Are You Operating an Air Rotary Drilling Rig? Is It LOUD?

By David K. Ingram and R.J. Matetic

Photo by Byron Adams

Is it simply their reputation or are air rotary rigs one of the loudest rigs in operation today?

It may be the engine, or the compressor, or the cooling fan, or the hammering activity that takes place during drilling, or it could be all of the above. Whatever the causes, it is clear that air rotary drilling rigs are loud.

Because of this, the National Institute for Occupational Safety and Health (NIOSH) is investigating the noise exposures of water well drillers while they are drilling water wells for our communities. Nationally, much attention has been given to the ever-increasing problem of Americans losing their hearing due to occupational noise exposure. In 1996, NIOSH's National Occupational Research Agenda identified hearing loss as the most common occupational-related disease in the United States.

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What Is Too Loud?

It is important to understand that loud noises can cause permanent hearing loss. But it is just as important to understand that hearing loss can be prevented by knowing what levels of noises can damage our hearing and taking action to protect our hearing.

Most of us cannot readily explain what is too loud. We know the difference between something that weighs 5 pounds and something that weighs 100 pounds, but most of us don't know the difference between 20 dB noise levels and 100 dB noise levels.

Many of us do not even know that we measure noise levels in decibels (dB) or A-weighted decibels (dBA). The term dBA refers to noise levels detectable by the human ear. The A-weighting or "dBA" adjusts the "dB" noise levels to account for the shape of the human ear, because the shape of our ears causes a change in the noise levels as they enter the ear. So when noise levels are expressed in terms of human hearing, they are usually referred to and measured as dBA, or A-weighted.

Generally, the range of noise levels relevant to human studies is between 0 and 120 dBA. Any sound levels under 0 dBA cannot be heard by the human ear. Most sounds over 120 dBA will likely damage human hearing immediately, and sometimes painfully and permanently.

Normal human conversation occurs around 65 dBA. Leaves blowing in the wind are about 25 dBA. Revving motorcycles are about 95 dBA, and air-powered jackhammers are about 110 dBA.

Past and current NIOSH research is trying to identify at what noise levels human hearing becomes damaged. These studies have shown that exposure to excessive noise levels above 90 dBA for more than eight hours a day over a 40-year working lifetime increases your risk of losing your ability to hear.

These studies have also shown that hearing loss can be painless, occurs over long periods of time, and cannot be medically corrected. Even today's medical technology cannot repair or reverse hearing loss.

Are Air Rotary Drill Rigs Loud?

To address this question, NIOSH investigated three different models of air rotary rigs with three different drill operators at three different sites (Rigs 1, 2, and 3).

What type of air rotary rigs were tested and what were they drilling?

Testing on Rig 1 occurred while it drilled a 6-inch domestic water well 250 feet in depth in glacier till (unconsolidated material). This truck-mounted rig had a compressor (660 cfm), a large cooling fan, and a dedicated engine for drilling.

Over a single day, drilling operations and noise testing started at 9:30 a.m. and continued until 2:00 p.m. (4½ hours) when the hole was completed. The hole was drilled with a downhole pneumatic hammer bit while water was used to remove cuttings and suppress the dust. The surface casing for the hole was pushed into the hole via the rig's hydraulic head. At different times during casing installation, the casing had to be hammered into the hole with a modified pneumatic hammer bit on top of the casing.

Rig 2, similar to Rig 1, was truck-mounted, had a compressor (450 cfm), a large cooling fan, and a dedicated engine for drilling.

On the day of testing, Rig 2 firs worked to retrieve a drill bit lost in the hole the previous day. After the drill bit was recovered, drilling resumed to complete a 6-inch domestic water well 245 feet deep in glacier till. Testing began at 8:18 a.m. and ended when it started to rain at 12:10 p.m. (almost 4 hours). The hole was drilled with a downhole pneumatic hammer bit while water was used to remove cuttings and suppress the dust. Again, similar to the situation for Rig 1, installation of the casing involved pushing and hammering the casing into the hole with the rig's hydraulic head.

Rig 3, also truck-mounted, drilled a 6-inch domestic water well 110 feet deep in sedimentary deposits. Drilling operations and noise testing began at 9:15 a.m. and ended at 12:20 p.m. when the hole was completed (a little over 3 hours). Rig 3 had a compressor (450 cfm) and a large cooling fan, but, unlike Rigs 1 and 2, used the truck's engine to drive the drilling head. The hole was drilled with a downhole pneumatic hammer bit with the cuttings being removed with water. In this case, installation of the casing did not require the casing to be hammered into the hole; rather, the casing was dropped into the hole by hand and then grouted in place.

What kind of noise tests were conducted on these air rotary rigs?

Two types of noise measurements were taken. One focused on the actual noise generated by the drill rig. The other focused on how much noise the drill operator was actually exposed to. Noise measurements on the rig were taken to identify how noise radiates out from the rig and what areas around the rig are the loudest. Noise measurements on the drill operator were taken to identify how much noise the operator was exposed to and

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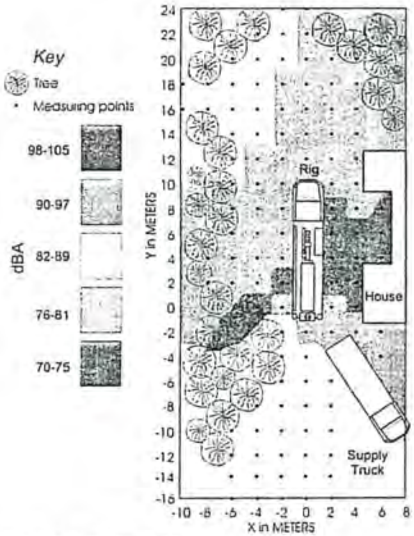

Figure 1. Rig 1 sound pressure profile.

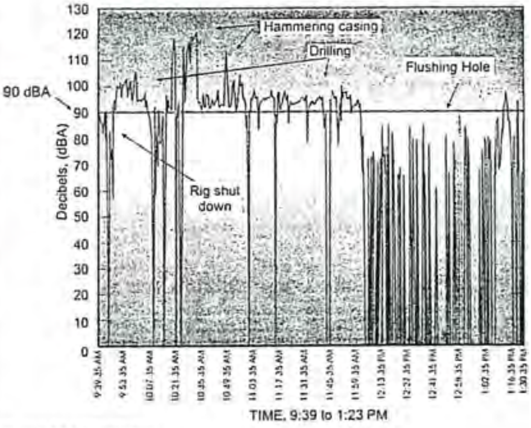

Figure 2. Rig 1 dosimeter data.

from page 18

what drilling activity provided the greatest noise exposure.

Noise measurements (sometimes referred to as "sound pressure" or "sound level measurements") around the rig were taken at points established on a grid system after the drill rig was in position and ready to drill. The test points were on 2-meter centers, and the total size of any grid system was no larger than 18 × 40 meters. However, at most sites there were surface features (trees, house, supply truck, etc.) that limited some of the measuring points.

All of the noise or sound pressure measurements were taken only when the rig was drilling. Noise or sound pressure measurements were not taken during non-drilling periods or when the operator was adding or removing drill steel. All the noise or sound pressure values recorded for each point were then plotted and contoured on a map to show how the varying noise levels radiated out and away from the rig as it was drilling.

Noise measurements on the drill operator were taken with an instrument called a dosimeter. This instrument detects noise with a microphone positioned near the operator's ear. The microphone is connected to a small data collection (computer) box worn on the operator's belt. The dosimeter continuously measures and processes noise levels near the operator's ear, then automatically calculates the average level of noise exposure that the operator obtained while he was wearing the dosimeter.

A time motion study was also conducted while the driller wore the dosimeter. This study logged the time of the different drilling activities (drilling, changing drill rods, flushing hole, etc.) preformed by the operator. The time motion study was then compared to the noise measurements collected by the dosimeter to identify the noise exposure to the driller while performing each drilling activity.

How loud were the air rotary rigs?

Rig 1. Noise measurements to identify how much noise was radiating out from this rig are shown in Figure 1. This shows areas of mid to upper 90 dBA noise levels along the sides of the rig where the rig's cooling fan, engine, and compressor are located. It is also believed that the location of the house, where noise measurements could not be taken, restricted the diffusion of the noise generated by the rig and caused a reverberation of the noise. Overall, Figure 1 shows noise levels of more than 90 dBA all around the rig except for the back left corner of the rig. This area is where the operator's control panel is located. The length of time the operator stays in that area while drilling will impact the total noise exposure.

Noise measurements recorded by the operator's dosimeter and during the time motion study are shown in Figure 2. This shows that the operator was exposed to noise levels above 90 dBA during most of the actual drilling of the water well. The noise levels fell below 90 dBA only when the drill operator was flushing the hole. During flushing, the operator was standing about 15 feet away from the rig. The total noise dosage calculated by the dosimeter for the 4½ hours it took to complete the hole indicates the operator accumulated 134 percent of his daily allowable limit as recommended by federal standards—in other words, the operator had an overexposure of noise by about 34 percent. In fact, the operator reached his daily allowable noise dosage in a little over an hour into drilling this hole. The main reason for this noise overexposure was due to the excessive noise levels (up to 120 dBA) experienced during the hammering of the casing. Finally, if this operator was conducting the same drilling activity for 8 hours instead of only 4½ hours, he would have had a noise dosage of 276 percent.

continued on page 22

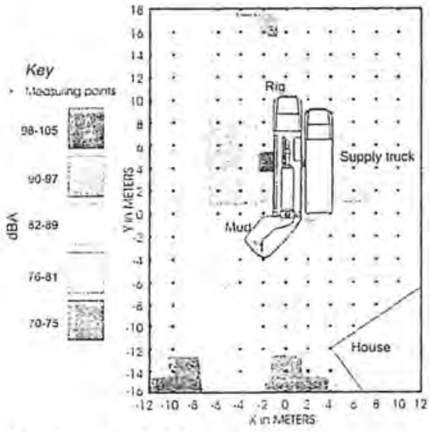

Figure 3. Rig 2 sound pressure profile.

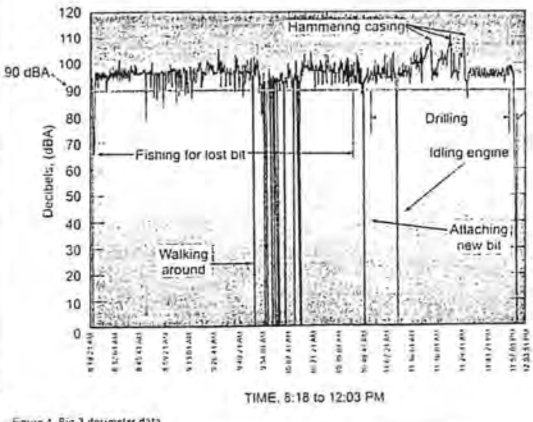

Figure 4. Rig 2 dosimeter data.

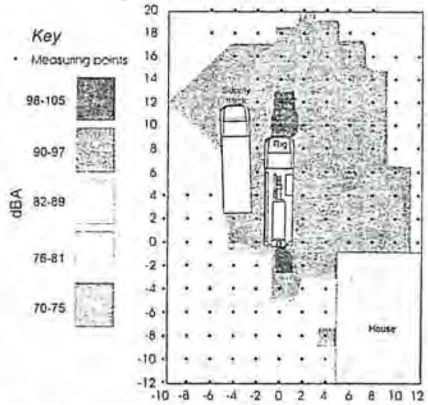

Figure 5. Rig 3 sound pressure profile.

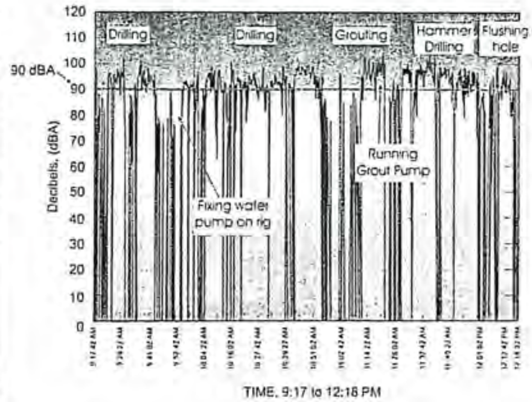

Figure 6. Rig 3 dosimeter data.

from page 20

Rig 2. Noise measurements to identify how much noise was radiating out from this rig are shown in Figure 3. This shows the loudest area (90 dBA and above) to be on the left side of the rig where the cooling fan is located. Further, it is believed that if noise measurements could have been taken where the supply truck was parked, the right side of the rig would also have had 90 dBA or above noise levels. Overall, Figure 3 shows that the loudest areas are along both sides of the rig. Both areas in front and back of the rig have noise levels just below 90 dBA. However, the area around the back of the rig may have been louder if measurements could have been taken where the mud pit was located.

Noise measurements recorded by the operator's dosimeter and during the time motion study are shown in Figure 4. As with Rig 1, this shows that the operator was exposed to noise levels above 90 dBA during most of the 4 hours he was wearing the dosimeter. The total noise dosage calculated by the dosimeter for the 4 hours indicates that the operator accumulated 132 percent of his daily allowable limit as recommended by federal standards. Similar to the operator on Rig 1, the operator on Rig 2 had an overexposure of noise by about 32 percent. As with Rig 1, the loudest contributing noise for the operator at Rig 2 resulted from the hammering of casing recorded at 110 dBA. Again, similar to Rig 1, if this operator was working on this well for 8 hours instead of 4 hours, his noise dosage would have been 268 percent.

Rig 3. The noise measurements for Rig 3, shown in Figure 5, show different characteristics than the noise measurements taken for Rigs 1 and 2. The reason for this difference was that the power source driving the drill head on Rig 3 came from the truck's engine in front of the rig. Overall, Figure 5 shows the loudest areas (upper 90 dBA) to be in the front and back of the rig. Noise levels along both sides of the rig show low to mid 90 dBA readings. Similar to Rigs 1 and 2, the left back corner of Rig 3 was near an area below 90 dBA. This is the area where the operator's control panel is located and may have influenced the operator's total noise exposure.

Noise measurements recorded by the operator's dosimeter during the time motion study are shown in Figure 6. Unlike the circumstances associated with Rigs 1 and 2, in this case the operator was not continuously exposed to noise levels above 90 dBA during the drilling of this hole. The total noise dosage calculated by the dosimeter for the 3 hours indicates that the operator accumulated 56 percent of his daily allowable limit as recommended by federal standards. However, at that noise dosage rate, the operator would have received 130 percent of his allowable dosage had he worked 8 hours on this well.

There are several possible reasons why the operator on Rig 3 had less noise exposure than those on Rigs 1 and 2. One of the main reasons was that there was no hammering of metal casing to develop this water well. Secondly, the operator's control panel was elevated about 4 feet above the hole because of the contour of the ground surface and the position of the rig. This kept the operator farther away from the area of the drill hole, where noise levels were louder during drilling. Thirdly, the operator was involved in other activities, like repairing the rig's pump and grouting the hole during the developing of the hole. Finally, the operator completed this hole in less time than the holes drilled by Rigs 1 and 2.

What Can Operators Do to Protect Themselves?

Wear Hearing Protection (Personal Protective Equipment)

There are three major considerations recommended for selecting and using hearing protection: availability, proper fit, comfort.

Make hearing protection readily accessible for all drillers, helpers, and site visitors. Have boxes of disposable earplugs on the rig, in the supply truck, and in the shop. Encourage or consider requiring everyone at the drill site or near loud noises to wear hearing protection.

Proper fit is very important. Many people are not aware there is a proper technique for inserting earplugs into the ear so that they are effective. The same holds true for earmuffs. There must be a good seal all the way around the earmuffs and wearer's head. There will be little to no protection if the earplugs or earmuffs are not used correctly.

As we all know, we will not wear something that is not comfortable. Everyone's ears are not the same size or shape. There are many different types of earplugs and earmuffs on the market today. Try as many different types of earplugs or earmuffs as you can until you find the ones most comfortable and suitable.

Finally, wearing both earplugs and earmuffs at the same time will give maximum hearing protection around extremely loud noises.

Avoid Excessively Noisy Areas (Administrative Controls)

This can be easier than you think, and it does make a difference.

Become familiar with the sounds of your machine. You don't need a sound level meter to know where the loud zones are on your machine. Usually these areas will be near the compressor, the cooling fan, the engine, and the hole. These loud areas may change somewhat from site to site and can be affected by the surrounding environment, so walk around your rig and be aware of your surroundings. Avoid these loud areas or minimize how long you have to work in them. As the operator on Rig 1 did when flushing the hole, move away from the rig when possible.

Be aware of the people around your rig. Encourage them to avoid these loud areas. Finally, avoid the metal against metal banging or jarring of the drilling equipment. Recall the 110 to 120 dBA noise levels while the metal casing was being hammered into the ground. These same high noise levels also occur when drill rods are banged together during loading and unloading or when someone is using a hammer to loosen a locked drill rod or clamp.

Physically Change or Modify Your Rig (Engineering Controls)

Unfortunately, most modifications to reduce loud noises on air rotary rigs can be accomplished more easily by the manufacturer than by the operator at the shop or at the site. It is also probable that the cost of manufacturing a quiet air rotary rig will be very expensive and above today's market prices.

However, it was observed during this investigation that certain fabrications or modifications on supplemental tools used during drilling could help reduce loud noises. One example was with the tools used to hammer casing into the hole. It may be possible to add or install some type of inexpensive disposable padding or plastic shield in between the metal contact zone to reduce the loud banging.

Another idea is to provide some form of barrier (temporary or permanent) between the position of the operator and the compressor, cooling fan, and engine. This barrier could be tailor-made from plywood with sound-absorbing material for individual rigs and quickly installed and taken down during set-up and tear-down.

Finally, as the saying goes, try thinking outside of the box. Drillers are some of the most resourceful people in the workforce. Remember, you are consistently making modifications to your rigs and drilling techniques because your working conditions can change from site to site. Apply this same creative thinking to reduce or avoid loud noises.

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R.J. Matetic is employed by the National Institute for Occupational Safety and Health, Pittsburgh Research Laboratory as a Section Chief for the Hearing Loss Prevention Section. He has been involved in health and safety research for 19 years. Additionally, his current research focuses on identifying health and safety hazards associated with surface drilling operations and offering recommendations to provide a healthier and safer working environment to workers associated with surface drilling operations.

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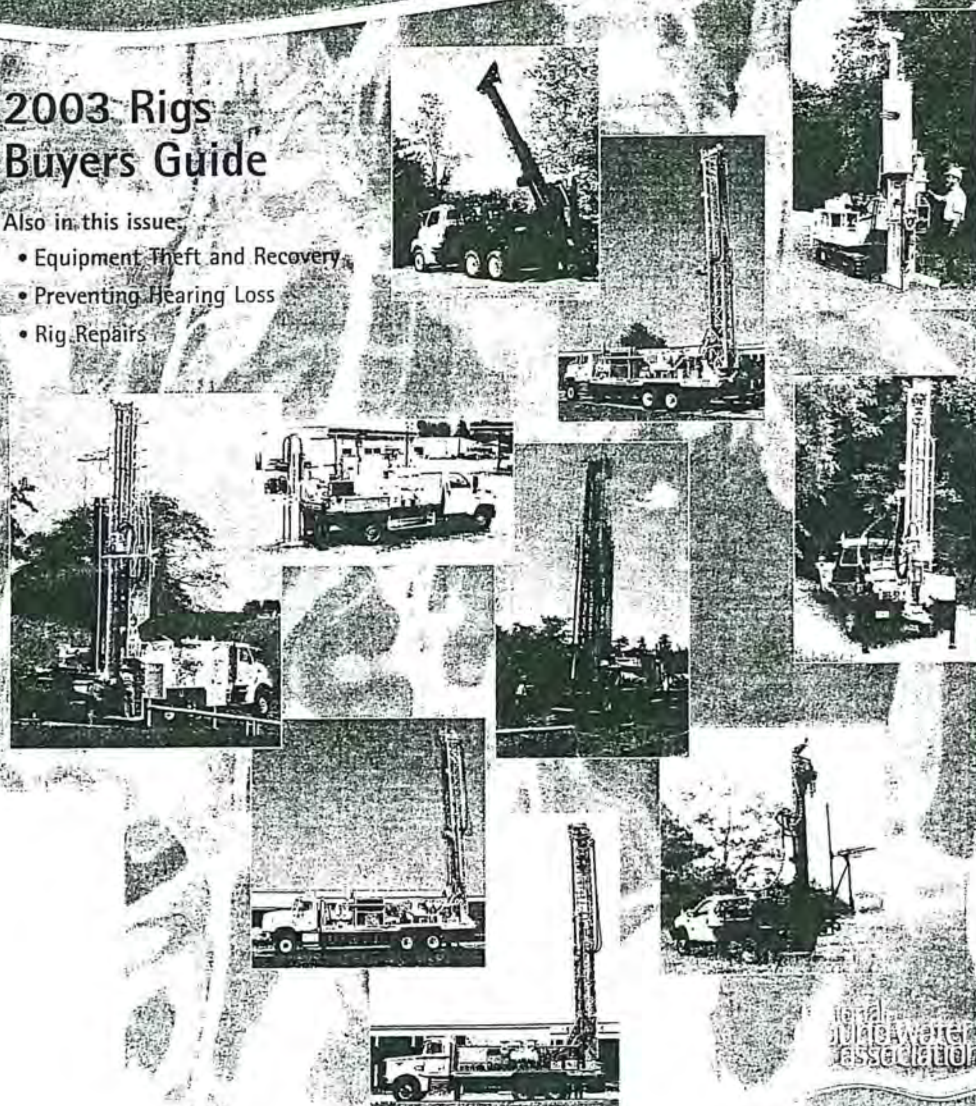

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