentals. This may seem like an exaggerated view, but it is based on long-term experience. The need outside of the military and aerospace research markets is for individuals who can serve all divisions of a company or government activity. In some organizations a single engineer may have the total responsibility for *noise*. He must be able to:

- Define the product-customer relationship in terms of allowable noise.
- Advise the health department concerning acceptability of plant noise exposures in terms of applicable statutes.
- Operate and maintain suitable instrumentation for noise measurement and evaluation.
- Assist the plant engineering department on architectural acoustics problems.
- Serve as the company's technical expert before the local municipal zoning authorities when noise from existing or proposed plant facilities is on their agenda.
- Assist the design department in selecting goals for and in achieving product noise reduction.

In view of the needs for qualified personnel in this field, and the current activities of our major scientific and engineering societies and educational institutions, we wonder whether the bandwagon is not turning into just another noise source.

Lewis S. Goodfriend
Editor

Age of Sophistication

Now that we are leaving the era in which military and aerospace research have dominated the technology scene, we find that new concepts and Nth generation instruments are available. Some of the instruments are small and relatively low in cost. Such items include digital multimeters, desk-top counters, wide-band oscilloscopes, and small digital computers. Also available are some larger higher cost items including fourier analyzers, interactive process control computers, noise monitoring network systems with hard-copy readout, and real-time narrow-band analysis systems.

At the same time that the nation has changed its research emphasis there has been a downturn in the economy and a reassessment of priorities, social as well as technological.

Many problems have developed during this change of seasons. The difficulty of applying technology to solving social and environmental problems is one of them. To a defense contractor, the cost of a $50,000 item of research or test equipment was just part of getting the job done. However, for a privately owned small business, manufacturing a noisy consumer item, or requiring electronic process control to reduce pollution, the cost of a fourier analyzer or a mass spectrograph may be prohibitive. Federal programs and the increasing number of equipment leasing firms may offer some help in this area. The next question is who will run these new industrial systems? It is our conviction, that after a number of false starts, those displaced from the areospace and military research teams will end up in these other industries. We also suspect that although initial salary scales may be less attractive in other industries, the challenge of the pollution and production control areas will provide the right environment for the technically skilled engineers and scientists from the glamour industries of the 1950's and 1960's.

In the sound and vibration area, we still need more effective methods of describing acoustical environments. Also, needed are techniques for predicting public acceptance of the noise from a given appliance or device. It appears from the current activity that a number of industrial trade associations are underwriting the costs of some of the research on human response to noises of various types. Although these trade groups have in the past done some work in the noise field, the present level of expenditure is much more likely to produce a research program capable of providing answers rather than just summarizing the work of others. This is another answer to the expensive, sophisticated test equipment financing problem. A trade association laboratory supported by an entire industry can readily provide the testing and certification needed to comply with new laws and public demand.

We look forward to a year in which the necessary readjustments within our society and within industry can be effected quickly so that the modern technology and those skilled to use it can be applied to solving all of our environmental problems, sound and vibration problems included.

Lewis S. Goodfriend
Editor

Editorial

The Profession

There are many differences between a scientific society and a professional organization. Among the most important are scope of interest, treatment of the organization under the tax laws, and attitude toward business and professional activities of the membership.

It has become clear over the years that the Acoustical Society of America serves its members well. In a field that covers such a wide range of disciplines all related to sound and vibration, the Society provides the optimum environment to meet and to exchange ideas and to publish. The activities of the Society relate to the group needs rather than the specialized needs of researchers, educators, consultants, or manufacturers. It does not lean toward one specialty or another in the field of acoustics. At times it appears that meetings are more concerned with one area than another, but in the long term, all of the Society's specialties receive due emphasis. As in all areas of science, some topics are of more interest at one time than at another.

In light of the Acoustical Society's growth and health, and the fact that it is meeting the needs of its members in the way that most members wish, the plans for continued programs to improve its effectiveness are certainly valuable. However, one of the activities the Acoustical Society is not permitted to do under its present charter and its Internal Revenue Service tax-exempt status, is to structure its membership or act as a certification body. On the other hand, organizations such as the National Society of Professional Engineers, the American Medical Association, and the American Institute of Architects are organized under another section of the Internal Revenue Code as so called "business leagues" and can establish codes of ethics or professional practice and can establish grades of qualification to be achieved by the membership on accomplishment of certain requirements or by examination. The Acoustical Society of America neither can, nor should, do anything to assist those who need personnel in determining anyone's qualifications.

Because noise and vibration control have become critical elements in the environment, many firms and individuals are offering services to other businesses, to every level of government, and to the public without any proof of capability or qualifications. In most cases, these are qualified people. However, where will various governmental agencies at each level find their consultants and the noise inspectors to examine plans of buildings and industrial plants for approval prior to construction, or to inspect the completed building for conformance? It is obvious that these people are not now available. Training courses are of all levels of competence. Thus, we can find new "professionals" today in the field who have training ranging from a one day seminar through a PhD in physics.

We are most enthusiastic about the prospects for a new engineering organization now being considered. As we see it, this new group will provide the professional structuring needed in this area, while at the same time cooperating with the Acoustical Society and those other scientific and engineering societies currently interested in related or peripheral activities. Publication in the area of noise is growing at a rapid rate, and **Sound and Vibration** will strive to publish more of the basic noise and vibration engineering material. S)V, of course, will continue to meet the needs of those in the field who have responsibility for the applied aspects of the field! As for the profession, it is about time we have a code of some kind within which to operate and a means of permitting those who need certification, in order to function within their agency, to be certified.

We must certainly move carefully, but as a profession, we merely damage our own reputations by moving so slowly that we avoid the issues of professional responsibility.

Lewis S. Goodfriend
Editor

Changing of the Guard

It has been almost five years since we sat down with the Publisher and discussed the concept and goals for a magazine to cover the field of sound and vibration. As the date for our first issue approached we had fixed our goals, the nature of our desired audience and a list of prospective advertisers. Among our editorial goals, and high on the list, were technical excellence, broad interest, and the obvious need to bridge a gap between abstruse scientific material and newspaper science writing, even at its best. For both readers and advertisers, we proposed to provide a marketplace where advertisers could display their wares to prospective purchasers. In the proposed field of coverage there was no single publication that reached an audience ranging through all of the disciplines and specialties that we believed had personnel interested in the subject and a responsibility for specifying or purchasing all of the various products, materials, instrument systems and services that our list of prospective advertisers made or sold.

It was our belief then, as it still is, that we should publish on a narrow subject, in title only, to an audience that is extremely broad and varied in interests and responsibilities. Reader and advertiser-response surveys have confirmed our judgment.

We have weathered the recent economic trial and expect that with renewed public and governmental interest that there will be a resurgence of economic support for all elements of the area that S)V serves. The growth of interest and activity in this field have resulted in greater demands on the Editor's time by those other activities in which we are engaged. Further, we believe that a part-time editor reaches a limit of usefulness; successful publications need more and more of the editor's time as they grow. It is therefore, with considerable regret, that we turn over these responsibilities to our Publisher, Jack Mowry who has tolerated the Editor's foibles, and supported his editorial policies.

We are sure that as the field continues to expand S)V will be called on to serve more readers and to serve in new and more effective ways. It is also with a feeling that there is still so much more to do that we must retire from our stewardship. We have agreed to continue as part of the S)V management and plan to continue to contribute editorially in the future.

To our readers, our authors, and our advertisers who have with their continued support through letters, through interesting and effective papers, and through continued advertising respectively, made the Editor's job a rewarding one, we extend our thanks.

Lewis S. Goodfriend
Editor

Editorial

Community Noise Regulations

The Noise Control Act of 1972 has as a major goal the reduction of noise exposure of citizens within the community. At first glance, it appears that it should be easy to set down a simple regulatory procedure for states and municipalities to adopt for the protection of their citizens against excessive noise. In 1975 there are still no laws, only conflicting guidelines. What has happened in the intervening two years?

Simply stated the question is what levels and what methods of measurement and evaluation are to be used to set standards of noise in the community from sources in industry, commerce, and the community itself?

The Environmental Protection Agency (EPA) reports, Community Noise and the Levels Document (Information on Levels of Environmental Noise Requisite to Protect Health and Welfare with an Adequate Margin of Safety), were a step forward and a step backward, respectively, in less than two years. The proposal for adopting the Community Equivalent Level (CNEL) on a normalized basis (NCNEL) presented a method of evaluating noise impact based on level *and* sociological considerations. The normalizing factors included consideration of community attitudes toward the noise source, the existing ambient, and the character of the noise (tones and impulse). The L_{dn} used in the Levels Document is sociologically blind as it cannot be used to indicate whether the community is in a city, suburb, or rural setting. Sociologically, a city as a total environment is far different from the other two regions, and they, in turn, have their own individual characters.

NCNEL, in considering the ambient, may be acknowledging an existing ambient that is higher than some engineers, scientists, or politicians might consider desirable, but it exists now. Where the risk is high, as in water or serious air pollution, the potential economic impact on the community must be borne. This may include a plant closed by a company that is unable or unwilling to spend the money required to upgrade the effluent. However, noise control criteria between the desirable and the hazardous leave much room for political decisions based on the needs of the community. Adopting a raw measured number, weighted only for time of day (L_{dn}), will serve no one's interests and will work hardship on many. In many rural and semirural communities throughout the country, the L_{dn} is well above the 55dB(A) level cited by EPA. There are other rural environments and some suburban communities where the L_{dn} is well below 55dB(A). Should new noise sources be permitted to move into these areas and raise the L_{dn} just because it might be the law?

In addition to the federal studies, several states have enacted laws containing receiving boundary-line or source boundary-line noise limits. Few are related to existing ambients, intrusions from highways, and neighboring land use. These, too, present no answer to the national need.

A proposal for a national baseline noise survey might produce some interesting data, particularly if the full proposal to carry out a detailed interview program were carefully and sensitively implemented. Even then, the number of locations surveyed must be limited and though technically correct, such a survey may miss the sociological criteria so important in evaluating the environmental noise needs of every neighborhood.

As long as planning and zoning are done at the municipal level, there must be a municipal regulation concerning noise. It should be related to land use and the community's needs. The tools are already available. A number of reasonably good local zoning performance noise regulations have been written during the past twenty years. Many of these regulations use a CNR type of contour and various adjustments accounting for the factors also now included with the NCNEL. Some towns have selected the wrong numbers for their contours, and others have made mistakes in copying the octave band center frequencies. This does not diminish the value of the concept of these noise regulations, however.

Actually, even with the data from a national survey, a community should still look at its ambient, the chances for holding it or reducing it, and then select some numbers to go into its municipal regulation. The EPA can act now, by providing a simple model noise regulation, not a book of definitions and theoretical background. This would give the basic elements needed to tell local industries, commercial establishments, residents, and prospective new members of these groups what levels they will be expected to meet and how they will be assessed. Time factors allowing short periods in excess of the specified values must be included, but certainly not the excesses permitted by the proposed ISO 1996. Such proposed local zoning regulations include all of the principles used in the L_{dn} and NCNEL, but permit their practical application by building inspectors, municipal engineers, and appropriately trained police or health officers.

The real requirement is that each community examine itself—in terms of its existing noise climate—and then prepare a regulation around a model framework that could come out of the EPA quickly. The local survey is not such a burdensome task. Now, the Department of Housing and Urban Development is requiring surveys wherever they are indicated by the guidelines, and highway impact statements require noise surveys. Thus, a well-conceived, uniform national code with locally selected criteria levels should be almost immediately feasible and will go a long way toward achieving the goals of the Noise Control Act of 1972.

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Editorial

(Opinions expressed here are those of the author and not necessarily those of the Institute of Noise Control Engineering.)

Community Noise Assessment

In the forty-five years since the standardization of the A-weighting network in the draft sound level meter standard of 1934, the A-weighting network has been adopted for the assessment of community noise, abandoned, and now once again adopted for standard use in community noise goals and noise assessments. There is much literature that supports the use of the A-weighted sound level for this purpose. However, for those who write and enforce state regulations and local statutes, the A-weighted sound level still creates some serious problems.

There is no doubt that the impact of certain continuous noises or slowly varying noises can be assessed using this descriptor. However, the typical neighborhood complaint may involve equipment that cycles on and off, with different transient noises at the start and stop of the cycle, or equipment that generates pure tones with sound pressure levels several decibels above their A-weighted level. In both cases, the signals may have a high annoyance effect, even if they are below the A-weighted sound level set by a regulation, or below the level that would show a change in the yearly day-night level (YDNL) proposed in the Committee on Hearing and Bioacoustics (CHABA) "Guidelines for Preparing Environmental Impact Statements on Noise."

From the earliest days of acoustics, it has been acknowledged that the ear is an integrator, a detector, and a filter, and these properties often play a major role in individual responses to noise in the community. Those who drafted the Guidelines and its predecessor, the Levels Document, looked at communities as single entities, not as groups of individuals. It is for this reason that there is a caveat in the Levels Document with respect to annoyance, and an acknowledgment in the Guidelines that "five percent of the population will be highly annoyed," even when there is no "average community reaction" and there are no "health and welfare" effects. The Guidelines also point out that "this is not to say that all individuals have the same susceptibility to noise; they do not. Even groups of people may vary in their response to noise, depending on previous exposure, age, socio-economic status, political cohesiveness, and other social variables."

At the state and municipal level, regulatory methods are still needed to assess noise problems in the quiet small town environment and to assess the two common noise situations discussed in the first paragraphs — cycling signals with transients and just-detectable pure tones. The Composite Noise Rating (CNR) of Rosenblith, Stevens, and Bolt (1952) was an ingenious method of facing the problems of spectral change and the impact of even a moderate noise in a very quiet existing ambient. It is not as easy to use as the A-weighted sound level and it may not be universally understood, but it does provide important information that is lost by using a single descriptor system such as A-weighting.

There is, as yet, no means in the CNR technique for handling the low-level transient and cycling signals, but this is just one more area for future research. In the meantime, a modification of the CNR to provide a penalty for the frequency of cycling could probably be introduced with reasonable accuracy.

Both the Levels Document and the Guidelines are useful tools for mass population impact assessments, but there is still an urgent need for agreement on a method of assessing local tranquil microenvironments in which many individuals and their families live. Here is an ongoing challenge to today's noise control engineer.

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EDITORIAL

Forty Years of *Sound and Vibration* Magazine

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In 1966, five years after the demise of *Noise Control* magazine, I began to discuss with my associates the need for a technical journal that would publish articles on the application of new technology in the field of noise and vibration control. Unknown to me was the fact that Jack Mowry, then an applications engineer for B&K Instruments, had the same idea. B&K Instruments, Inc. was then the U.S. distributor for Brüel & Kjær dynamic measurement instrumentation.

Early that year he called me, and without telling me any details, asked if he could pay me a visit. At that meeting he told me of his plans for a new business-to-business publication that would cover the fields of noise and vibration control. I outlined my thoughts on the subject, and we discussed the various potential audiences for such a publication. Before we were through, Jack asked whether I would be interested in being the editor. After consultation with my firm's senior staff, I agreed. Jack had indicated that he wanted to be publisher but not editor. I indicated that I wanted to be editor but not publisher, so it was a perfect match.

From there on, Jack and I busied ourselves with obtaining mailing lists, papers, advertisers, news items, and new product announcements. The result has been 40 years of continuous publication of this informative magazine, including more than a thousand interesting articles, hundreds of technical briefs, news of the field, thousands of advertisements, and of course Eric Ungar's whimsical A-to-Z rhymes.

I continued as editor of S&V for the next five years through February 1971. Then there were a series of editors and Jack Mowry took over as both editor and publisher in August 1974. He has worn both hats ever since. George Fox Lang joined him as associate editor in January 1988 and the S&V masthead has listed a long string of distinguished contributing editors for decades.

During the past 40 years, there have been many changes in the field, with instrumentation moving from discrete components to miniaturized devices based on integrated circuitry. Computers used for data analysis have shrunk from the size of a rack that contained decks of hard drives, boxes of magnetic core memory, and a processor to hand-held devices that contain FFT analyzers, octave- and 1/3-octave band filters, and processors that yield statistical distributions of sound levels. Sound level meters have shrunk to the size of a pack of cigarettes from suitcase-size boxes half filled with batteries. Data loggers, formerly unwieldy boxes filled with electromechanical counters yielding A-weighted statistics in two- and three-decibel increments, are now the size of a small paperback book that provide statistical sound level data in one-tenth decibel increments along with a histogram. Airport noise monitors yield a wide range of noise statistics and can automatically integrate radar data and flight information in their reports. In the area of sound intensity measurement, where formerly no commercial equipment was available, relatively simple, easy-to-use, commercial, two-microphone systems are available today. Today many acoustical instruments have processors as powerful as a laptop computer, and there is software available that permits PCs to simulate a variety of sound and vibration instruments. Also many instruments can be interfaced with PCs using the ubiquitous RS-232 and USB interfaces.

Along with these changes in instrumentation, noise modeling for industrial and community noise impact analysis has advanced from slow, mainframe-generated contours to software packages that work interactively on a laptop. These systems offer instant response to changes in source conditions, elevation, barrier location, and other parameters. Also, they map sound levels by color bands in any desired increment.

Other areas where the speed and programmability of microprocessors have enabled a wide variety of software and hardware applications include, to name only a few:

- Modal analysis
- Noise cancellation systems
- Statistical energy analysis
- Finite-element analysis
- Automobile noise control
- Spectral waterfall plots
- Integrated-circuit piezoelectric accelerometers

Not all of our noise and vibration problems have been so easily resolved. There are unresolved problems in the areas of architectural acoustics and of human response in terms of what we now measure. Today we measure the sound isolating capability of a building partition by constructing a sample of the partition in the opening between two large laboratory rooms. We then generate high-level noise in one room and determine the ratio expressed in decibels of the power applied to the partition to the power transmitted, in each of a subset of the ANSI-preferred, 1/3-octave bands. This is essentially the same method used in the 1920s, and it depends on having diffuse sound fields in both rooms throughout the frequency range of interest. The result is a table of sound transmission loss values.

The labs are large enough that there are an adequate number of modes in the lowest frequency band of interest. But these data do not permit the prediction of the low-frequency sound isolation that will occur in small rooms the size of a typical office or bedroom. Further, use of a rating scheme that relates the partition's effectiveness in isolating human speech, the sound transmission class (STC) has become common.

Unfortunately, people who live in modern townhouses and apartments have large-screen TVs with large loudspeakers that have good low-frequency response. Some may even have home-theater equipment capable of reproducing the TV sound and a wide variety of recorded media having very low frequency content. The result is that high-level, wide-band audio is often generated close to the floor or to a demising wall. With no reliable data for small rooms at low frequencies, we are not in a position to design suitable floor-ceiling systems and demising walls to provide adequate sound isolation. A similar problem exists with respect to impact isolation from children running and adults walking shod or barefoot on structurally sound but very flexible floor-ceiling structures. The only reliable tests available to builders and developers is construction of a mock-up of three adjacent rooms that can be tested with live people and home-theater equipment under real-life conditions.

Another interesting situation in architectural acoustics is where acoustical test data are acquired in 1/3-octave bands, but the results are only published as single-number ratings that are no longer relevant. Similarly, sound absorption, sound insertion loss, and HVAC source data are acquired in 1/3-octave bands but are usually published for six or seven octave-band center frequencies. This does not give the architect and mechanical engineer adequate information to design quiet, comfortable buildings. Some possible solutions to the problem might be generated if the acoustical engineering and research communities were to study the behavior of low-frequency sound in small rooms, find a new sound isolation rating scheme, and present data to the public over the entire frequency range of interest.

A large segment of the public – purchasers of high-end audio equipment – already deal with frequency response curves and narrow-band equalizers, so spectral data is not a new idea.

One more area where we do not have adequate information is in the area of community response to noise. Back in the early 1950s, the Composite Noise Rating (CNR) allowed matching of a noise spectrum to a noise-rating contour and provided some adjustments for time of day, season, and quality of the noise. Use of the spectra were essentially abandoned with EPA's adoption of the A-weighted sound level as the metric and acceptance of the Schultz curve as the predictor of community response. These changes have led to where we are unable to predict with reasonable probability the expected community response to noise. The current method almost works for transportation noise, but efforts to tweak it have not been successful. The method works poorly for industrial and commercial sites – noises from orbital crushers, truck refrigeration units, and rooftop condensing units, for example.

The CNR has been criticized because it had been developed using too small a data base. It seems to me that a move in the right direction would be to return to the concept of the CNR and using the currently large databases of industrial and consulting firms to develop a revised CNR.

One final thought concerning noise assessment: I wonder why we are still using A-weighted sound level in the 21st century. There is already an ANSI standard method for computing loudness. It appears that it is the commitment to history – the decibel – that forces municipal officials, architects, planners, and engineers to deal with decibels, a unit that has no physical or sensory meaning. Current technology permits conversion of narrow-band measurements directly into loudness and loudness level in a handheld meter.

Congratulations S&V for documenting the exciting growth in our ability to measure and control noise and vibration over the past 40 years. S/V

Please comment on this editorial. Send them to: lsg@lsga.com.