Hearing Protection and Air-rotary Drilling – Part 2

by David Ingram and Paul Jurovcik
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Today's hearing protection products are much more comfortable than previous designs.

The results from the sound level measurements, the dosimeter recordings and the time-activity studies on four different air-rotary rigs indicate a wide variation of operator noise exposure during hole development. These variations appear to be dependent on the cab design and the operator's drilling behavior.

Studies have documented that exposure to high sound levels for long periods of time can cause hearing loss. The results of this study help identify the loudest parts of the drilling cycle. Sound level measurements on the four rigs show that all the rigs generate sound levels that are 90 A-weighted decibels (dB(A)) and above within 6 feet around the rigs during drilling. It is easy to conclude that some type of noise protection, such as a cab, is needed to protect the operator from overexposure to noise for an eight-hour shift of uninterrupted drilling. However, even when rigs are outfitted with cabs, operators observed in this study are being exposed to sound levels above 90 dB(A) during some activities required to complete a drilling cycle.

An evaluation and comparison of the four dosimeter recordings and time-activity studies during one drilling cycle may explain why variations in operator exposure occur. Table 1 summarizes the time-weighted average (TWA) and accumulated dose percentages for each of the four operators during the time needed to

complete one typical hole cycle.

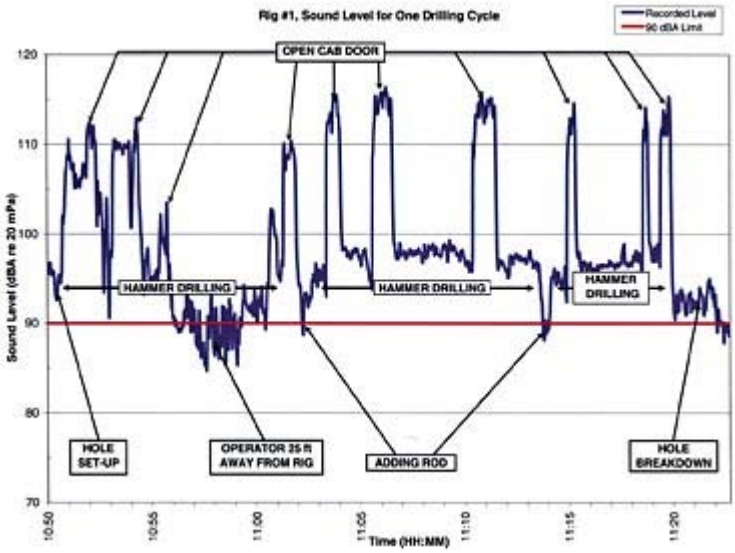

Figure A.

Several observations can be made when comparing the values in Table 1 and the illustrated sound level recordings in Figures A, B, C and D. The rig 1 operator was obviously exposed to sound levels above 90 dB(A) (Figure A on p. 59). In 33 minutes, the operator had a TWA of 103 dB(A) and reached approximately 42 percent of his daily allowable noise dose. The main reason the operator was exposed to levels above 90 dB(A) was due to his need to open the cab door next to the hole while drilling. The door was open because the strata were highly fractured and the operator had trouble removing the hole cuttings and could only see the drill hole when the cab door was opened. If the strata were more competent, the operator would not have had to open the door as frequently and would probably have similar exposure levels as the Rig 2 operator because of the similar characteristics of Rigs 1 and 2.

The rig 2 operator was exposed only to sound levels 90 dB(A) and above twice during the 21 minutes of the representative drilling cycle (Figure B). This occurred because the operator opened the cab doors. The first time was when the operator was setting up on the hole and the second time was during drilling to check the return cuttings. The TWA was 87 dB(A) during this drilling cycle, therefore the noise dosage was only about 3 percent.

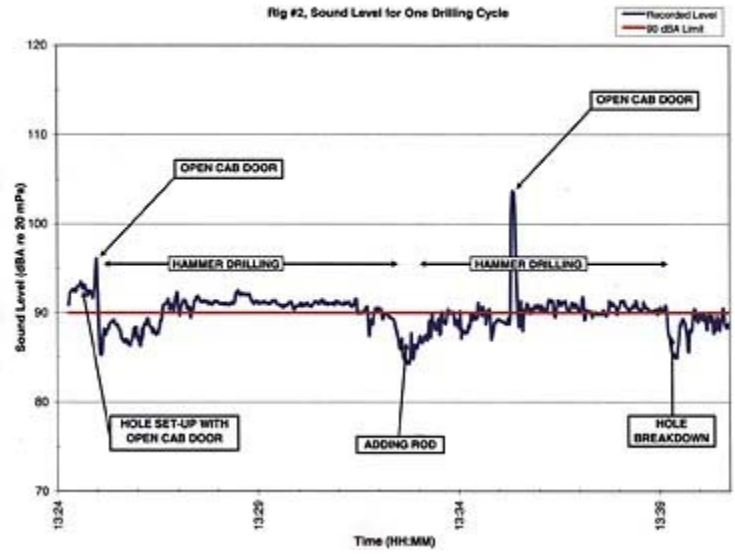

Figure B.

The rig 3 operator had a TWA of 64 dB(A) and received less than 1 percent of a daily allowable dose during the 46 minutes of this observed drilling cycle. However, there are about seven episodes during the drilling cycle when the sound level went above 90 dB(A), which cannot be explained (Figure C on p. 60). As previously mentioned, these sound bursts could have been caused by the operator's activity inside the cab or some other function of the rig not observed by the time-activity investigator. Even with the short sound bursts, the operator's TWA and accumulated dose percentage were low in comparison to operator exposure for Rigs 1 and 2.

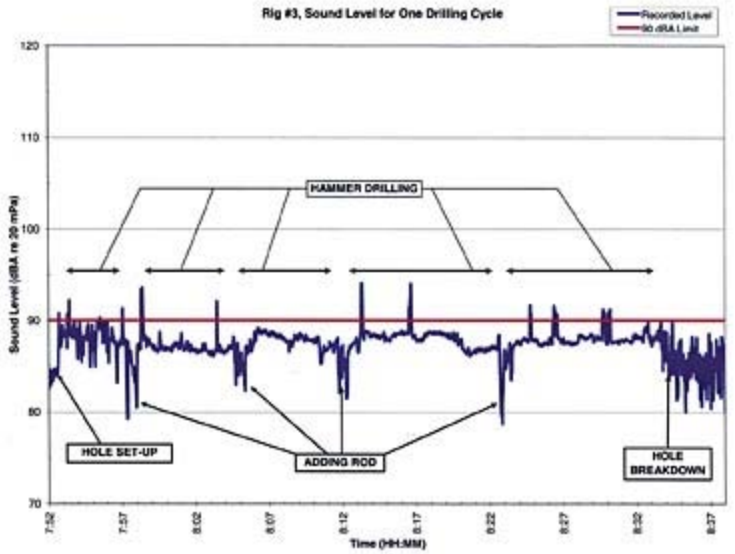

Figure C.

The rig 4 operator was never exposed to sound levels above 90 dB(A). This is obvious by his TWA only being 43 dB(A) and accumulated dose percentage being less than 0.1 percent for the 48 minutes it took to drill the one hole in Figure D (see p. 60). Further, sound levels were between 80 and 85 dB(A) during the sample drilling cycle. This is the lowest sound level measured from all four rigs. The reason for these low sound level readings could be due to the construction of the cab. Rig 4's cab control panel was the only one that had electronic over hydraulic controls. Structural vibration measurements taken on the rig's control panels in conjunction with the sound testing indicated less vibration on Rig 4's control panel during drilling than the control panels on Rigs 1, 2 and 3. The vibration is caused by pressure pulses transmitted along stiff hydraulic lines from the hydraulic pumps to the control panels. It is believed that this vibration causes structural noise, which adds to the overall sound levels in Rigs 1, 2 and 3. The lower level of vibration in Rig 4's control panel could be the reason Rig 4 has lower overall sound levels than Rigs 1, 2 and 3 during drilling.

Study Summary

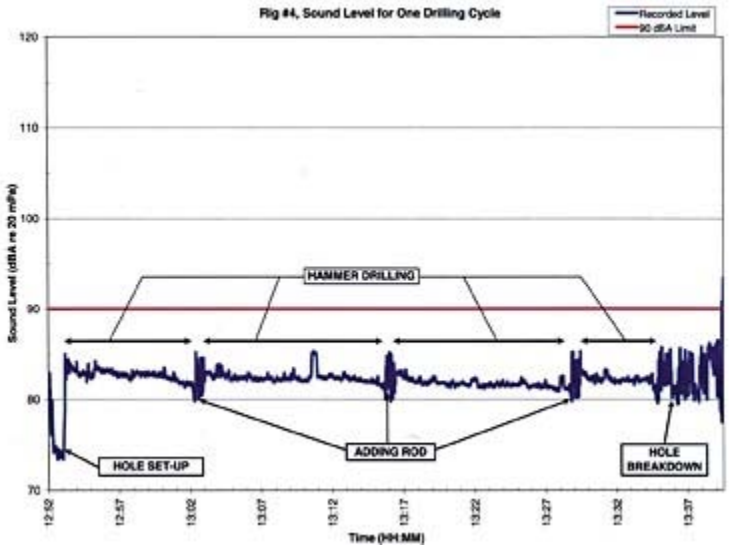

Figure D.

This study, which focused on hazardous noise exposures on air-rotary drill rigs with cabs, found that operators of these rigs can be exposed to sound levels of 90 dB(A) or more when developing a blast hole. Given the potential for the TWA to be over 90 dB(A) when developing one drill hole and assuming the operator has a productive day of drilling holes, it is possible that the operator will have a TWA over 90 dB(A) and an accumulated dose over 100 percent for the workday.

The cabs of all four drill rigs appear to have the potential to protect the operator

from overexposure to noise. However, field test results indicate two main controlling variables – cab design and operator work habits.

The cabs on Rigs 3 and 4 are mounted on a hydraulic arm, which could be moved in four different directions. This allows the operator to move the cab away from the hole to a better observation position during drilling and may also reduce sound levels in the cab. These cabs are outfitted with several wide windows for easy viewing and one access door, opposite the hole. Overall, these cab designs appeared to offer the operator the most visibility and mobility to develop a hole. This flexibility reduces the need for the operator to leave the cab during the drilling of a hole. Further, dose measurements from Rigs 3 and 4 indicate lower noise exposures during development of one hole. Given the TWAs, accumulated dose percentages, and the time it took them to drill one hole, these two rig operators essentially could drill holes continuously for eight hours and receive less than 3 percent of their allowable daily noise dosage.

Rig Number	Time Period (minutes)	TWA	Accumulated Dose Percentage
Rig 1 Operator	33 min.	103 dB(A)	42.14%
Rig 2 Operator	21 min.	87 dB(A)	2.72%
Rig 3 Operator	46 min.	64 dB(A)	0.27%
Rig 4 Operator	48 min.	43 dB(A)	0.02%

Table 1. Measured time, TWA and accumulated dose percentage for one drilling cycle.

The cabs on Rigs 1 and 2 basically are the same since both rigs are the same model. The cabs are rigidly fixed with rubber-mounted contacts to the rig beside the drilling table. There are two doors; one door opens next to the drilling table and one door opens opposite of the drilling table. There are three windows in the cab, one in each door and one behind the operator's seat. Dose measurements on the Rig 1 operator show the operator receiving a TWA of 103 dB(A) and an accumulated dose percentage of 42 percent for one drilling cycle. Given the dosimeter values and time period, the Rig 1 operator would be over the permissible exposure limit by the fourth hole. The reason for this noise exposure is that the operator could not see the return cuttings during drilling and therefore had to open the door. As demonstrated by this example, visibility appears to be a problem with this cab design. There also may be a visibility problem. However, dosimeter results on the Rig 2 operator indicate that if visibility were not a problem and the door could have been kept closed, the sound level averages

would most likely be below 90 dB(A). The Rig 2 operator had a TWA of 87 dB(A) and an accumulated dose percentage of less than 3 percent. Given these values, the Rig 1 operator would be able to drill about 14 blast holes at 35 minutes per hole and receive a noise accumulated dose of only 38 percent in eight hours.

Operator's Work Habits

Both the sound level and duration of exposure are factors in noise-induced hearing loss.

Work habits can be described as personal drilling techniques that each operator develops with experience. For example, some operators prefer to top off the fuel tank on their rig when they start their shift, while other operators like to wait until the tank is close to empty. It is human nature for each person to develop their own habits when doing repetitive chores or functions during work. Naturally, habits are restricted by the work environment, equipment, other people and physical capabilities. However, the factors with the greatest influence on work habits for drilling blast holes are most likely the drill rig and drilling conditions. Further, the specific drilling conditions may result from other persons who developed the site for drilling.

Observations of the four operators during this study identified several individual habits that impacted overexposure to noise during drilling. The most obvious habit was the Rig 1 operator opening the door during drilling. In doing this, the operator was exposed to sound levels above 90 dB(A). The Rig 2 operator would occasionally walk away from the rig during drilling to perform other chores. The Rig 3 operator opened the door, but only in between the drilling cycles because the air conditioner was not working. In the latter two examples, the operators were moving away from or avoiding excessive noise levels. As these examples demonstrate, it is important to recognize that work habits can influence noise exposures, and in many instances, habits can be changed to help avoid excessive noise exposure.

Some Suggestions

To achieve maximum benefit from hearing protection devices, they must be worn properly.

Acknowledging that noise hazards exist on air-rotary drill rigs with cabs during hole development can help operators protect themselves against hearing loss. The noise protection offered by the cabs appears to be out of the operator's control. However, the operator can perform maintenance on the cab or modify the cab to provide maximum noise protection:

• Replace broken windows and ensure the doors have a good seal when closed.

• Make sure the air conditioner and heater are working efficiently.

• If an area inside the cab is noticeably noisy, inspect it. Maybe the bolts or screws need to be tightened or replaced. Sound absorption or barrier padding can also be added to the cab.

• Determine if mirrors or cameras can be mounted to improve visibility on rigs with cabs that have restricted viewing. This would allow the operator to keep the doors closed.

All operators should examine their work habits to understand how these habits influence their noise exposure. Once these habits are fully understood, the following measures can be conducted:

- Modify or change work habits to avoid or minimize exposure to loud noises.
- Wear personal protective equipment, such as earplugs, and carry them at all times during the workday.
- Become familiar with the operation of the rig in relation to sound. Find out where the loudest areas are around the rig and avoid those areas when possible.
- When possible, move away from the rig during drilling, reduce the engine to idle, or shift out of reverse when it is not needed in order to switch off the back up alarm.

Noise exposure is dependent on rig/cab design and the operator's work behavior.

These are suggestions that this investigation identified through observation of and discussion with drill operators. All drill rigs, operators and drill sites have their own characteristics that influence the noise the operator will be exposed to during drilling. Ultimately, it is the responsibility of the employer to protect the hearing of workers. However, the drill operator also should recognize that excessive noise exposure will cause permanent hearing loss, and should try to minimize their risk.

Drillers are some of the most resourceful people in the workforce. They consistently are modifying their rigs and drilling techniques to adapt to varying work conditions. They should apply this same creative thinking to protect themselves against damaging noise levels. ND