

TIMETABLE FOR VEHICLE NOISE REDUCTION

Warren M. Heath
California Highway Patrol

The present California schedule of reduced noise levels for new passenger cars, motorcycles, trucks, and buses had its origins in a 1967 addition to the California Vehicle Code (1). That law established the first sound-level standards for new motor vehicles and was applicable to vehicles manufactured after January 1, 1968.

The new limits were a compromise between what was desired by the author of the bill and what was economically practical at the time. Under specified wide-open-throttle acceleration tests from initial speeds of 30 mph (48 km/h) or lower, limits were set at 88 dBA for trucks and buses, 86 dBA for passenger cars and pickups, and 92 dBA for motorcycles (with a limit of 88 dBA required after January 1, 1970). In a meeting prior to committee hearings on the bill, the author, the California Highway Patrol, and representatives of the vehicle manufacturers agreed to these numbers to the extent that they would allow the feasibility of metered noise enforcement to be demonstrated.

By 1970, the California legislature had become environmentally conscious in many areas and in that year adopted a resolution directing the state Department of Health to appoint an advisory committee on noise. The resolution stated that "some of the blame for the disorientation and frustration of today's urban life can be placed on the high noise levels that act as subliminal irritants, and, in addition to these mental symptoms, definite and measurable hearing loss has been found among those who work or play under

noisy conditions." It requested that a report be prepared "on the subject of noise including the noise from industrial equipment, construction, motor vehicles, boats, aircraft, home appliances, electric motors, combustion engines, and any other noise-producing objects, identifying the sources of noise pollution, and recommending means of controlling the harmful effects of noise, including recommending standards of noise level emissions." Quite an assignment to be accomplished within a 5-month deadline by a voluntary advisory committee that was not then in existence!

The committee appointed by the Department of Health consisted of 20 members from various public organizations, private firms, and associations. The deadline for preparing the report was so short that there was time for only 3 monthly meetings of the full committee and no time for research or literature review. The information and recommendations included in the final report came from the knowledge, opinions, and feelings of the individual members.

The first meeting began with a discussion of the full range of noise problems and their effects. It ended with the drafting of tables of sound measured at the hearer's ears relating to (a) noise levels at which various harmful effects occur, (b) levels that people want, (c) levels that people will accept without undue complaint, and (d) estimated community response to noise at various levels above the acceptable levels. The tables included levels for locations ranging from industrial zones to wilderness areas.

It was obvious that there was not enough time for the committee to recommend either limits or methods of source control for a large number of products as different as kitchen garbage disposals and supersonic aircraft. Thereafter, its effort was concentrated on making specific recommendations concerning transportation noise. Vehicle noise and aircraft noise caused the most complaints throughout the state. More important, in each of these areas, state departments were already working on the problems and were actively enforcing the limited standards that were then in effect. It was felt that more benefit could be obtained in the short time available by enhancing programs already in operation rather than by attempting to establish a catalog of noise limits on items that would require legislative enactment of new programs.

The committee eventually adopted 13 recommendations: 1 applied to the establishment of an office of noise abatement at the state level; 2 applied to aircraft noise; 1 recommended a 75-dBA occupational noise exposure level mandatory for all industry by January 1, 1980; 6 applied to motor vehicle noise; 1 applied to freeway barriers and design features; 1 recommended that state agencies require noise control on equipment that they purchase or that is used in construction of state projects; and 1 requested that the advisory committee on noise be continued (2).

Since the emphasis of this paper is on vehicle noise, only the committee recommendations pertaining to that subject will be discussed.

NEW-VEHICLE NOISE LIMITS

After much somewhat unfruitful discussion on the wide-ranging subjects of vehicle noise, its measurement, and its control, the advisory committee decided its most effective procedure would be to develop a recommended schedule of noise reduction during a period of several years. In the past, different sessions of the legislature seemed to have differing attitudes toward vehicle noise reduction and the amount of noise reduction that was economically feasible. Vehicle manufacturers were faced each year with the threat of new legislation and had no lead time to do necessary research and make changes in the design and production of their vehicles.

A schedule recommended in 1970 to project decreasing levels in coming years would meet 3 objectives: (a) establish an eventual limit that was low enough to practically eliminate public annoyance and complaints, (b) allow sufficient lead time so manufacturers could design and tool up to meet production deadlines, and (c) allow the legislature to consider in an orderly manner any needs that may arise for future revisions of the timetable. Table 1 gives the schedule that was finally adopted by the committee (with far from unanimous agreement).

Table 1. Timetable for noise reduction of new vehicles.

Year	Trucks and Buses (dBA)	Passenger Cars, Pickups, and Motor-Driven Cycles (dBA)	Motorcycles (dBA)
1970	88	86	88
1973	86	84	86
1975	83	80	80
1978	80	75	75
1988	70	70	70

Note: Noise was measured at 50 ft (15 m) from the centerline of the vehicle.

The levels shown for 1970 and 1973 were already in the Vehicle Code at the time the advisory committee met. The 1973 values had been adopted in 1969 to give manufacturers 3 years to reach the new limits. The proposed 1975 date for further lowering the limits was intended to give new-vehicle manufacturers 3 years from the 1971 session of the legislature to bring their vehicles into compliance.

With respect to trucks, 83 dBA was proposed on the basis of what could be done by using knowledge already avail-

able without a massive increase in cost to quiet the larger vehicles. The committee recognized that this limit would require a substantial reduction in exhaust system noise on heavy diesel-powered vehicles, quieting of intake noise and fan noise, and provision of some sound-absorbing enclosures on certain models.

The 1975 passenger car limit of 80 dBA was based on information that many of the car models already complied with an 80-dBA performance and the belief that the louder models should be reduced to that level. It was also thought that by 1975 new motorcycles should be quieted to the same level as new passenger cars instead of being as loud as trucks, as previously permitted.

The 1978 level of 80 dBA for trucks was proposed as a limit that was considered to be possible with available knowledge but that will require extensive changes in the vehicle and engine. A lead time of 7 years will probably be required, and major increases in manufacturing costs will have to be passed on to the truck operators in the form of higher prices.

The committee recognized the desirability of coordinating the noise-reduction schedule with a proposed timetable for air pollution emission standards for diesel trucks, because both affect engine design. Such coordination was not accomplished, but later modifications in the emission standards seemed to make it less essential.

The 1988 requirement of 70 dBA for all classes of new vehicles was a conjectural one that had little support among most of the members of the committee. It was included because it seemed to be an acceptable limit below which further quieting of vehicles would not be necessary to eliminate general complaints. Information was not available to indicate that far in advance whether it would be an acceptably low limit for the public and whether it would be economically feasible for manufacturers. The 70-dBA limit was not technically feasible with the then-current types of trucks, tires, and engines, but it would allow manufacturers a lead time of at least 16 years to attempt to meet that goal.

The foregoing proposals applied only to the maximum noise produced by a single motor vehicle from an initial speed of 30 mph (48 km/h) or less. Vehicles that met these limits under the low-speed, wide-open-throttle acceleration test would not necessarily be this quiet on the highway. The enforcement limit for open highways would need to be greater because the new-vehicle tests do not include tire and other operational noises that occur at higher speeds, nor do they include the additional noise produced by tires and running gears of trailers and semitrailers.

The recommended schedule of new-vehicle noise reduction was enacted into law in 1971 and has already proved to be more effective than anticipated. It has resulted in the quieting of new vehicles sold not only in California but in many instances across the country. It has also served as a point of departure for other states, the federal government, and some cities in developing their own new-vehicle noise requirements.

The schedule has given manufacturers the opportunity to present their cases before the legislature in instances where they thought the timetable could not be met. Motorcycle manufacturers successfully obtained legislation in 1974 to raise the proposed 80-dBA limit for 1975 to 83 dBA, thereby keeping cycles at the same loudness level as trucks instead of quieting them to the passenger car level. The truck manufacturers

at the same session sought legislation to postpone the 83-dBA limit for 2 years because the difficulties in bringing a few of their louder models down to this level would result in discontinuing their sales in California. That legislation did not pass, and, at the time of this writing, the limit remains at 83 dBA for trucks sold in California after January 1, 1975.

HIGHWAY NOISE LIMITS

Quieting new vehicles in itself will not effectively reduce highway noise unless quiet limits on vehicles in use are enforced. An attempt was made by the committee to set a highway noise-reduction schedule similar to that for new vehicles. However, such a long-term proposal would have been even more of a guess than that for the new-vehicle standards. No information was then available on the practicality of bringing older vehicles into conformance with substantially lower standards in future years. The committee limited itself to making the one-step proposal given in Table 2 beyond the already scheduled 1973 limits in the Vehicle Code.

The proposed 1975 reductions in the limits for trucks were at that time thought to require no basic redesign of the older trucks or engines but only the use of the best available mufflers and quiet-running tires. Obtaining the reduction was recognized to be far more difficult for diesel truck operators than for operators of other classes of trucks.

Truck operators were having difficulties in obtaining mufflers to meet the 88- and 90-dBA limits, principally because of lack of communication among the dealers, the service shops, the original truck manufacturers, and the muffler manufacturers. The California Highway Patrol, in following up on the outcome of muffler violations, was told by older truck owners that 2 or 3 replacements had to be made before they stopped receiving noise-limit violation notices. The industry was not prepared for servicing older vehicles with muffler systems that were adequate to meet the then-current limit.

The highway noise limits recommended by the committee were not enacted into law, as was the new-vehicle noise schedule. There was no assurance that owners would be able to obtain equipment at reasonable cost to further quiet their vehicles. The results of a 1965 study conducted by the California Highway Patrol indicated that the proposed 1975 limits would have been exceeded by 38 percent of the diesel trucks at speeds greater than 35 mph (56 km/h), a violation figure that appeared to be unacceptably high to the author of the other noise bills.

Not yet developed is a practical means of applying lower highway limits to vehicles manufactured after 1974, so the quieter new vehicles cannot be modified to produce as much noise as the current operational limits. Any legislation on this subject will apparently need to include a 2-level arrangement to keep newer vehicles properly muffled while allowing relief for older vehicles that cannot economically be quieted to lower levels.

Table 2. Timetable for noise reduction of in-use vehicles.

Year	Trucks and Buses (dBA)		Passenger Cars, Pickups, and Motor-Driven Cycles (dBA)		Motorcycles (dBA)	
	<35 mph*	>35 mph	<35 mph	>35 mph	<35 mph	>35 mph
1970	88	90	76	82	82	86
1973	86	90	76	82	82	86
1975	83	86	74	78	74	78

Note: Noise was measured at 50 ft (15 m) from the center of the lane of travel.

*56 km/h.

HEAVY TRUCK CLASSIFICATION

The committee's recommendations continued in effect the gross-vehicle-weight rating (GVWR) of 6,000 lb (2770 kg) that was the dividing point between light trucks and heavy trucks. This figure originated in 1967 when a survey made by the California Highway Patrol of pickup trucks manufactured before that date indicated a substantial proportion of $\frac{3}{4}$ -ton (680-kg) pickups were rated at less than 6,000-lb GVWR. Since then, various federal safety regulations, a public interest in improved styling, comfort and accessories, and stronger components for carrying heavy camper bodies have resulted in most of these vehicles now being heavier than the 6,000-lb limit.

Some of the 4-wheel-drive vehicles that used to be in the lightweight jeep category, minivans that used to be in the Volkswagen bus category, and medium-sized pickups now exceed the 6,000-lb limit. California law should now be changed to adopt the 10,000-lb (4534-kg) division point contained in the Environmental Protection Agency standards applying to noise from motor carrier vehicles engaged in interstate commerce.

NEW URBAN TRANSIT BUS LIMITS

Several members of the committee were quite concerned about the high level of noise emitted by city buses when they accelerated from an intersection or bus stop under full power. They proposed an additional new-vehicle limit that would apply to city transit buses. Measurements would be taken with a microphone at a distance of 15 ft (4.6 m) from the centerline of the vehicle. Readings would be taken as the vehicle accelerated from a standing stop; the distance from the starting point to the point at which the rear of the bus passed the microphone has yet to be established.

The suggested new-vehicle limits for this test at 15 ft were the same as those for the trucks and buses under the 50-ft test. No data were available to support the proposed numbers, and this recommendation did not find its way into legislation.

CERTIFIED TIRES

The committee realized that quieting traffic noise on open highways would not result simply from continually lowering the noise of new vehicles accelerating under full power. At fast speeds, high noise levels still persisted even when engine and exhaust noises had been substantially reduced.

A number of tests by passenger car manufacturers showed that cars at high speeds gave much the same sound-level readings whether their engines were operating or not. The noise from these cars was principally produced by the tires on the road. Truck manufacturers also found the same situation to be true. Quieting the exhaust and power plant noise of a new truck to levels below the 1978 levels would not have any effect on the total noise produced by a combination of vehicles at legal highway speeds (although it would quiet low-speed operation).

The next major step in noise reduction was eliminating noisy tires. At that time, an operator who was cited for excessive noise due to loud tires had no way to determine which tires on the market could be used to correct the violation. Truck operators needed a list of tires that were certified by the manufacturer as being below certain noise-level limits both when new and when well-worn.

As a result of the committee's recommendation, legislation was enacted requiring the California Highway Patrol to adopt regulations setting noise standards for pneumatic tires. These standards were to be the lowest level of noise consistent with economic and technological feasibility and with public safety. The law specifies that the U.S. Department of Transportation must be considered before independent standards are developed for tire noise. Tire noise standards have not yet been adopted because the federal transportation department has not published (as of 1974) a report of its tire noise study.

CERTIFIED MUFFLERS

Considerable committee discussion was devoted to the observation that truck operators in particular and other operators in general could not know with reasonable certainty whether a particular replacement muffler would quiet a vehicle to within the highway operation limits. Many members expressed a desire for the state Department of Health to publish a list of certified mufflers similar to the present lists of approved lighting equipment. Other members of the committee, including representatives of the health department, were concerned that such a program as then conceived would be so unwieldy as not to be enforceable. The approving and listing of mufflers for every combination of vehicle model, engine type, and exhaust pipe configuration appeared to be a monumental task.

Despite the potential problems, legislation was enacted and funds were appropriated for the health department to conduct a study of the most feasible method of certifying exhaust systems. This study was done under a contract awarded to McDonnell Douglas Astronautics Company (3). Stationary vehicle test procedures were suggested as was a simplified method of manufacturers' certifying the contents of their exhaust system catalogs.

An informal advance notice of proposed regulations based on the report was mailed to major organizations. Extensive comments received on the informal proposal and a considerable amount of test data were presented. This information resulted in a revised official notice that has been mailed to the industry and interested parties for formal comment.

INSPECTION OF MUFFLER RETAIL OUTLETS

The committee believed that muffler retail outlets should be inspected in the same manner as lighting equipment outlets to prohibit the sale of illegal mufflers that are designed to increase noise output of a vehicle. The new law on exhaust system certification, in conjunction with certain laws that were already in existence, will allow this to be done.

The proposed exhaust system certification regulations will require exhaust systems and their major components listed in any catalog to be certified by the manufacturer as meeting the noise limits for the particular vehicles for which they are listed. When the certification program becomes operational, the officers who inspect retail outlets throughout the state for illegal automotive equipment will include mufflers on their list of items to be checked.

MUFFLER CERTIFICATION STATIONS

The development and licensing of official muffler certification stations similar to the present official stations for lamps, brakes, and air pollution control devices on vehicles were suggested. It was proposed that the health department develop instrumentation and test procedures for such stations so that a vehicle that is cited for exhaust noise can have the violation cleared by a test at an official station in a similar manner as for headlamp-aim violations.

This recommendation was adopted in legislation requiring the department to establish regulations for licensed exhaust-system certification stations. Proposals for stationary tests to be conducted at licensed stations were included in the McDonnell Douglas report (3). These proposals, as modified by the department, have been sent out for comment in a notice of proposed regulations.

DYNAMOMETER TESTING

The committee informally suggested that the health department consider installing

chassis dynamometers at each of the on-highway truck inspection facilities for measuring the noise output of trucks under full power. This recommendation was not implemented because such an operation would be quite expensive in terms of land, equipment, and personnel for the number of violations that might be detected. It also had other problems, such as tire noise on the dynamometer rolls and slippage between the tires and rolls under full load.

The EPA noise limits that were recently adopted for motor carriers engaged in interstate commerce appear to be a more feasible type of stationary test. The EPA standard establishes a limit of 88 dBA at 50 ft (15 m) for trucks equipped with governors when the accelerator is rapidly opened and held open until the engine reaches the governed rpm. It has been included in the proposed California regulations for certified exhaust systems and licensed muffler stations.

The advisory committee also suggested, prior to the idea of a stationary test, that moving-vehicle testing facilities be set up at the local highway patrol offices. The intent was that any road patrol officer who apprehended a vehicle that appeared to be excessively loud could require the driver to take it to a highway patrol office for a noise test using a sound-level meter.

This suggestion was not entirely practical because of land and personnel costs and the excessive travel distances for motorists. Part of it will become effective when muffler stations are licensed and authority is obtained for passenger vehicle inspection teams to take sound-level readings on exhaust systems when the vehicle is stationary.

HIGHWAY MEASUREMENT SITES

The committee encouraged the health department to proceed as rapidly as possible with a study on easing the restrictions on highway measurement sites. At that time, the test procedures specified 100 ft (30 m) of clear area around the microphone and around the portion of the roadway on which vehicles were being measured. The requirement for large, clear, open areas was so restrictive that it was difficult to find test sites except on major highways. Enforcement on most city streets was not possible because of the proximity of buildings.

The study was conducted by Wyle Laboratories under contract to the health department (4). Regulations allowing for sound-level reading corrections based on variations in test distance from the center of the roadway to the microphone and on the presence of reflecting buildings and other objects within 10 ft (3 m) of the microphone were subsequently adopted.

INCREASE IN NOISE TEAMS

When the committee was reviewing vehicle noise enforcement, the health department had 6 noise teams in the field working half-time. These teams could not cover all locations that had obvious noise problems. Doubling the number of noise teams was informally recommended. The following year the teams that were operating only half-time were assigned to full-time enforcement. Every year since, the department has budgeted for an increase in the noise-enforcement teams but has not been successful in obtaining additional person-hours.

LOCAL NOISE ENFORCEMENT

A further informal recommendation was that local law enforcement agencies establish noise-enforcement programs. With few exceptions, most police departments understandably consider vehicle noise enforcement to be an incidental function subordinate to traffic safety. Noise violators are not sought out but are apprehended only when an outstandingly loud vehicle happens to be encountered.

In most cases, exasperating noise in residential areas occurs sporadically and in locations where the use of meters is not feasible because the violators who go out of their way to make noise temporarily avoid operating where the meters are. Officers who are informed of noise problems and who observe the defects can more effectively apprehend these violators under current muffler statutes. Suitable backing from the courts is also required.

Although there is no statewide control over the operation of local enforcement agencies, the health department has assisted some in training their officers in the use of sound-level meters. It has also encouraged individual police departments to increase noise enforcement by all officers assigned to traffic duty. The highway patrol has expanded its enforcement in this manner by a substantial amount in recent years. In fact, 97 percent of the department's exhaust-system enforcement actions are taken as a result of eye and ear observations and not by meter readings. During times when one member is off duty, an instrument is being repaired, or the wind is too high, even the noise teams disperse to problem residential areas or locations around schools where enforcement by ear has been quite effective.

TESTS FOR MAXIMUM NOISE

The committee recognized that the test procedures for new vehicles in effect at that time did not measure the maximum possible noise that the vehicles could produce. The only exception was the procedure for trucks; however, even in this case, a particular condition of operation was found that would emit slightly more noise than the standard procedure. The committee consequently recommended that the new-vehicle tests be conducted in such a manner as to produce maximum noise.

As a result of the recommendation, some minor changes have been made in the regulations, such as now requiring cars with 5-speed transmissions to comply with the new-vehicle noise limits in first gear as well as in second gear. The health department has also participated in work of the Vehicle Sound Level Committee of the Society of Automotive Engineers in developing tests to measure the maximum acceleration noise from passenger cars and from motorcycles.

It has not been possible to adopt these procedures as administrative regulations without some legislative increase in the Vehicle Code limits. Those limits were based on the current methods that produce less than maximum noise for many vehicles. Also, the vehicle manufacturers are concerned that such procedures would allow a low-powered vehicle that requires most of its power, and consequently maximum noise, during cruise conditions to be louder on the highway than a high-powered vehicle that uses only a portion of its power for cruising.

ABOLISHMENT OF ADVISORY COMMITTEE

Perhaps the best way to end this paper is with the statement that the legislature rejected the recommendation that the advisory committee be continued in existence. Unlike other similar committees, it accomplished its major purpose in a short time and then disbanded. Seven of its recommendations were partially or fully enacted into law. Despite some major disagreements among members of the committee and the cursory way in which some of the recommendations were developed, the committee's report had a substantial influence on new noise legislation for motor vehicles.

REFERENCES

1. 1967 California Vehicle Code. California Department of Motor Vehicles, Sacramento, Section 27160.
2. Report to the 1971 Legislature on the Subject of Noise. California Department of Health, Sacramento.

3. Exhaust System Certification Study. California Department of Health, Sacramento.
4. Research on Highway Noise Measurement Sites. California Department of Health, Sacramento.