

MINUTES OF THE HOUSE ECONOMIC DEVELOPMENT AND TOURISM COMMITTEE

The meeting was called to order by Chairman Lana Gordon at 3:30 P.M. on February 26, 2008 in Room 519-S of the Capitol.

All members were present except:
Robert Olson- excused

Committee staff present:
Emalene Correll, Kansas Legislative Research Department
Ryan Hoffman, Kansas Legislative Research Department
Jason Long, Office of the Revisor of Statutes
Matt Todd, Office of the Revisor of Statutes
Ann Deitcher, Committee Assistant

Conferees appearing before the committee:
Representative Ann Mah
Richard Cram, Department of Revenue
Dan Heskett, Department of Wildlife & Parks
Mark Burghart, Attorney
Marlee Carpenter, Ks Chamber of Commerce

HB 2657 - concerning motorboats; relating to exhaust noise requirements.

The Chair opened the hearing on **HB 2657**.

Matt Todd explained the amendment to **HB 2657** which included the proposal for the Sound Muffling Law Amendment that was agreed upon. (Attachment 1).

Questions and answers followed.

Dan Heskett explained that the decibel level in the amendment to **HB 2657** was based on Texas and Florida law while the verbiage in the enforcement provision is based on Missouri law. Copies of "Pleasure Motorboat Model Noise Act" were distributed. (Attachment 2).

Representative Mah spoke briefly in support of **HB 2657** referring to **HB 2679** which was previously heard by the Committee.

A motion was made by Representative Worley and seconded by Representative Hill to adopt the amendment to **HB 2657**. The motion carried on a voice vote.

A motion was made by Representative Swanson and seconded by Representative Craft to pass **HB 2657** as amended. The motion carried on a voice vote.

HB 2603 - allowing qualification for certain business tax credits through other members of a unitary group.

The Chair opened the meeting on **HB 2603**.

Jason Long explained **HB 2603** to the Committee.

Marlee Carpenter addressed the inclusion of HPIP into the bill saying that wasn't the intent. No written testimony was provided.

CONTINUATION SHEET

MINUTES OF THE House Economic Development and Tourism Committee at 3:30 P.M. on February 26, 2008 in Room 519-S of the Capitol.

Questions and answers followed.

Richard Cram told the Committee that **HB 2603** need a clarification amendment.

A motion was made by Representative Hayzlett and seconded by Representative Swanson to amend **HB 2603** with clarification language. The motion passed on a voice vote.

Mark Burghart gave an explanation of the clarifying language that was to be made in the bill.

Representative Hayzlett made the motion to pass **HB 2603** as amended. Representative Worley seconded the motion which passed on a voice vote.

The meeting was adjourned at 4:40 pm. The next meeting is scheduled for Wednesday, March 5, 2008.

HOUSE BILL No. 2657

By Representative Tafanelli

1-23

2/20/2008, KDWP & Lake Perry Boaters amendment: HB2657_Balloon.
Prepared by the Revisor of Statutes Office: MBTodd

9 AN ACT concerning motorboats; relating to exhaust noise requirements;
10 amending K.S.A. 2007 Supp. 32-1120 and repealing the existing
11 section.

12
13 *Be it enacted by the Legislature of the State of Kansas:*

14 Section 1. K.S.A. 2007 Supp. 32-1120 is hereby amended to read as
15 follows: 32-1120. (a) ~~The exhaust of every internal combustion engine~~
16 ~~used on any motorboat on the waters of the state shall be effectively~~
17 ~~muffled by equipment so constructed and used as to muffle the noise of~~
18 ~~the exhaust.~~

19 ~~—The muffler system shall be in good working order and in constant~~
20 ~~operation and effectively installed to prevent any excessive or unusual~~
21 ~~noise.~~

22 ~~—(b) Muffler means a sound suppression device or system designed~~
23 ~~and installed to abate the sound of exhaust gases emitted from an internal~~
24 ~~combustion engine and which prevents excessive or unusual noise.~~

25 ~~—(c) A motorboat operating on the waters of the state shall have an~~
26 ~~exhaust water manifold or a factory-type muffler installed on the engine.~~

27 ~~—(d) A person shall not operate or give permission for the operation~~
28 ~~of any motorboat in or upon the waters of this state if the motorboat is~~
29 ~~equipped with an altered muffler, muffler cutout, muffler bypass or any~~
30 ~~other device designed or installed so that it can be used continually or~~
31 ~~intermittently to bypass any muffler or muffler system installed on the~~
32 ~~motorboat, or to reduce or eliminate the effectiveness of such a muffler~~
33 ~~or muffler system.~~

34 ~~—(e) A motorboat shall not be operated on the waters of this state~~
35 ~~under any condition or in any manner whereby the motorboat exhaust~~
36 ~~noise emits a sound level in excess of 86 decibels on the "A" weighted~~
37 ~~scale, when measured from a distance of 50 feet or more from the mo-~~
38 ~~torboat, as prescribed in by society of automotive engineers standards, in~~
39 ~~SAE J34 and or when the motorboat exhaust noise emits a sound level in~~
40 ~~excess of 91 decibels when subjected to a stationary sound level test as~~
41 ~~prescribed by SAE J2005.~~

42 ~~(f) No person shall remove, alter or otherwise modify in any manner~~
43 ~~a muffler or muffler system installed on a motorboat to prevent the muf-~~

1 fter or muffler system from being operated in accordance with this statute.
2 —(g) (b) The provisions of subsections (c) through (e) subsection (a)
3 shall not apply to motorboats officially registered and competing in or
4 while on trial runs 48 hours immediately preceding a regatta, race, marine
5 parade, tournament or exhibition which has been authorized or permitted
6 by the department.

7 (h) (c) A law enforcement officer who has reason to believe a motor-
8 boat is being operated in violation of the noise levels established in this
9 section may direct the operator of the motorboat to submit to an on-site
10 test to measure noise level. An operator of a motorboat who receives a
11 request from a law enforcement officer pursuant to this section shall allow
12 the motorboat to be tested. If, based on a test to determine the noise
13 level of a motorboat, the noise level of the motorboat exceeds the decibel
14 levels established in this section, the law enforcement officer shall direct
15 the operator of the motorboat to take immediate and reasonable measures
16 to correct the violation, including, but not limited to, terminating the
17 voyage of the motorboat until the motorboat no longer operates in vio-
18 lation of this section.

19 Sec. 2. K.S.A. 2007 Supp. 32-1120 is hereby repealed.

20 Sec. 3. This act shall take effect and be in force from and after its
21 publication in the statute book.

Any officer authorized to enforce the provisions of this section who has
reasonable suspicion to believe that a motorboat is not in compliance with
the noise levels established in this section may direct the operator of such
motorboat to submit the motorboat to an on-site test to measure noise levels,
with the officer on board if such officer chooses, and the operator shall
comply with such request. The owner of any motorboat which violates any
provision of this section shall have sixty days from the date of the violation
to bring the motorboat into compliance with the provisions of this section.
Thereafter, it shall be the owner's responsibility to have the motorboat tested
by the department. If the motorboat fails such test, the owner shall
immediately moor the motorboat and shall keep the motorboat moored until
the department certifies that the motorboat is in compliance with the
provisions of this section. Failure to comply with a request or direction of an
officer made pursuant to this subsection is a class C misdemeanor. Nothing
in this section shall be construed to limit the officer's ability to enforce this
section and to issue citations to the owner or operator of any motorboat
during the sixty-day compliance period.

Proposal for Sound Muffling Law Amendment
2/20/2007

The following recommended changes to the KDWP proposed bill were agreed upon.

1. Utilize the proposed amended bill by KDWP with the following changes:
2. Leave the strikeout intact to allow the cutout devices as stated in the proposed amended bill by KDWP requiring the vessel to maintain the requirement listed below in number 3.
3. Strike any language that would utilize the 86 dB rating on the A weighted scale according to SAE J34 and maintain the testing requirement of 92 dB changed from 91 dB on the "A" weighted scale, when subjected to a stationary sound level test as prescribed by SAE J2005.
4. Add the following language adopted from the Missouri law on noise level regulations:

"Any officer authorized to enforce the provisions of this section who has reasonable suspicion to believe that a motorboat is not in compliance with the noise levels established in this section may direct the operator of such motorboat to submit the motorboat to an on-site test to measure noise levels, with the officer on board if such officer chooses, and the operator shall comply with such request. The owner of any motorboat which violates any provision of this section shall have sixty days from the date of the violation to bring the motorboat into compliance with the provisions of this section. Thereafter, it shall be the owner's responsibility to have the motorboat tested by the Kansas Wildlife and Parks. If the motorboat fails the Kansas Wildlife and Parks test, the owner shall immediately moor the motorboat and shall keep the motorboat moored until the Kansas Wildlife and Parks certifies that the motorboat is in compliance with the provisions of this section. Any person who fails to comply with a request or direction of an officer made pursuant to this subsection is guilty of a class C misdemeanor. Nothing in this section shall be construed to limit the officer's ability to enforce this section and to issue citations to the owner or operator of any motorboat during the sixty-day compliance period."

It should also be noted that during the conversation, I stated that KDWP law enforcement personnel would conduct courtesy inspections at selected marina's including Perry for awareness purposes.

PLEASURE MOTORBOAT MODEL NOISE ACT

Economic Development & Tourism
Date: 2-26-08
Attachment # 2-2

Pleasure Motorboat Model Noise Act

EXECUTIVE SUMMARY

In the interest of protecting the public health, safety and welfare, all available research concludes that excessive noise has an adverse impact on people and that it should be abated or eliminated whenever and wherever possible. Regarding noise caused by recreational boating, research conducted by the U.S. Environmental Protection Agency (EPA) confirms studies conducted by law enforcement agencies and the boating industry that identify exhaust noise as the number one noise problem.

Most pleasure motorboat propulsion systems incorporate means of expelling exhaust gases through the hub of the propeller. By routing exhaust gases beneath the surface of the water the problem of exhaust noise is completely eliminated. Research indicates that boats with above-water exhaust are up to four times louder than their under water exhaust counterparts. Consequently, for these craft, additional efforts to reduce exhaust noise requires some form of exhaust muffling.

Studies cited in this paper support the following statements of fact:

- Noise limits in residential suburbs should not exceed Day-Night Sound Levels (L_{DN}) of 55 dBA
- Intermittent noise from boat traffic exceeding 75 dBA in a 60 dBA ambient can cause some shoreline residents to become highly annoyed
- Exhaust noise is the number one cause of complaints against noisy boats
- Early state boating noise regulations limited pass by noise with limits ranging from 82 to 86 dBA, and one state (FL) at 90 dBA
- Boats with unmuffled exhaust cannot operate at planning speed on most inland waterways without exceeding 75 dBA at the shoreline
- Surveys show that boats that exceed 88 to 90 dBA in the stationary mode per SAE J2005 do not employ effective exhaust silencing means
- Correlation studies indicate that boats with stationary sound levels exceeding 90 dBA produce pass by sound levels that can be well in excess of 100 dBA at a distance of 50 ft.
- Tests performed on large twin-engine motor cruisers conclusively prove that high-powered boats can be fitted with exhaust muffling systems producing pass by sound levels in the range of 74 to 84 dBA measured at a distance of 50 ft. Power ratings for these boats ranged from 700 to 1600 horsepower
- Ohio regulations are extremely lenient in that they impose specific sound level limits on exhaust noise in the idle speed mode only, thereby imposing absolutely no limitations on full throttle operation and/or power.

Pleasure Motorboat Model Noise Act

A BRIEF HISTORY of BOAT NOISE REGULATIONS – 1970 to 1987

The first significant effort to regulate sound emissions from pleasure motorboats in the U.S. came about as a result of amendments to the Clean Air Act of 1970. Under this act the U.S. Environmental Protection Agency (EPA) established the Office of Noise Abatement and Control (ONAC) with the intent studying the noise problem in the U.S. Following the initial EPA study of product noise, Congress passed a bill that authorized establishment of the Noise Control Act of 1972. This legislation authorized EPA to label products as to their noise generating characteristics and to determine feasible goals for product noise reduction. Products that were within the scope of EPA jurisdiction included construction, agricultural, commercial and recreational equipment to name a few. The stated objective by EPA was to eventually require manufacturers to issue warrants that their products were in compliance at the time of sale.¹ An initial EPA survey of products in the recreational field identified exhaust systems as the primary source of noise.

Federal activity regarding noise control regulations caused the marine industry to initiate activity within the Society of Automotive Engineers [SAE] in the early 1970's to develop a measurement standard for certifying compliance. Development of this standard began in 1971 and eventually became known as SAE J34, the Exterior Sound Level Measurement Procedure for Pleasure Motorboats.

Following an extended period of indecision on the part of the federal government it was eventually decided that EPA would not attempt to regulate sound emissions from pleasure motorboats and other commercial/recreational products as earlier indicated. Consequently, individual states began enacting legislation, subsequently developing agencies within the framework of the various state governments to instigate legislation and enforcement of state boat noise regulations. Unfortunately, efforts to apply SAE J34 to on-the-water enforcement of local/state boat noise regulations were largely unsuccessful. The primary problem was that SAE J34 was designed as a manufacturers test and did not lend itself to on-the-water enforcement.

Complaints about noise from inboard and outboard powered boats in the decades of the '60's and 70's were generally the result of boats that were modified by their owners. However, the advent of the "off-shore" performance boat in the 80's and 90's along with proliferation of personal watercraft resulted in a rapid increase in the number of complaints about noisy boats. During these two decades, the size of a typical pleasure motorboat increased substantially while the maximum power of the engines increased by a factor of approximately 10. Consequently, the pass by sound level for production line boats increased by as much as 20 dB. This four-fold increase in sound level was primarily due to the presence of offshore boats that were being sold with above-water straight-through exhaust systems.

As shoreline loudness increased by a factor of four, so did the complaints. Subsequently, property owner associations sought local regulations to deal with the problem.

¹ The apparent intent of EPA was to require boat manufacturers to certify the sound level of recreational powerboats as a pre-condition for sale. Consequently, each boat would be required to pass federal sound certification before it could be put on the open market.

Pleasure Motorboat Model Noise Act

Unfortunately, these regulations often punished the average boater, whose boats were equipped with under-water exhaust and were typically 5 dB quieter than the boats they had been operating a decade earlier. Restrictions usually took the form of speed limits and/or weekend boating bans, while some lakes banned all boats with internal combustion engines. While achieving the objective of reducing the noise, the restrictions often had a negative effect on tourism, on water usage by everyone including property owners and were viewed by many as extremist measures. It was becoming obvious that some type of concerted effort to control shoreline noise was needed so as to ensure the future of recreational boating.

When "offshore" boats began appearing in greater numbers on small inland lakes, state boating regulators around the country began to pressure the marine industry to take appropriate action. What was originally thought of as a misapplication of boat types (offshore style boats on small inland lakes) suddenly became a status symbol. Local performance boating clubs were formed, often proclaiming their right to own and operate boats that regularly exceeded 95 to 100 dBA based on the SAE J34 pass by test. Law enforcement efforts to stem the tide of offshore boat popularity were largely unsuccessful. Soon, law enforcement officials and the marine industry were discussing ways to ameliorate a situation that was deteriorating with each new boating season.

EARLY MARINE INDUSTRY SOUND TESTS

The first industry sound emissions test program that was initiated as a direct result of the offshore boat noise problem was sponsored by NMMA² and took place in Sarasota, FL. in January 1987. A wide range of boats was tested with measured sound levels ranging from <80 dBA to ~110 dBA. Some of the boats produced sound emissions so low that waves lapping at the shoreline prevented accurate measurements, while others were so loud that they could be heard operating beyond the horizon before they could be seen. The unofficial conclusion of that investigation was that boats with above-water exhaust pose a real problem for the long-term future of recreational boating if they are operated anywhere near the shoreline at full throttle speeds.

A follow-up test program in August 1987 was initiated to determine the effects of boat operational variables on the pass by sound level³. A total of 21 boat/motor combinations were tested, resulting in approximately 1200 data points being recorded. Boat types included single and twin outboards, sterndrives with underwater and above water exhaust, and inboards. One of the conclusions of that report was that for propagation of sound over water the effect of distance causes the sound pressure level to reduce by 5 dB per doubling of the distance. Regarding the effect of engine speed on pass by sound level, doubling the engine speed increases the pass by sound pressure level [S.P.L.] by ~10 dB⁴. In mathematical terms;

$$\Delta \text{ S.P.L.} \approx 35 \text{ Log RPM Ratio Increase}$$

² National Marine Manufacturers Association

³ R. Lanpheer, National Marine Manufacturers Association, "Powerboat Sound Level Engineering Report" 16 October 1987

⁴ R. Lanpheer, IMEC Report 17F/01, "Recreational Motorboat Sound Level Test Report" 21 June 1993.

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Pleasure Motorboat Model Noise Act

Having established the relationship of pass by sound level with engine speed and distance from a boat to an observer, the groundwork had been laid for a concerted effort to reduce complaints about boat noise.

THE NASBLA/NMMA BOAT SOUND LEVEL TASK FORCE

In 1988, NMMA and NASBLA⁵ formed a Joint Sound Level Task Force where it was agreed that the primary objective would be resolution of the exhaust noise problem. Specific objectives of the Joint Task Force included the following:

1. Initiate the development of a sound level measurement procedure that was safe to perform in on-the-water law enforcement situations. Prior difficulties in applying pass by test methods by law enforcement agencies led to the conclusion that the primary effort should focus on a stationary mode test.
2. Conduct sound level surveys of above-water exhaust boats in the stationary mode using the newly developed procedure and attempt to correlate the results with full throttle pass by data if possible.
3. Based on the above developments, recommend a maximum sound level for the stationary mode test that would facilitate identification of boats that produce high levels of exhaust noise as an indicator of inadequate exhaust muffling.
4. Initiate development of a sound level measurement procedure to facilitate monitoring and enforcement of shoreline sound level limits.
5. Perform sound level surveys on the shorelines of recreational boating areas to develop a consensus of opinion regarding maximum allowable shoreline sound level limits. Attempt to rationalize the sound level limit based on known pass by sound levels for boat types that do not generate noise complaints. Compare property line noise levels and restrictions in suburban and rural environments with recreational boating areas to ensure the health, safety and welfare of shoreline residents.

As the Joint Task Force began to delve into the task at hand, the need for immediate action was clear. The combined effects of increasing numbers of offshore boats and personal watercraft were creating a situation where property owners were voicing an ever-increasing number of complaints about boat noise. While the levels weren't high enough to cause hearing damage, shoreline residents were becoming increasingly irritated because their quality of life was being diminished.

SOUND LEVEL MEASUREMENT STANDARDS FOR PLEASURE MOTORBOATS

In the United States, sound level measurement standards for pleasure motorboats are developed under the auspices of the International Society of Automotive Engineers [SAE]. The SAE Marine Sound Level Subcommittee was convened for the purpose of developing the two measurement standards that would be needed to support the requirements for stationary and shoreline sound level measurements. A collaborative effort between SAE, NMMA and NASBLA led to the development and approval of two new sound level measurement procedures;

⁵ National Association of State Boating Law Administrators

Pleasure Motorboat Model Noise Act

- SAE J2005, Stationary Sound Level Measurement Procedure for Pleasure Motorboats and
- SAE J1970, Shoreline Sound Level Measurement Procedure.

BOAT NOISE IN THE RECREATIONAL BOATING ENVIRONMENT

The U.S. EPA published a document in March 1974 in which they examined levels of environmental noise necessary to protect public health and welfare⁶. In that document EPA performed outdoor sound level surveys across the country, concluding that the equivalent sound level varies widely throughout the country depending primarily on the population density. That is, the urban population is subjected to much higher levels of noise than in rural areas. To evaluate the situation EPA utilized a variation of the equivalent sound level concept that is referred to as the Day-Night Sound Level or L_{dn} .

The definition of L_{dn} is “the A-weighted equivalent sound level for a 24-hour period with 10 decibels added to nighttime sounds (10 pm – 7 am)”. To illustrate, if an environment has a daytime equivalent of 60 dB and a nighttime equivalent sound level of 50 dB, the Day-Night Sound Level is 60 dB. The reasoning behind weighting nighttime sound levels by 10 dB is to compensate for the fact that people react adversely to intrusive noise when they are in their homes and, particularly, when they are sleeping.

The EPA survey of Day-Night Sound Levels for various parts of the country indicated that the median L_{dn} was 59 dB with an average population density of 6300 people per square mile. Rural and suburban residential areas typically have L_{dn} values of 50 and 55 dB respectively, with population densities of 630 and 2000 people per square mile⁷ (Figure 1).

Research reported by Eldred reinforced the EPA figures but in somewhat greater detail⁸. Residual noise levels (L_{90}) were found to range from 17 dBA in the Grand Canyon to as high as 78 dBA next to a freeway. Figure 2 illustrates some of the data presented by Eldred.

LOCATION	DAYTIME OUTDOOR NOISE LEVELS					
	L99	L90	L50	L10	L1	Leq
Grand Canyon, North Rim	11	17	20	31	47	29
Farm in Valley	33	35	39	45	54	43
Suburban Residential in Hill Canyon	34	38	48	60	68	58
Small Town Residential Main Street	37	40	48	58	66	56
Suburban Residential at City Outskirts	40	41	45	57	67	55
Urban Residential 6 mi. to Major Airport	47	50	54	63	70	61
Third Floor Apartment Next to Freeway	76	78	81	85	89	83

Figure 2

⁶ EPA/ONAC 550/9-74-004 “Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety” March 1974

⁷ EPA/ONAC 550/9-74-004 “Protective Noise Levels; Condensed Version of EPA Levels Document” – Summary - March 1974

⁸ K. M. Eldred, Noise Control Engineering, “Assessment of Community Noise”, September-October 1974

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ESTIMATED PERCENTAGE OF URBAN POPULATION EXPOSED TO OUTDOOR DAY-NIGHT SOUND LEVELS DUE TO TRAFFIC

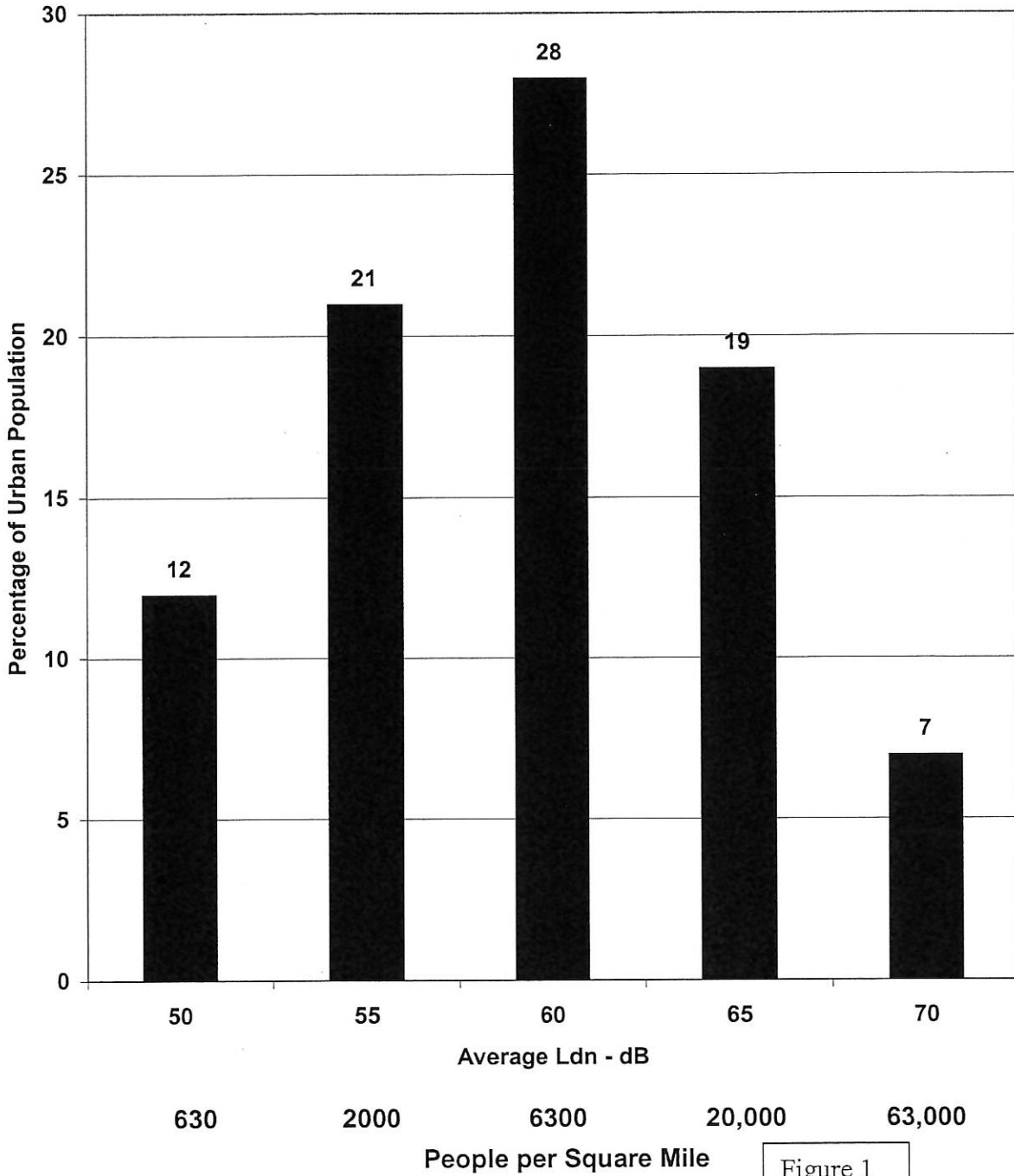


Figure 1

Pleasure Motorboat Model Noise Act

As a result of the EPA investigation, they concluded that the range of Day-Night Sound Levels that are sufficient to protect public health and welfare from the effects of environmental noise are as listed in the following table (Figure 3)⁷.

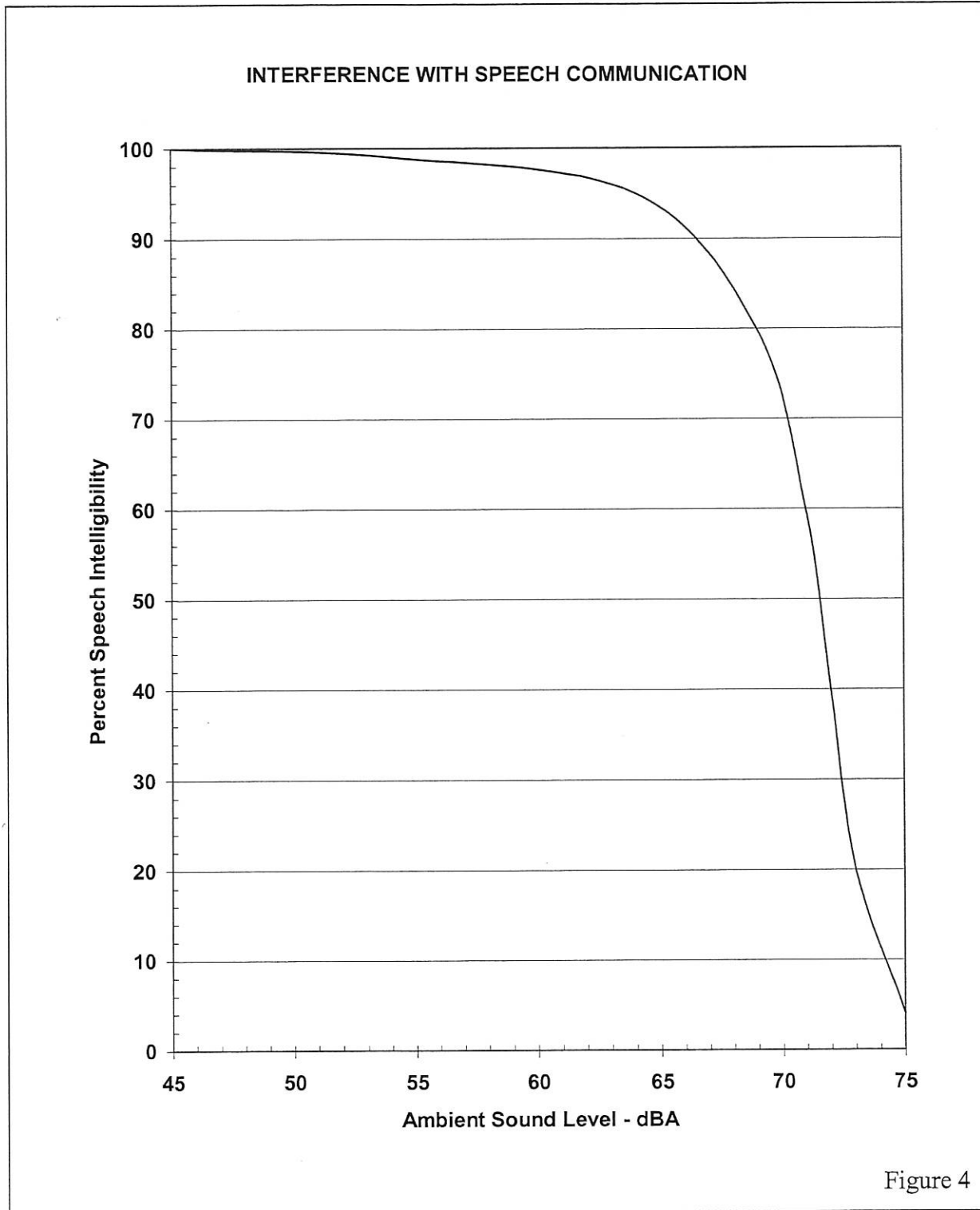
YEARLY Ldn VALUES THAT PROTECT PUBLIC HEALTH AND WELFARE WITH A MARGIN OF SAFETY		
EFFECT	LEVEL	AREA
Hearing	Leq(24) <70 dB	All areas (at the ear)
Outdoor Activity Interference and Annoyance	Ldn <55 dB	Outdoors in residential areas and farm and other outdoor areas where people spend widely varying amounts of time and other places in which quiet is a basis for use.
Outdoor Activity Interference and Annoyance	Leq(24) <55 dB	Outdoor areas where people spend limited amounts of time, such as school yards, playgrounds, etc.
Indoor Activity Interference and Annoyance	Ldn <45 dB	Indoor residential areas
Indoor Activity Interference and Annoyance	Leq(24) <45 dB	Other indoor areas with human activities such as schools, etc.

Figure 3

Figure 4 illustrates the impact of steady-state ambient noise on speech interference⁸. The data indicates that indoor speech interference for relaxed conversation with a normal voice level remains at 95% intelligibility with a 64 dB ambient noise level. However, intelligibility drops off very rapidly so that a 70 dB ambient results in only 60% intelligibility. At 75 dB, intelligibility is down to 4% with a normal voice.

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Pleasure Motorboat Model Noise Act



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Figure 5 is a table of values illustrating outdoor communications at various distances with a normal and raised voice⁷. Note that when the steady-state ambient noise level is 72 dBA, normal voice communication is only 0.5 metres (~20 inches). Consequently, for normal voice communication in a lakeshore environment it would be necessary to maintain the equivalent sound level at 72 dBA or less during the time when boats are passing.

Steady A-weighted Sound Levels That Allow Communication with 95 Percent Sentence Intelligibility Over Various Distances Outdoors for Different Voice levels.						
VOICE LEVEL	COMMUNICATIONS DISTANCE (METRES)					
	0.5	1	2	3	4	5
Maximum Ambient Sound Level in dBA - Normal Voice	72	66	60	56	54	52
Maximum Ambient Sound Level in dBA - Raised Voice	78	72	66	62	60	58

Figure 5

Based on this research it would appear that residential areas surrounding the nation's water recreational sites could be expected to exhibit Day-Night Sound Levels in the range of 50 to 55 dBA.

THE NASBLA/NMMA MODEL NOISE ACT

Most complaints about boat noise came from riparian property owners, so the most logical objective of any type of noise legislation would be directed at reducing noise at their property lines, i.e., the shoreline. A review of property line noise regulations in various U.S. cities confirmed that suburban/urban property line sound level limits in the U.S. typically vary from 65 to 75 dBA.

EPA research revealed that annoyance resulting from intrusive noise varies greatly among individuals. Human reaction to extraneous noise depends heavily on what type of activity they are engaged in at the time of the noise intrusion. Generally, activities requiring higher levels of mental concentration are more easily disrupted by intrusive noise. For example, when speech communication is interrupted by intrusive noise, people are often extremely disturbed.

Realizing that the primary issue was related to annoyance, the NASBLA/NMMA Joint Sound Level Task Force agreed that the main objective for establishing a shoreline sound level limit would be to minimize the number of complaints based on annoyance of

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Pleasure Motorboat Model Noise Act

shoreline residents. Based on prior research, it appeared that the focus should be directed towards controlling shoreline noise to ensure minimal speech interference on the shoreline.

The marine industry conducted shoreline surveys on holiday weekends on two lakes in southern and central Wisconsin that resulted in respective L_{eq} (8) and L_{eq} (12) values of 58 dBA. The EPA Levels Document (Figure 3) suggests that L_{eq} (24) should not exceed 70 to prevent hearing loss and that L_{dn} should not exceed 55 to prevent annoyance. These figures indicate that while there is no danger of hearing loss under these circumstances, the probability of annoyance is fairly likely if there is any substantial increase in the noise level. It should be noted that the two Wisconsin surveys were performed in the decades of the 70's and 80's, and that the influence of offshore-type boats was zero for the first survey and of minor significance for the second.

Referring back to the table in Figure 5, in a steady state ambient of 72 dBA, normal communication is impaired beyond a distance of 0.5 metres (~20 inches). Since passing boats produce discrete noise events that resemble an equilateral triangle [when plotted in a time vs. sound level format], it became a matter of determining the maximum pass by sound level for a discrete pass by event with an equivalent sound level of 72 dBA or less. As it turns out, a typical boat with a maximum pass by sound level of 75 dBA produces an equivalent sound level of ~71 dBA (Figure 6)⁹. Consequently, passing boats that produce sound levels in excess of 75 dBA can result in causing shoreline residents to become highly annoyed.

The Joint Task Force finally settled on a shoreline sound level limit of 75 dBA to achieve the following objectives:

1. to minimize annoyance due to speech interference
2. to establish property line sound level limits in recreational boating areas that are no higher than urban sound level limits
3. to maintain consistency with states that limit pass by noise to an average of ~85 dBA at a distance of 50 ft., thereby allowing on-plane operation at a distance of 200 ft. or greater from the shoreline
4. to preclude local regulations that restrict all forms of recreational boating when the primary problem is caused by boats with high levels of exhaust noise

⁹ R. A. Lanpheer, IMEC 17 F/03, "Merritt Island Sound Level Test Report" 31 August 1998

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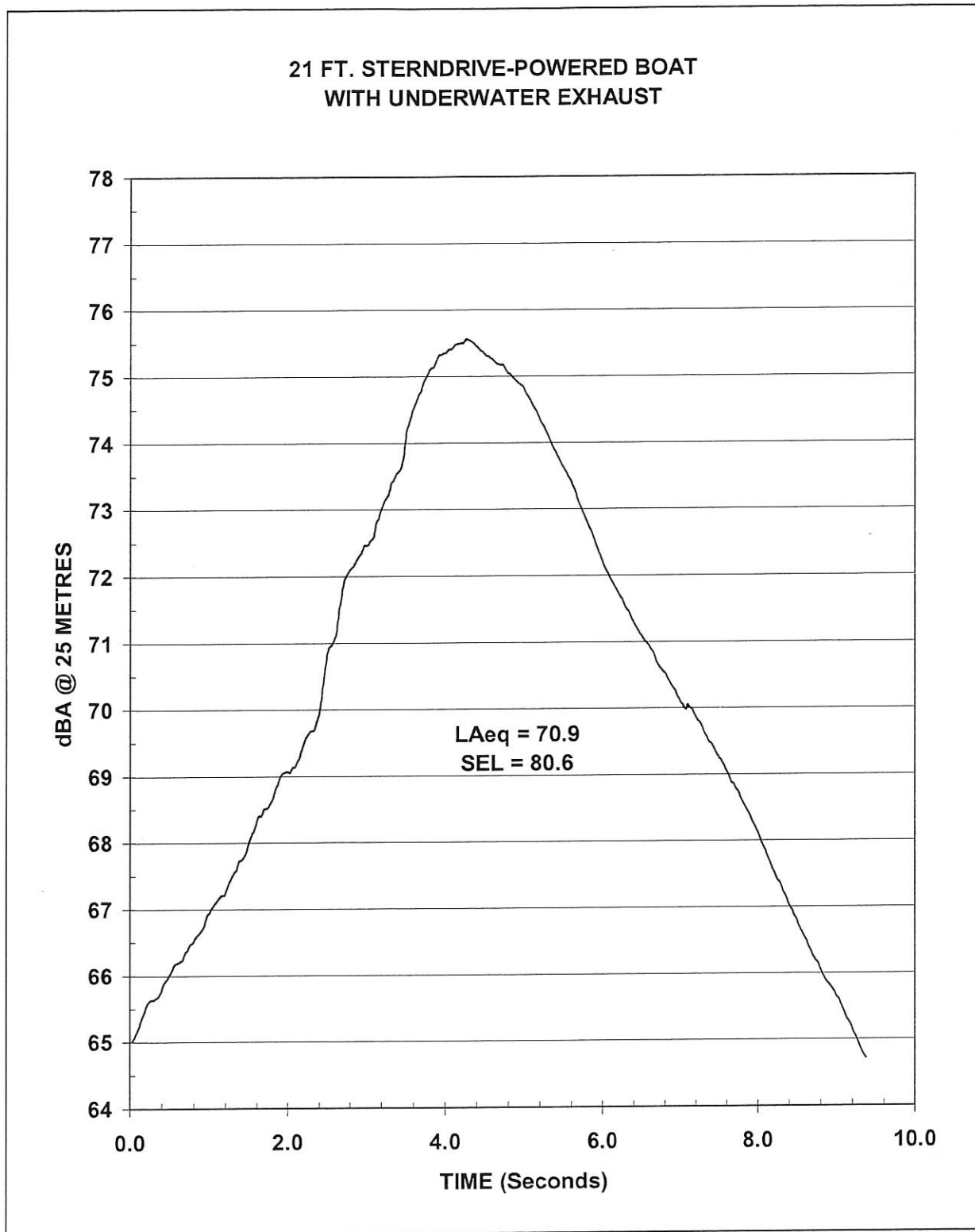
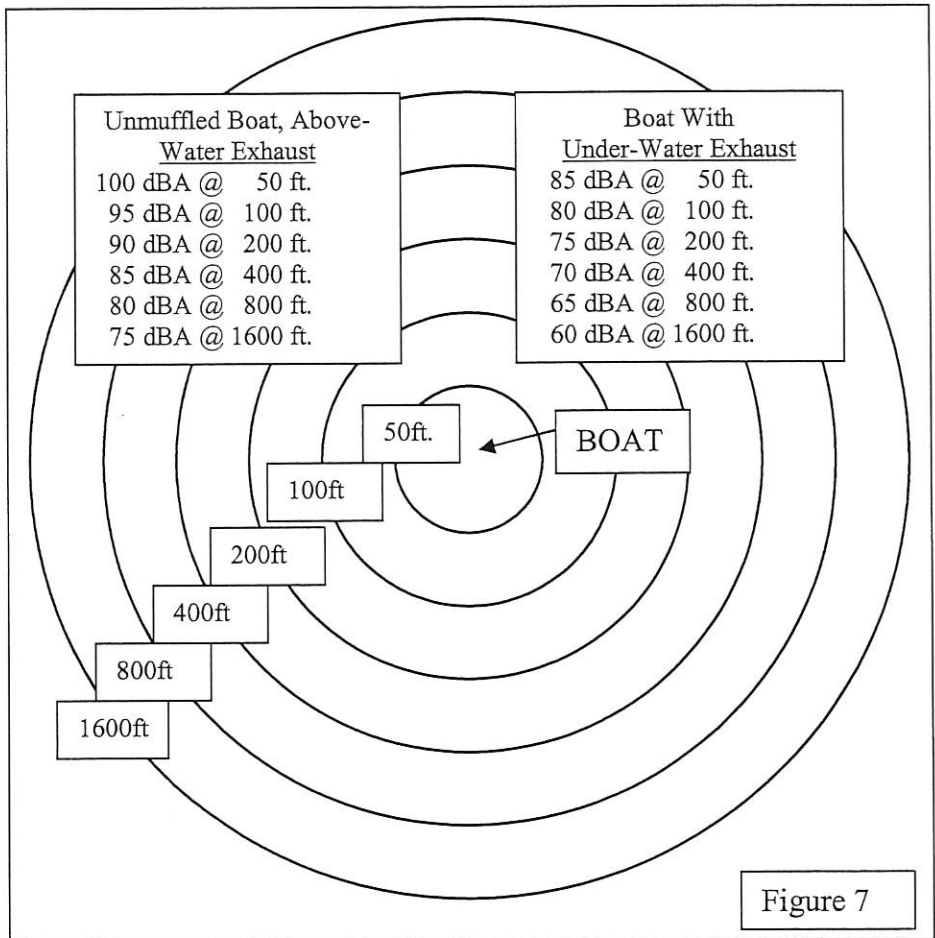


Figure 6

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Pleasure Motorboat Model Noise Act

Regarding stationary sound levels, there was complete agreement on the part of the Joint Sound Level Task Force that exhaust noise was the primary source of complaints. To further one's understanding of how this happens, consider a situation where two boats are being operated at the same distance from the shoreline (Figure 7). Assume that the boats are identical in all respects except that one is equipped with above-water unmuffled exhaust and one with under-water exhaust.



As illustrated in Figure 7, assume a boat with open exhaust produces a sound level of 100 dBA at a distance of 50 ft. Earlier research showed that doubling the distance from 50 ft. to 100 ft. would reduce the sound level to 95 dBA. At 200 ft the sound level would be 90 dBA, 85 dBA at 400 ft., 80 dBA at 800 ft., and 75 dBA at 1600 ft. Consequently, to adhere to a shoreline sound limit of 75 dBA it would be necessary to limit full throttle operation of a twin-engine offshore boat with open exhaust to distances of approximately one-third of a mile from shore! However, since a high percentage of inland lakes are too small to accommodate such a situation, boats would need to be equipped either with underwater exhaust or with an effective exhaust silencer for above-water exhaust systems.

A major part of the Joint Task Force investigation included several stationary mode sound level surveys that were performed on a variety of boats in various parts of the country. The resulting data indicated that boats with measured sound levels per SAE J2005 exceeding 88 to 90 dBA invariably had no provisions for exhaust muffling other than water injection into the exhaust stream. Correlation tests showed that most of the above-water exhaust boats that were equipped with straight-through exhaust pipes were often 95 to 105 dBA and higher when measured in the pass by mode per SAE J34 at a distance of 50 ft. [see Figure 8.] Consequently, the sound level limit for stationary mode tests was established at 90 dBA.

Pleasure Motorboat Model Noise Act

It should be noted that manufacturers of offshore boats in the late '80's began constructing their boats with swim platforms. These platforms often act as noise baffles that are particularly effective in subduing the sound level in the stationary test mode while having little or no effect at planing speeds. Consequently, it was later decided that the stationary sound level limit should be reduced to 88 dBA to compensate for swim platform effects. Final approval of the Model Noise Act by NASBLA and NMMA was granted in the early '90's.

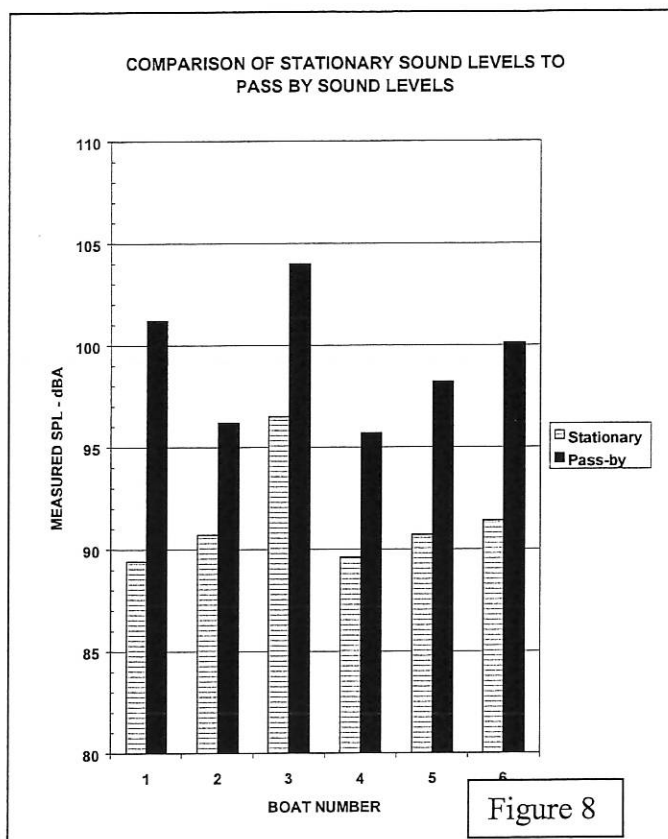
MUFFLERS

The application of internal combustion engines to marine applications requires consideration of some unique muffler requirements that do not necessarily apply to other internal combustion engine applications such as on-road and off-road vehicles. A list of muffler requirements for pleasure motorboats might include the following:

- Mechanical considerations, i.e., size, geometry, construction materials, etc.
- Insertion loss, i.e., difference in sound pressure levels with and w/o the muffler
- Flow loss, i.e., the amount of restriction to flow of exhaust gases, usually measured in terms of back pressure and/or loss of performance
- Economic considerations, i.e., affordability to the general public

The basic objective when installing an exhaust muffling device on an internal combustion engine is to substantially reduce the variations in pressure that occur in the stream of exhaust flow. Sound waves at a point directly adjacent to the exhaust valve consist of extremely sharp variations in pressure, and the job of the exhaust system is to convert the stream into steady-state flow. If steady-state flow can be achieved before the gases exit from the outlet, the remainder is flow noise.

The best way to achieve elimination of exhaust noise emissions from powerboats is to route the exhaust outlets under the surface of the water. All modern outboard motors and sterndrives with integral exhaust systems in the drive mechanism achieve essentially total exhaust noise abatement in this manner. Likewise, inboard boats can be designed to accommodate mufflers and underwater exhaust to eliminate exhaust noise. Stationary sound levels per SAE J2005 on boat/motor combinations with underwater exhaust are generally in the 65 to 75 dBA range, and full throttle pass by sound levels generally are in the range of 75 to 85 dBA when measured at a distance of 50 ft.



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There are three basic types of mufflers; dissipative, reactive and electronic. Dissipative mufflers depend heavily on conversion of acoustic energy into heat energy, which can be accomplished by various means. One popular method is to pack the muffler with sound absorptive materials such as fibreglass, which removes acoustic energy from the exhaust by converting it into mechanical energy that is expended by "working" the fibres. This type of muffler is effective in removing high frequency components of the acoustic energy in the exhaust stream, but has limited effect on the low frequency components.

The reactive muffler is basically an acoustic filter. The basic premise behind this type of muffler is to utilize specially designed chambers to reflect sound waves back towards the source (exhaust valve). Reactive mufflers are highly dependent on their geometric characteristics, the amount of space required being a function of the required cut-off frequency. It is relatively simple to make reactive mufflers perform at high frequencies and increasingly difficult to make them perform at low frequencies.

Electronic mufflers rely on noise cancellation techniques that are accomplished by generating high energy acoustic waves that are equal in magnitude and opposite in phase to the sound waves produced by an engine. Generation of noise canceling waves requires some relatively sophisticated electronics along with placement of audio speakers in the exhaust system. By comparison to the other two types of mufflers, noise canceling mufflers are relatively new, and the results can be quite astounding.

Regarding insertion loss issues, marine engines typically operate at relatively low engine speeds thereby generating low frequency sound waves. Consequently, dissipative mufflers produce limited results under conditions of full power because the frequency of the sound waves is sufficiently low, resulting in poor insertion loss.

Ohio regulations only require that the stationary mode sound pressure level does not exceed 90 dBA at idle speed. Under these circumstances the required insertion loss is generally in the 5 to 10 dB range to ensure compliance. Consequently, a proper dissipative muffler design can readily accomplish the required idle mode insertion loss for most applications. These mufflers can be designed to fit within the confines of the boat or they can be fitted as "tip mufflers" which simply connect to the exhaust outlets protruding through the transom. Retail cost for a pair of tip mufflers starts at <\$500.

Reactive mufflers, while they can be very effective at high engine speeds and high power levels, are not well suited for low engine speeds where the wave length of the sound is more than 20 feet in length. Obviously, they can be designed to function anywhere within the range of human hearing, but geometric considerations become a major concern. However, this can be remedied by combining dissipative and reactive filter design into one muffler package. One highly effective system of this type is the NRS system developed and sold by the High Performance Division of Mercury Marine. Because of the added complexity the cost of reactive mufflers exceeds that of dissipative mufflers by a factor of 2 or more, depending again on the application.

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MODEL NOISE ACT CURRENT STATUS

The Model Noise Act has been quite effective in dealing with excessive boat noise in those states where there has been vigorous enforcement. Most boaters generally support efforts to keep recreational boating areas quiet because they appreciate the natural environment when it is quiet and at least some of them realize that their boating privileges are threatened by excessive noise. However, owners of "offshore" boats often resist these regulations, often indicating indifference to the rights of property owners to enjoy peace and quiet in and around their homes.

Some common arguments that boaters raise against exhaust noise regulations are:

- anticipated loss of performance
- engine damage due to back pressure from mufflers
- mufflers will 'ruin' the sound, and take away the fun of operation
- infringement on the right to operate w/o mufflers
- added cost

Arguments regarding loss of performance and back-pressure are the same basic issue. It is true that excessive back pressure will affect performance and engine life. However, it is also true that neither of these situations will occur if the proper exhaust system design is employed, just as is done with large motor cruisers.

Some boat owners are concerned that mufflers will destroy the tonal quality of the exhaust, if not the volume. The author has conducted investigations of sound levels at the operator's ear in comparison with the pass by sound level. These investigations have led to the conclusion that there is little or no correlation between the pass by sound level and the sound level at the operator's ear. In fact, interior boat noise is generally dominated by induction noise [flow noise into the carburetors/fuel injection system] and engine mechanical noise. There is even some evidence to suggest an inverse relationship between exhaust noise in the pass by mode and interior [operator's ear] noise. Consequently, fears of ruining the 'sound of power' are unfounded as it relates to the operator of a performance boat.

Insofar as infringing on the right to operate a boat without mufflers, this is difficult argument to understand. If mufflers are required for on-road and off-road vehicles, why should they not be required on boats? The fact remains, when exhaust noise from unmuffled boats crosses private property lines, the rights of property owners are infringed, not the other way around.

Regarding the issue of added cost, for the majority of marine engines, compliance with Ohio regulations would only require the addition of simple tip mufflers. As stated earlier, these mufflers can be purchased for less than \$500, roughly the cost of fuel for a few weekends of operating a boat with twin 500 horsepower engines at today's fuel prices.

Finally, it is true that increasing amounts of power produce increasing amounts of exhaust flow. Obviously, high output engines require exhaust systems with high flow capacity, but that doesn't mean that the exhaust cannot be effectively muffled. For example, large motor

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cruisers require very high levels of power to propel them through the water, yet they can be very quiet indeed. The author has performed sound tests on boats up to 18 m (59 ft.) in length generating a total of 1600 brake horsepower. Not only are these boats extremely quiet in the stationary mode while idling, the loudest boat of this type that was tested produced a maximum pass by sound level of 81 dBA at a distance of 25 metres¹⁰. Meanwhile, offshore boats often produce pass by levels in the 95 to 100 dBA range under the same test conditions.

CONCLUSIONS

On a national basis the best solution for all parties including especially the general public, would be a uniform, achievable yet cost effective national boat noise regulation that would ensure compatibility of all types of boats with the recreational boating environment. Under such a scenario boat manufacturers and dealers throughout the country would all operate under the same set of guidelines. This approach would reduce the burden on local law enforcement officials because the only remaining noisy boats would be those that were custom built or owner-modified.

The next best option in terms of achieving uniformity of compliance can be achieved via harmonized state regulations. Some states such as Utah acted early to adopt the Model Noise Act and they have virtually eliminated complaints about noise through boater education and rigorous enforcement. Currently, 19 states in the continental U.S. have adopted Model Noise Act legislation [see attached U.S. map.] Today, it is the conclusion of both NASBLA and NMMA that the Model Noise Act is the key to protecting the health, safety and welfare of the general public in recreational boating areas.

¹⁰ R. Lanpheer, IMEC Report 17 F/03, "Merritt Island Sound Level Test Report" 31 August 1998

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STATE BOAT NOISE REGULATIONS



KEY

PB = Pass By Sound Level in dBA @ 50 ft. per SAE J34
 ST = Stationary Sound Level in dBA @ 1 metre per SAE J2005
 SL = Shoreline Sound Level in dBA during operation per SAE J1970
 *Note - 92 dBA Stationary Limit is not a state-wide regulation in Texas

R. Lanpheer, 15 Nov. 2000