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# Ototoxic Occupational Exposures for a Stock Car Racing Team: I. Noise Surveys

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*The National Institute for Occupational Safety and Health (NIOSH) surveyed noise exposure for a professional stock car team at their race shop and during two races at one racetrack. At the team's shop, area sound pressure levels (SPLs) were measured for various work tasks. Equivalent levels (Leqs) ranged from 58 to 104 decibels, A-weighted (dBA). Personal noise dosimetry was conducted for at least one employee for each job description in race car assembly (n = 9). The Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) of 90 dBA for an 8-hour, 5-dB exchange rate time-weighted average (TWA) was never exceeded, but in two instances values exceeded OSHA's action level of 85 dBA for hearing conservation implementation. The NIOSH recommended exposure limit (REL) of 85 dBA for a 3-dB exchange rate Leq was exceeded for five of the measured jobs. During the races, SPLs averaged above 100 dBA in the pit area where cars undergo adjustments/refueling, both before and during the race. Peak levels reached 140 dB SPL. NIOSH REL was exceeded for every personal noise dosimetry measurement. Recommendations for hearing protection and communication are presented.*

**Keywords** automobile racing, noise, professional stock car racing, race shop, racetrack, track operation

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**A**lthough high-performance automobile racing has a strong record of safety innovations and practices, hazardous noise and chemical exposures have not been empirically studied, nor has hearing protection use been enforced. Aside from isolated case reports and editorials, little is known about noise exposures for the sport as a whole, much less about specific categories of automobile racing such as stock cars. Reports of auto racing in general describe engine sound pressure levels (SPL) of 125

to 140 decibels (dB),<sup>(1–4)</sup> which are uncomfortably loud<sup>(5)</sup> and cause the Occupational Safety and Health Administration (OSHA) daily permissible exposure limit (PEL) to be exceeded in only a few minutes.<sup>(6,7)</sup> The only empirical study reported in the literature was conducted on Group C closed and fully covered long distance race cars used in German and international racing championships.<sup>(1)</sup> Lindemann and Brusis<sup>(1)</sup> reported noise levels of 130 dB, A-weighted for a field of 20 cars measured 5 meters from the edge of the track. Noise levels inside the cockpit of a car ranged from 117 to 125 dBA.

Professional auto racing associations, which are not subject to OSHA guidelines, do not require the use of hearing protection. However, most high-performance auto racing crews and drivers have recognized the benefits of hearing protection devices (HPD) during the last 10–15 years and wear some variety of HPD when racing. However, the suitability of these devices for the specific noise exposures and unique communication needs of a race environment has not been studied or documented. Anecdotal reports based on personal communication with stock car and Indy car (open wheel) drivers and team members imply that current HPD use may not offer maximum protection or optimal communication benefit. Despite wearing HPDs, individuals describe a variety of noise-related complaints, including inability to hear important sounds and difficulty communicating with team members during a race, as well as muffled hearing and/or tinnitus for hours to a day after a race. One driver described an episode of dizziness/vertigo that seemed to be related to lack of hearing protection when an HPD dislodged during a race.

The actual prevalence, degree, and type of hearing loss associated with professional automobile racing are unknown. Lindemann and Brusis<sup>(1)</sup> described audiometric results for 18 Group C drivers (average age 35.2 years) and 11 pit crew members (average age not specified) and concluded that only one driver evidenced noise-induced hearing loss, while pit crew members had marked hearing loss. They explained

the difference in terms of overall exposure time and hearing protection use, with drivers having less of the former and more of the latter.<sup>(1)</sup> Scientific investigations of the auditory effects of snowmobile and motorcycle noise confirm that motor sports can be deleterious to auditory sensitivity<sup>(8–11)</sup>

The significant noise issues, as well as combined effects of noise, chemicals, heat, and vibration, not only represent potential hearing health and miscommunication risks but also possible detriments to effective occupational performance.<sup>(12)</sup> Some nonauditory noise effects reported in the literature are physiologic changes, fatigue, increased reaction time, reduced concentration, and irritability.<sup>(13–18)</sup> It is probable, therefore, that improved noise reduction could result in improved performance and consequently safer racing conditions.

Because of unanswered questions regarding the health, safety, and performance effects of mixed (i.e., noise and chemicals) exposures in the automobile racing industry, the National Institute for Occupational Safety and Health (NIOSH) partnered with a professional stock car racing team to survey noise and chemical exposures. The purpose of these surveys was to assess the level of exposures and then to make initial recommendations for improved hearing protection and communication for this team. Exposure assessments included two site visits to the race team's shop and two site visits to races at the Bristol Motor Speedway, Bristol, Tennessee. The stock car team felt that Bristol Motor Speedway represented a worst-case exposure scenario due to its small size, steep banking, and high grandstand configuration. This article reports exposure levels for noise and recommendations for hearing protection in this unique occupational environment, while a companion article reports exposure levels for potentially ototoxic chemicals.

## METHODS

Noise exposure assessments consisted of sound level measurements and personal noise dosimetry at the team race shop and at the racetrack. Sound level measurements were conducted with a Quest Model 1800 sound level meter (SLM) (Quest, Oconowoc, Wisc.), which conformed to the American National Standards Institute (ANSI) Specification for Sound Level Meters (S1.4-1983, R2001).<sup>(19)</sup> The SLM was set to "slow" response, and "A" frequency-weighting response. Personal noise dosimetry was conducted with Quest model M-27 dosimeters, which conformed to ANSI S1.25-1991 (R1997).<sup>(20)</sup> For shop measurements, the dosimeters were set to measure both the OSHA PEL (90 dBA criterion level, 5 dB exchange rate, based on an 80 dB recording threshold) and NIOSH-recommended exposure limit (REL; 85 dBA criterion level, and 3 dB exchange rate). All dosimetry data were downloaded to a computer for analysis. The equipment used to document SPLs and noise dosimetry were factory calibrated within the previous year by the respective manufacturer. Field calibration was conducted on the survey date using a Quest CA-12B (110 dB at 1000 Hz) battery-operated calibrator.

## Race Shop Noise Exposure Assessment

The race team shop is a large one-story building with approximately 15,000 square feet (1393.5 square meters) of indoor floor space. The shop is divided into two main areas: the setup area and the fabrication area. The setup area consists of a front lobby, enclosed offices, a break room, restrooms, a parts room, and a gear/suspension room. The remaining setup area is a large open space where the finished car bodies are stored. This is also where the mechanics install the suspension, engine, and driveline in the cars. The fabrication area is a large room in the rear of the building consisting of a paint/body shop with an enclosed paint booth, a machine shop and metal working area with two level floors, and a storage area.

Team members for the surveyed team typically work 10–12 hours per day or 60 hours per week in the shop. There were 14 full-time employees, 80% of whom had been in the auto racing business for at least 10 years. Seven of the 14 team members usually arrive at a racetrack 3 days prior to a race, and the 5 pit crew members arrive 1 day prior.

There are typically 30–35 race events during the 9-month race season and 15 testing events per year, where they take a car to a track for evaluation. During the off-season work week, hours may be reduced compared with the race season, but team members continue to work in the shop to refine car design and mechanics.

Sound level measurements of various fabrication and body shop machines were conducted only for the initial visit to the team shop. Personal noise dosimetry was conducted during both visits for at least one employee for each job description in race car assembly ( $n = 9$ ). On Day 1 of the initial visit, three team members wore the dosimeters approximately 10 hours, from the beginning until the end of their work shift. On Day 2 of the initial visit, three team members wore the dosimeters for 4.5 hours. During the second shop visit 1 month later, three workers wore noise dosimeters for approximately 10 hours, from the beginning until the end of their work shift. Most workers perform a variety of tasks during their typical 10-hour shift and move from workstation to workstation, thereby varying their exposures.

## Racetrack Noise Exposure Assessment

Bristol Motor Speedway is a 0.533-mile (0.8578 kilometer) oval track with 36° banking and seating capacity for 135,000 spectators. Grandstand seating extends upward around the track, creating a bowl-like configuration. Bristol Motor Speedway is widely known as the noisiest racetrack in the stock car racing circuit and has the nickname "Thunder Valley."

All race car haulers are parked in the infield area of the speedway. Teams are given limited space in front of the haulers to arrange equipment and tools. Teams work to tune the performance of the race cars in the pit area prior to the race. The pit area has marked positions for each of the 43 race cars and is separated from the infield by a low concrete wall. During practice and the race, race cars cycle through the pits for tuning adjustments, fuel, and tire changes, thereby making this the most noise-exposed area of the track facilities.

During the initial site visit to the track, racing events took place over 2 days. On the day before the race, activities included two practice periods and qualifications. On the day of the race, a total of 43 cars were in the starting lineup for an afternoon race that encompassed 133.25 miles (214.4 kilometers) and lasted 2 hours. Area sound level measurements were made within 0.91–4.6 meters of the pit area during each day of the race weekend.

Additionally, a noise dosimeter was positioned on the pit crew's toolbox, and two NIOSH researchers wore dosimeters throughout each day. Primarily these researchers were positioned by the team's race car hauler in the infield area of the track within 0.91–4.6 meters of the pits, although they roamed freely within the larger infield area and sometimes went inside the team's hauler. This was considered a fair representation of a team member's activities and thus their exposure. The dosimeters were turned on at the beginning of the day and measurements were recorded in an internal data logger until the end of the day (approximately 8.5 hours). A fourth dosimeter was positioned inside the stock car during two practice periods. Inside the car, the microphone was attached to a roll bar close to the driver's head.

During the first practice period, which lasted approximately 1 hour and 20 min, there were 10–12 cars running on the track. The second practice period lasted 1 hour and is referred to as "Happy Hour" by the racing community. During this

hour there were 33 to 43 cars running on the track, a close simulation to actual racing conditions. Race rules prohibit placing any electronic devices inside the race car during the actual race, so real-time race noise measurements could not be made.

During the follow-up site visit to the track 5 months later, all racing events were combined into 1 day of activities since this was an evening race. This race also encompassed 133.25 miles (214.4 kilometers) and lasted approximately 2 hours. During this site visit, two NIOSH researchers wore dosimeters throughout the day and evening. As with the first race, they primarily stayed near the team's pit (within 0.91–4.6 meters) but were free to roam the larger infield area and go inside the team's race car hauler.

## RESULTS

### Race Shop

The work routine of the team (including duration of specific tasks) was highly variable, both within and between days. In such circumstances it is valuable to identify the tasks that may contribute to excessive noise exposures. The tasks that produced the loudest noises during the initial visit are presented in Table I. Team members were subject to short periods of relatively high noise levels each day. The equivalent levels (Leq) (dBA) in the race shop ranged from 58.0 in the

**TABLE I. Sound Levels During Selected Work Tasks in Race Shop, Charlotte, North Carolina**

Job Title	Location	Task	Sound Pressure Level (dBA)		
			Minimum	Maximum	Leq <sup>A</sup>
Mechanic	Outdoors	Engine testing and tuning	101	107.3	104.4
Fabricator	Fabrication area	Operating orbital sander	91.1	100.8	98.2
		Using compressed air hose	88.3	99.6	97.1
		Operating cut-off saw	73.4	102.7	96
		Operating hard disk grinder	79.4	97.8	94.7
		Operating pneumatic grinder	71.2	97.8	93
		Sanding and grinding	67.1	96.3	90.8
		Operating band saw	66.3	98.9	90.6
		Operating bench grinder	75.7	92.9	89.3
		Operating MIG welder	82.3	97.9	86.7
		Vacuuming	56.6	88.4	86.5
		Operating Milleromatic welder	76.3	88.7	84.6
		Operating TIG welder	70.8	74.2	72.4
		Bending sheet metal	70	82	72
		Avg. ± SD	82.7 ± 9.3	97.5 ± 8.3	92.8 ± 8.4
		Paint and body	Body shop	Painting	95.2
Painting cleanup	81.3			82.4	81.9
Sanding and grinding	71.6			76.8	72.8
Avg. ± SD	90.6 ± 11.8			92.5 ± 10.5	91.5 ± 11.7
Suspension assembler	Gear/suspension room	Checking rear axle alignment	51.9	82.7	68.7
Team owner	Office	Administrative	49.0	69.2	58.0

<sup>A</sup>Equivalent level (Leq) measurements were recorded with a sound level meter for 1–3 min per task using a 3-dB exchange rate.

**TABLE II. Personal Dosimetry, Race Shop, Charlotte, North Carolina, and Race #1, Bristol, Tennessee**

Job Title or Location	Minutes of Sampling Time	Leq (dBA) <sup>A</sup>	Time-Weighted		Maximum (dB SPL)	Minimum (dB SPL)
			Average (dBA) <sup>B</sup>	8-Hour Dose (%) <sup>C</sup>		
<b>1st Race Shop Visit</b>						
Welder/fabricator	259 (4.32 hours)	97.7	86.9	65.0	114.7	51.3
Fabricator/engine tuner	301 (5.02 hours)	94.7	82.9	37.4	122.6	51.3
Fabricator	354 (5.9 hours)	88.6	74.9	12.3	116.2	51.0
Mechanic/fabricator	640 (10.67 hours)	82.8	76.9	16.3	114.7	50.2
Crew chief	650 (10.83 hours)	82.7	78.3	19.8	108.7	50.6
Suspension assembly	600 (10 hours)	82.4	74.5	11.7	112.1	50.2
	Avg.	92.3	81.6	57.3	117.0	51.5
	SD	6.3	4.6	20.82	4.3	0.5
<b>2nd Race Shop Visit</b>						
Mechanic #1	628 (10.47 hours)	88.9	86.2	59.5	113.2	52.5
Mechanic #2	644 (10.73 hours)	88.1	82.2	33.9	119.2	51.0
Painter	626 (10.43 hours)	79.6	73.8	10.6	104.6	50.2
	Avg.	87.0	83.0	54.7	115.5	51.3
	SD	4.3	5.3	24.5	7.3	1.2
<b>Race #1 Practice/Qualifying Day</b>						
Inside stock car (during practice)	251 (4.18 hours)	114.4	NA	NA	127.5	60.7
Pit (on top of tool box)	545 (9.08 hours)	107.2	NA	NA	120	66.0
Pit area/infield Observer #1	504 (8.4 hours)	106.2	NA	NA	119.2	63.3
Pit area/infield Observer #2	555 (9.25 hours)	104.5	NA	NA	119.2	56.6
	Avg. for pit area	110.0	NA	NA	123.0	62.9
	SD for pit area	1.4	NA	NA	0.5	4.8
<b>Race #1 Race Day</b>						
Pit (on top of tool box)	322 (5.37 hours)	107.2	NA	NA	119.2	67.8
Pit area/infield Observer #1	429 (7 hours)	110.1	NA	NA	122.6	58.5
Pit area/infield Observer #2	325 (5.42 hours)	111.5	NA	NA	123.7	51.3
	Avg. for pit area	109.9	NA	NA	122.2	63.6
	SD for pit area	2.2	NA	NA	2.3	8.3

<sup>A</sup>Equivalent level (Leq) = average sound level for total exposure duration using a 3-dB exchange rate.

<sup>B</sup>Time-weighted average based on the OSHA 5-dB exchange rate and 80-dB threshold level.

<sup>C</sup>8-hour dose (%) = percentage of OSHA maximum allowable daily noise dose based on a projected 8-hour exposure.

NA = not available.

administrative area to 98.2 in the fabrication area and body shop. Engine tuning and testing was the loudest task with a Leq of nearly 104.4 dBA. Other loud tasks were involved with body fabrication and painting/finishing. Over both days of the initial visit, only three body fabricators of a total 14 team members (21%) were observed wearing earplugs during their work shift.

The results of the noise dosimeter survey for six team members from the first visit and for three team members from the second visit are presented in Table II. Table II provides a comparison of results obtained with the NIOSH 3-dB exchange rate (Leq) and the OSHA 5-dB exchange rate (8-hour time-weighted average [TWA]). The NIOSH REL of 85 dBA was exceeded for five of the nine measured individuals. Although the OSHA PEL was never exceeded for any individual, two individuals had values exceeding the OSHA action level (AL) of 85 dBA for an 8-hour TWA. This is the level at which hearing conservation implementation is required by law.

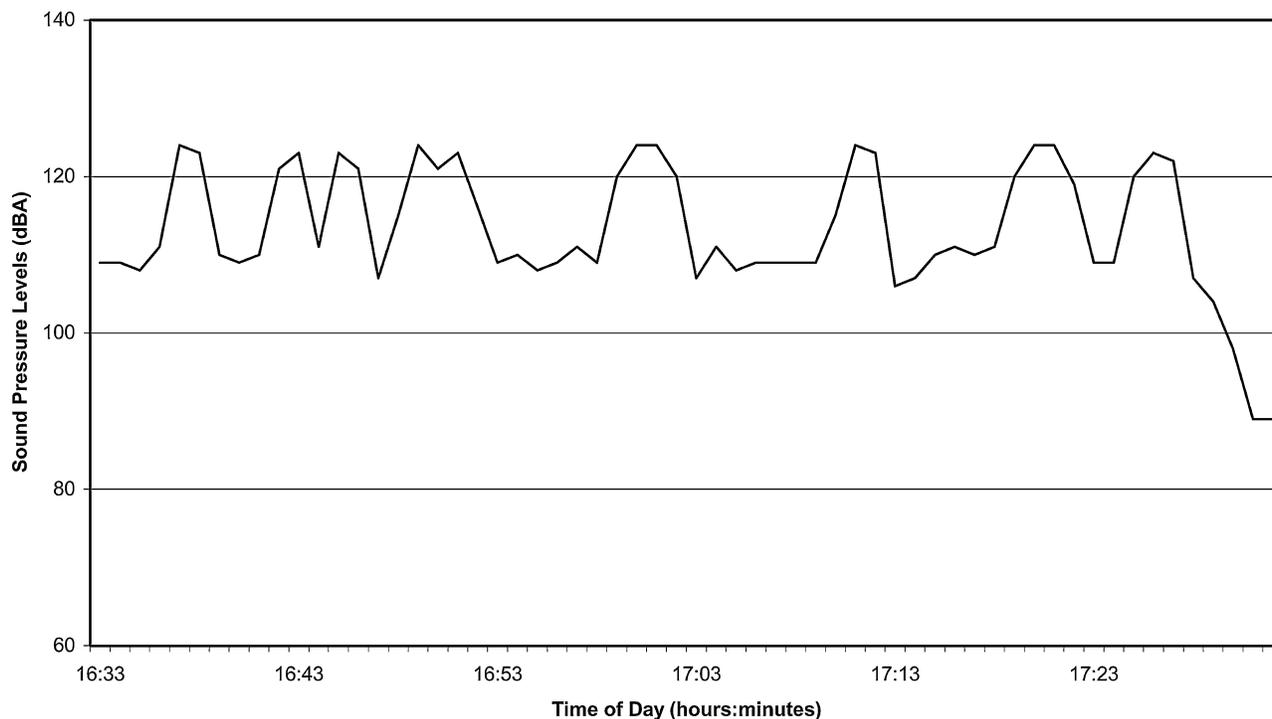
Overall, dosimetry findings obtained during the two visits to the shop were similar.

### Racetrack

Area sound level measurements were conducted at the racetrack for the 2 days of events at the first race. Sound pressure levels for nonrace activities during the first day (i.e., practice and qualifications) ranged from 76.8 to 117.8 dBA with periodic peak levels reaching 140 dBA. The Leq was 114 dBA during Happy Hour practice, which did indeed closely simulate race conditions. Sound pressure levels for race activities during the second day ranged from 88.8 to 123.0 dBA with periodic peak levels reaching 140 dBA. The Leq was 116 dBA when cars were running at full racing speeds under a green light (i.e., no interruptions).

The results of the noise dosimeter survey from the first race are shown in Table II and Figure 1. Table II summarizes

**Personal Noise Dosimetry  
Inside Stockcar During "Happy Hour" Practice  
1st Race at Bristol Motor Speedway, Bristol, Tennessee  
LeqA = 119 dB(A)**



**FIGURE 1.** Noise dosimetry results recorded from the inside of the stock car during a 1-hour practice session that simulates race conditions for the driver. Thirty-three to 43 cars were running on the track and periodically pulled into their respective pit for adjustments. The individual values plotted on the graphs are the result of 1-min integrations of sound levels measured 16 times per sec.

dosimeter measurements made in and near the pit during practice and actual racing, as well as those made inside the race car during practice. Figure 1 displays time-series data measured from the interior of the stock car. Since Happy Hour closely simulates race conditions, we can surmise that the driver probably was exposed to a Leq close to 114 dBA while racing, with maximum SPLs reaching 128 dBA. Therefore, for both practice and racing the NIOSH REL was exceeded for the driver. In and near the pit area, the NIOSH REL was exceeded in every instance (for nonrace and race activities), with noise levels averaging above 100 dBA at every measurement location, and maximum noise levels reaching 124 dBA. A representative sample of the time-series results of the noise dosimeter survey from the second race is shown in Figure 2. Noise levels from the second race were similar to the first race, and the NIOSH REL again was exceeded for both dosimeters worn near the pit area.

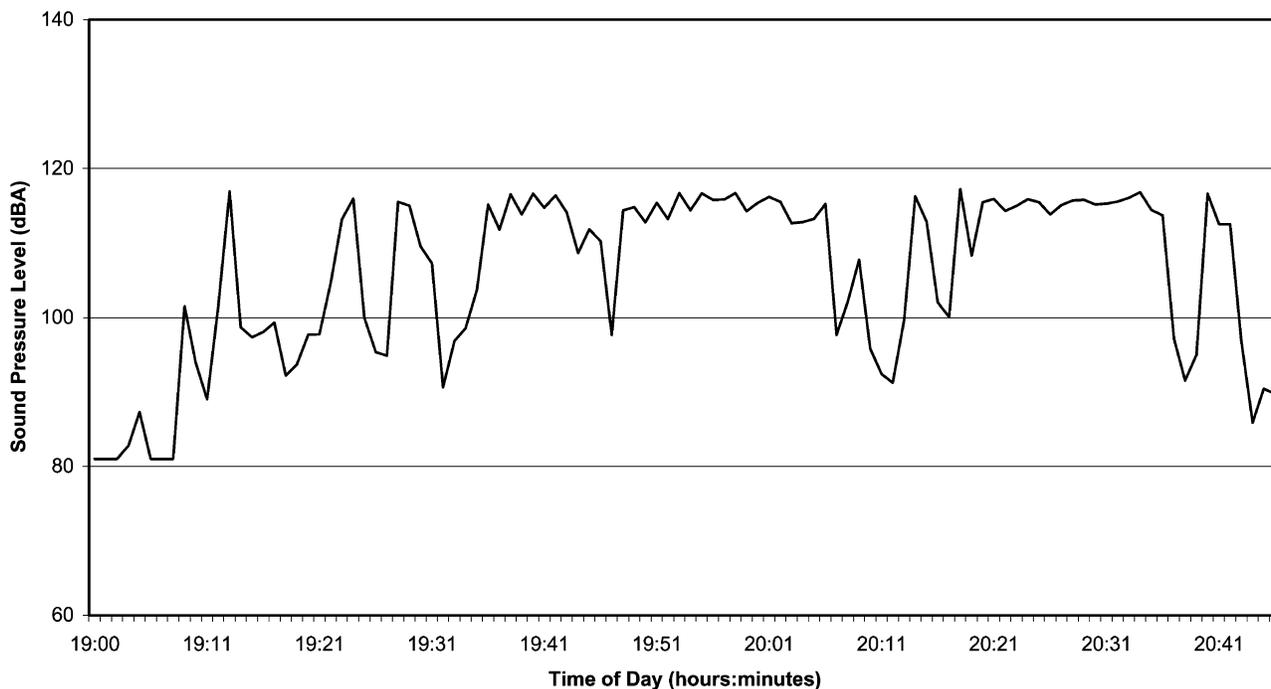
The majority of team members wore some type of HPD during the races but HPD use was quite variable during nonrace activities. It was commonly observed that both team members and spectators would remove an HPD to allow someone to speak directly into their ear in order to communicate against the extremely high background noise.

The HPDs used by race teams at the time of the survey had a communication (radio) system incorporated into the device, which allowed the crew chief to communicate with the driver, pit crew, and other team members. The driver wore custom earmolds that had a push-to-talk button connection to the electronic communication system of the car. A helmet (with a microphone incorporated into the chin area) was worn over the earmolds, which provided additional sound attenuation. Team members wore an earmuff/communication headset that incorporated an electronic speaker into the muff and that had an external boom microphone. (Since the date of the surveys, the stock car racing association has implemented new safety rules requiring all team members to wear helmets equipped with communication devices similar to those worn by the drivers.) The earmuffs used by the evaluated team had a derated noise reduction rating (NRR) of 18 dB (with reference to the NIOSH method described in *Criteria for a Recommended Standard: Occupational Noise Exposure*, 1998).<sup>(6)</sup>

## DISCUSSION

The survey data presented provide evidence that stock car racing teams are routinely exposed to extreme noise

**Personal Noise Dosimetry**  
**Race Track/By Team's Trailer/During 2-Hour Race**  
**2nd Race at Bristol Motor Speedway, Bristol, Tennessee**  
**LeqA = 114.5 dB(A)**



**FIGURE 2.** Noise dosimetry race results recorded within 0.91–4.6 m of the pit area (near the team's stock car hauler) during the second track survey. Thirty-three to 43 cars were running on the track for the 2-hour race and periodically pulled into their respective pit for adjustments. The individual values plotted on the graphs are the result of 1-min integrations of sound levels measured 16 times per sec. The valleys in the noise levels mostly correspond to slower speeds associated with a yellow (caution) period vs. full racing speeds associated with a green (racing) period.

levels known to be damaging to the ear. For the specific team surveyed, noise exposure was considerably variable in the team shop, but consistently was in the uncomfortable and damaging range for both pre-race and race activities at a racetrack that is considered to be a worst-case scenario. The daily REL was exceeded within only a few minutes of noise exposure at the track.

To our knowledge, this is the first published survey of noise exposure at a professional auto racing team shop. Although noise levels were measured above 85 dBA in several instances, team members spent limited time exposed to these levels. Since they build cars from a very simple frame, no day is a typical day. Work routines change until the car is completed. For the sampled days, five workers were exposed to levels that exceeded the 85 dBA NIOSH REL. There were no cases where the OSHA PEL was exceeded, but two individuals met the 85 dBA OSHA AL for initiation of a hearing conservation program. At the time of the surveys, the only preventive measure used by the evaluated team was to make hearing protectors available for those who asked for them.

More noise monitoring is needed for the employees of racing teams for their work in the shop. Considering the variability of tasks and exposures on any given day, a task-

based exposure assessment method (T-BEAM)<sup>(6,21)</sup> may be in order. To better assess a team's hearing loss prevention needs, measurements should be conducted during different times.

The need for hearing loss prevention is much more obvious during race weekends. The daily allowable noise dose was exceeded within 5 min of the start of the race. Even during preparatory nonrace activities, noise exposures are considered excessive and potentially hazardous. Noise levels at the racetrack were high, ranging from 77 to 123 dBA across practice, qualifications, and racing activities, and they exceeded the NIOSH REL. These noise levels were similar to those reported by Lindemann and Brusis<sup>(1)</sup> for Group C races (122 dB at 10 meters).

Although the need for racing hearing protection is obvious from these recorded noise levels, it is not possible to make recommendations as to whether these race team employees should be enrolled in a hearing conservation program based on race exposure alone. This survey was limited in scope to a worst-case scenario racetrack, and the dosimetry data represent the exposures of NIOSH researchers rather than the exposures of employees themselves. To make such a recommendation, more detailed data would need to be collected regarding

cumulative exposures over an entire year. This would need to include more race surveys at various racetracks as well as surveys during racetrack tests that are conducted throughout the year to assess car performance.

Audiometric testing was not a part of this survey, but it is a logical follow-up to obtain baseline measures for the driver and team members. Since the stock car noise levels are similar to the reported Group C race car results, one might expect the audiometric patterns to be similar as well, with drivers showing the least noise-induced damage and pit crew members showing the most damage.<sup>(1)</sup> Stock car audiometric results might deviate from Group C results; because the Group C season comprises 20–30 races per year while the stock car season comprises approximately 30–35 races, resulting in increased exposure duration. As with Group C racing, it was observed that stock car drivers seemed to have less exposure to noise during the week and race weekends than the crew, and consistently wore HPDs while driving. The team, on the other hand, was exposed to noise in the shop during the week and for long hours during race weekends. Their use of HPDs was more variable during nonrace activities and they often stayed in the pit area during breaks, thereby not giving themselves time away from the noise during the race weekend.

Although this survey did not formally assess the earmuff/communication headset used by the pit crew (or other HPDs for automobile racing), the reported NRR of 18 dB implies that these earmuffs did not provide adequate attenuation for the measured noise levels. Consequently, even when the HPD was used, the team members were still being exposed to excessive noise. Lindemann and Brusis<sup>(1)</sup> did not discuss the HPDs employed by Group C pit crews but did conclude that the earplug/helmet arrangement employed by Group C drivers was sufficient to protect hearing. Since the NRR of the earplugs (and helmet) used by the driver of the current survey is unknown, it is not possible to comment about the adequacy of protection provided.

Based on the results of the current survey, three recommendations were provided to the team owner to reduce the team members' exposure to hazardous noise levels at the race shop and racetracks. Although this survey was essentially a pilot assessment of the noise hazards associated with professional stock car racing, it is felt that the recommendations could be generalized to many professional racing venues. The first recommendation was to carefully assess the characteristics of the HPDs that are offered to workers at a race shop and racetrack. NIOSH<sup>(6)</sup> recommends that selected hearing protectors must be capable of keeping the worker's ear-level noise exposure below 85 dBA. Workers and supervisors should periodically ensure that the hearing protectors are fitted properly, worn correctly, and provide adequate protection for the noise levels occurring in the areas in which they are worn. Workers who are not required to use a communication set at the racetrack should consider using double protection, that is, earmuffs and earplugs in combination.

The second recommendation was to investigate the use of newer devices and alternative communication systems

that would allow workers, mechanics, and team members to perform their job without having to remove their hearing protection. Linear earplugs and custom earmold speakers that reduce background noise with compression circuitry may be of considerable benefit for team members. The third recommendation was to consider instituting administrative controls (such as increasing the number and/or length of breaks in less noisy areas) during workshifts at the shop and racetracks to reduce noise exposures.

## CONCLUSIONS

Although professional auto racing is a voluntary sport, it is nevertheless an occupation, and the occupational hazards are just as real as those found in industrial settings. According to this survey, employees involved in stock car racing are routinely exposed to extreme levels of noise, and auditory damage will ensue eventually. More immediate concerns include the occupational risks posed by possible noise-induced fatigue, stress, and miscommunication.

Since sporting venues, such as professional auto racing, have not historically been held to OSHA guidelines, it is the responsibility of sport associations and business owners to ensure the safety of their employees. Until professional auto racing associations require the use of HPDs and establish hearing conservation programs, it will be up to responsible team owners and employees to monitor and protect their own hearing. The surveys presented in this article are a first step in understanding the issues facing the stock car racing industry. Further analysis is warranted to (1) characterize noise exposures at other race shops/tracks; (2) assess HPDs that can optimize both protection and communication; (3) ascertain the prevalence, type, and degree of hearing loss induced by the extreme noise levels; and (4) determine if improved noise reduction could result in improved performance and thus safer racing conditions.

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More detailed information on this evaluation is contained in Health Hazard Evaluation Report No. 2000-0110-2849 available through NIOSH, Hazard Evaluation and Technical Assistance Branch; (800) 35-NIOSH; [www.cdc.gov/niosh/hhe/reports/pdfs/2000-0110-2849.pdf](http://www.cdc.gov/niosh/hhe/reports/pdfs/2000-0110-2849.pdf).

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