



## Jet Boat Hearing Safety

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### INTRODUCTION

The Forest Service uses boats on rivers and lakes to accomplish its land management tasks. They provide access to and from remote sites, allow employees to patrol areas which they manage, and are used for search and rescue operations. Forest Service employees who routinely operate boats as part of their job, including some passengers, may spend prolonged periods of time in the boats. Concerns have been expressed regarding the possible effects of noise from the boats on employees' hearing.

Tests were conducted in conjunction with a study on the manufacturing of quieter boats by the Welded Aluminum Jet Boat Manufacturers Association of Lewiston, Idaho. During the tests personal noise exposure levels of the occupants of some of the test boats were measured.

This report presents the results of the exposure tests, compares those exposure levels to the maximum levels allowed by occupational safety regulations, and makes recommendations to Forest Service boat operators regarding hearing health and safety based on that comparison.



### NOISE DOSE

Noise dose is a measure of exposure to noise energy. Both time and sound pressure level are measured to arrive at a time-weighted average level (TWA) in dBA. Noise dose measurements are required to be made without adjustment for attenuation provided by hearing protection.

The Occupational Safety and Health Administration (OSHA) has established limits to noise exposure in the work place. Title 29 of the Code of Federal Regulations (29 CFR) lists those limits and the required actions that must be taken when the limits are exceeded.

### 29 CFR

29 CFR is lengthy and detailed, and impractical to include in this report; however, it is briefly summarized below. Interested readers are encouraged to read the regulation in its entirety.

The regulation requires a detailed hearing conservation program be administered if employee noise dose exposures equal or exceed an 8-hour time-weighted average (TWA) of 85 dBA. This dose will hereafter be referred to as the "action level". If the TWA is increased above 85 dBA, the exposure time necessary to reach the action level decreases. See Table 1 for action-level dose times for higher sound levels.

The hearing conservation program specified in 29 CFR includes, but is not limited to: a monitoring program; notification of the results of the monitoring to those employees who are exposed to levels at or above the action level; an audiometric testing program including a baseline audiogram and

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annual follow-up audio grams; hearing protector requirements; a training program; and record keeping requirements.

If the action level mentioned above is exceeded, the regulation additionally requires that "...feasible administrative or engineering controls shall be utilized". This means reduce the exposure time and/or the noise level at its source, prior to using personal protective equipment (hearing protectors) to limit exposure.

Table 1. Action Level Noise Exposures.

SOUND LEVEL (dBA)	DURATION PER DAY (Hrs)
85	8.0
87	6.1
90	4.0
92	3.0
95	2.0
97	1.5
100	1.0
102	0.8
105	0.5
110	0.3

#### INSTRUMENTATION

We used two Bruel and Kjaer Noise Dose Meters (Type 4436), with wind screens attached, to measure and store the data. Each was calibrated with a Bruel & Kjaer Sound Level Calibrator (Type 4230) prior to testing.

The 4436 is a pocket-sized electronic instrument and uses a small rubber tube to carry the sound from near the ear to an internal microphone, where the sound levels are measured and stored. The data can then be dumped to a PC-type computer for processing with a special software application. (See figure 1.)

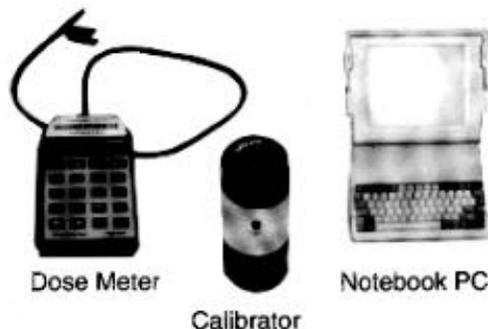


Figure 1. Bruel and Kjaer Noise Dose Meter (Type 4436); Bruel and Kjaer Sound Level Calibrator; and Notebook PC.

#### TEST PROCEDURE

A 42 ft (13 m), tri-engine tour boat; two 24 ft (7.3 m) single-engine pleasure boats; a 24 ft (7.3 m) single-engine Forest Service patrol boat; a 22 ft (6.7 m) single-engine pleasure boat and a 29' (8.9 m) twin-engine Forest Service patrol boat were used to gather the data during these tests.

The driver and one passenger for each boat were instrumented for the tests (with the exception of the 29 ft (8.9 m) Forest Service Patrol boat, where only the driver's exposure was measured). Data was gathered while cruising up and down the river at typical cruising engine rpm (approximately 3000 rpm). After each run, the data from the dosimeters were dumped to a portable notebook-type PC, and the dosimeters were made ready for another run.



Figure 2. Person wearing the Type 4436 Noise Dose Meter.

**TEST RESULTS**

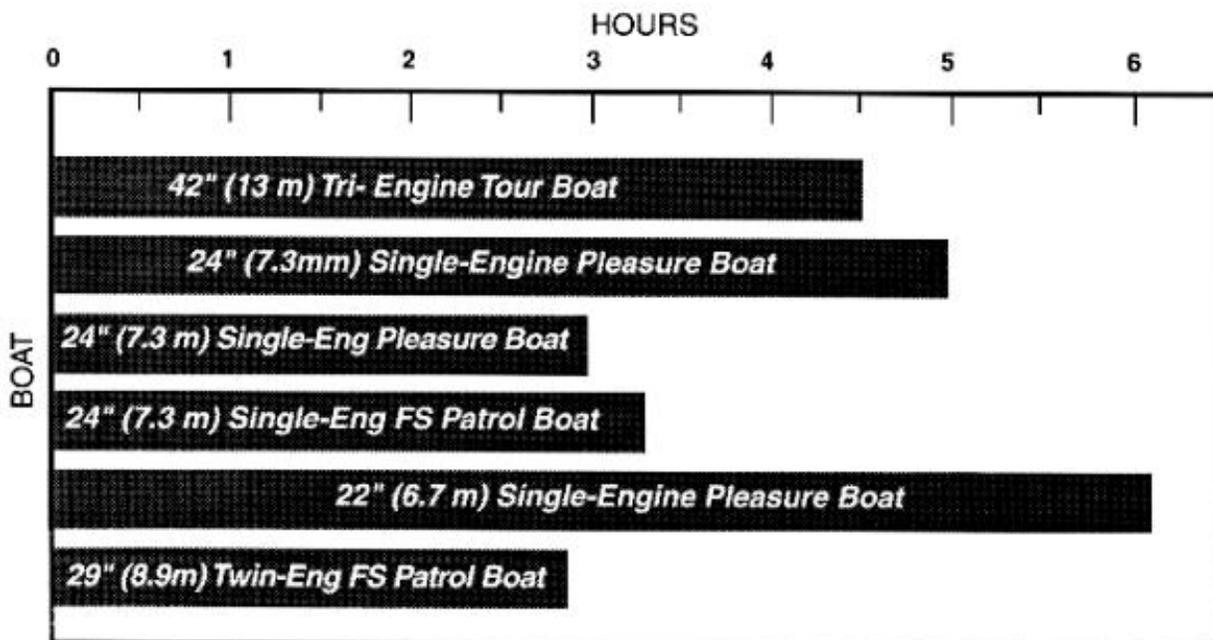
The results of the tests are shown in Table 2.

*Table 2. Noise exposure test results.*

<b>Boat</b>	<b>Occupant</b>	<b>Elapsed Time (HH:MM)</b>	<b>Avg Sound Level (dBA)</b>
42'(13 m) Tri-Eng Tour Boat	Driver	00:32	89.2
	Passenger	00:32	88.4
24'(7.3 m) Single-Eng Pleasure Boat	Driver	00:23	88.2
	Passenger	00:23	87.2
24'(7.3 m) Single-Eng Pleasure Boat	Driver	02:30	92.2
	Passenger	02:30	91.0
24'(7.3 m) Single-Eng FS Patrol Boat	Driver	01:11	92.0
	Passenger	01:10	89.2
22'(6.7 m) Single-Eng Pleasure Boat	Driver	01:03	86.8
	Passenger	01:03	84.3
29'(8.9 m) Twin-Eng FS Patrol Boat	Driver	00:33	92.3

**CONCLUSIONS**

Figure 3 presents a graph of the action level exposure times for each of the boats we tested.



*Figure 3. Action Level Exposure Time.*

By driving or riding in power boats similar to those tested, it is possible to exceed the limits of noise exposure set by OSHA if exposure times are long enough.

By limiting the cruising times in jet boats to 3 hours or less per day, the risk of exceeding the permissible noise exposure limits will be greatly reduced.

**Important Note:** *The results of these tests only consider the noise exposure caused by driving or riding in the boats. Additional noise exposure from other sources such as heavy equipment, chain saws, generators, compressors, and/or other occupational or recreational sources should be considered when determining a person's overall noise exposure.*

### RECOMMENDATIONS

It is recommended that cruising time be limited to 3

hours or less per day for similar jet boats. This should provide a margin of safety and keep exposures below the action level in most cases.

If longer exposure times are necessary or desired, or if the operator/passengers are engaged in other high noise exposure activities, the noise dose for each specific boat and activity should be measured, and if the dose is found to exceed the action level, the hearing conservation program specified in 29 CFR should be instituted, including the mandatory use of hearing protectors.

Hearing protectors (ear plugs or muffs) should be made available to all drivers and passengers of power boats, even if the exposures are expected to be below the action level.

When purchasing a new boat for use by Forest Service personnel, the at-ear sound level during cruise conditions should be considered.

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