



Sonalert Products

# **You Just Backed Up Over My Foot Why Didn't I Hear Your Back-up Alarm?**

by Dan O'Brien, Mallory Sonalert Products, Inc.

## Introduction

Audible alarms are used extensively in IUV applications for both problem warning and for safety. An example of using an audible alarm for a warning situation is issuing an audible alert for a low oil pressure situation. The list of safety uses in IUV's for audible alarms includes issuing a sound when moving forward, platform moving, load bed dumping, tilt warning, and for backing up. Of all the uses for audible alarms in IUV applications, the back-up warning application evokes the most debate among all parties due of the amount of injuries and deaths that occur every year to pedestrians.

The arguments for using audible back-up warning sounds are compelling. In an older but still relevant study by NIOSH (National Institute of Occupational Safety & Health), it was found that for forklifts alone, there were 20,000 injuries and 100 deaths with 40 to 50% of these involving pedestrians.

For smaller IUV's, deaths involving pedestrians are not a large concern, but certainly there is danger of injury, and unfortunately in our society today, liability is an important motivator as well. Considering the price tag of the IUV vehicles themselves as well as the costs of having an injured employee or a potential large liability settlement, the addition an audible back-up alarm to an IUV is almost always justified.

Even with the strong motivations for using back-up alarms in IUV's, the alarms are not always used effectively, and their application is not always straightforward. While each individual IUV application of a back-up alarm has its particular circumstances, there are some common problems that are sometimes encountered with their use. These include:

- Excessive noise level resulting in annoyance, fatigue, and hearing loss
- Pedestrians becoming habituated to the alarm
- Operators disabling or disconnecting the alarms

With collaboration among users and suppliers, and with the ability of audible alarm designers to use state-of-the-art technology to put "smarts" into back-up alarms at very low additional cost, all of the above potential complaints can be effectively addressed. In the following sections, each complaint will be address individually and suggestions will be given on how to overcome them. Before addressing these complaints, it is useful to explain some common terminology used for audible warning devices including back-up alarms.

## Short Over-view of Audible Alarm Technology & Terminology

Three different types of audible alarm technology are used in the back-up alarm application depending on the sound level needed. Below are examples of the three different types of technology:



Piezoelectric  
Technology  
105 dB @ 2 ft



Piezo-Hybrid  
Technology  
110 dB @ 3 ft



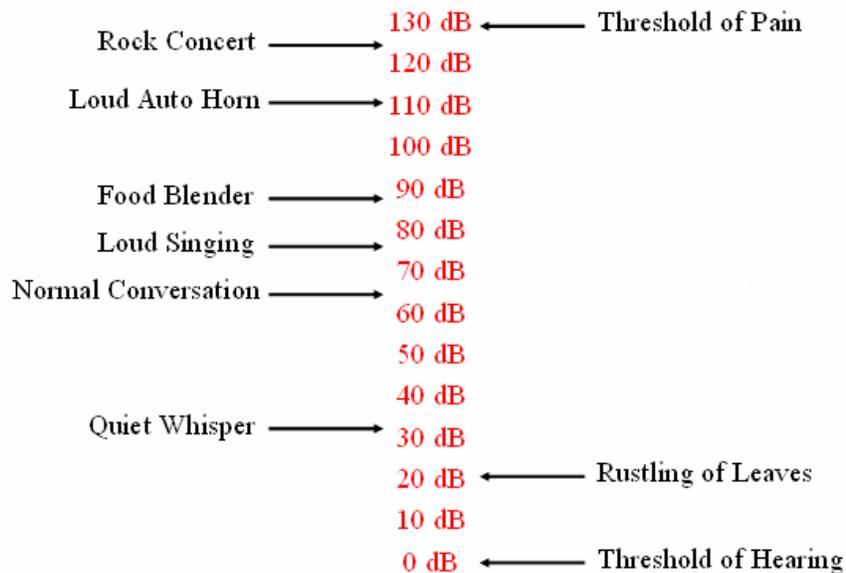
Speaker  
Technology  
112 dB @ 4 ft

The “105 dB @ 2 ft” under the piezoelectric technology picture means that this technology is capable of reaching a sound level of 105 decibels at a distance of 2 ft. The piezoelectric technology alarm shown on the left can achieve very loud sound levels, but the piezo-hybrid technology alarm shown in the middle can get louder, and the speaker technology alarm shown on the right can issue the loudest sound level of the three.

Sound level is measured on an arbitrary scale in decibels (dB) that ranges from 0 dB (threshold of hearing) to 130 dB (threshold of pain). Below is a chart showing some common sounds and their relative sound levels.

### Reference Sound Levels

(as if you were standing 2 feet from the sound source)



An audible sound that is 10 dB higher than another sound will sound twice as loud to the human ear. This is also the difference in sound level that is needed in order for an audible warning sound to be clearly heard over the background noise. For example, in order for an alarm to be easily heard over a food blender which can measure 90 dB, the alarm sound would need to be 100 dB which will make the tone generated by the alarm sound to the human ear about twice as loud as the food blender sound.

Another important aspect to sound is its sound frequency (musically known as pitch) that is measured in Hertz (Hz). For the back-up alarm application, frequency values can range from 200 Hz up to 3000 Hz. As a comparison, the keys on a piano will range from 27.5 Hz up to 4,186 Hz.

Now that some common terminology has been defined, the three common complaints of back-up alarm users that were mentioned above can be individually addressed.

#### Excessive Noise Level Resulting in Annoyance, Fatigue, & Hearing Loss:

The back-up alarm must be loud enough to be heard by pedestrians and other IUV drivers in the area. To reach this threshold, the sound that is issued cannot help but be somewhat annoying in order to catch someone's attention. The key is to make the warning sound loud enough that it can be distinguished over the background noise, but not so loud that it becomes extremely annoying or results in hearing loss. There are some strategies that can be employed to prevent this from happening.

1. Sometimes, the IUV application is using a back-up alarm that is too loud for the environment where it is being used. Louder is not always better. The warning sound only needs to be 10 dB above the ambient background noise in order to be easily distinguished and heard. How is this determined? One excellent way is to measure the ambient background noise using a sound level meter and then use an audible warning device that is rated 10 dB louder. Another way is to do some investigative work. Since a sound that is 10 dB louder than another one will sound twice as loud to the human ear, it is possible to judge whether the current audible warning sound is too soft or too loud for the environment.
2. Another strategy to address this problem is to use a back-up warning device that automatically adjusts its sound level based on the ambient noise level. While this technology has been around a while for the louder speaker technology type back-up alarms, it is just now being currently implemented in the other type of back-up alarm technologies. Improvements in electronics should also help to make this type of self-adjusting alarm even more affordable in the future.
3. Lower frequency sounds are sometimes considered less annoying. Unfortunately, how people feel about a particular sound frequency is very subjective. What is acceptable to one person could be extremely annoying to another. In general, however, most people consider lower frequency sounds to be more pleasant than higher frequency sounds. This is why door bells chimes are typically set at a relatively low frequency while a smoke

detector uses higher frequency alarm sounds. It may be that substituting a lower frequency back-up alarm will eliminate some of the annoyance factor.

4. There are many other low cost strategies that can be employed to reduce the annoyance factor, fatigue and hearing loss. For example, mounting the alarm so that it faces directly backwards will reduce the sound level of the alarm that reaches the operator. This is because the sound now has further to travel before it reaches back around or reflects back to the operator's ear. Another possibility is to put some sound-proof foam strategically around the alarm resulting in even less sound that will directly reach the operator. The main idea here is to direct the sound mostly backwards where it is needed and away from the operator. One additional strategy to reduce the level of sound reaching the operator is to use ear protection. While general sound blocking head phones or ear plugs work, these devices also muffle other noises (such as human voices) that could be important to hear. One solution is to use special head phones designed to block high level noise or higher frequency sounds. These head phones have been successfully employed by woodworkers for some time, and may be worth trying with IUV operators.

It should be noted that there are OSHA regulations for SEL (Sound Exposure Level) that are not addressed in this article that also need to be followed.

#### Pedestrians Becoming Habituated to the Alarm:

Although it varies depending on the individual, some people are good at blocking out sounds that are repetitive. While this can be a good thing if your computer fan is squeaking, it can be a bad thing if you block out the beep beep beep of an IUV back-up alarm that is bearing down on you. The obvious solution is to vary the alarm sound in some manner so that the warning sound is not so monotonous. Currently, there are no standard back-up alarm models that are generally offered that can do this. For example, how about making the warning sound beep faster the quicker the vehicle is moving? Changes in sound frequency are also possible. Another idea would be to use a different beeping pattern or sound frequency each time the IUV goes into reverse. With the ability for audible alarm designers to put this kind of "smarts" into the alarms now at a low cost, the possibilities are nearly endless to develop changing sounds that pedestrians will not block out.

#### Operators Disabling or Disconnecting the Alarms:

There are some simple things that can be done to discourage operators from tampering with the back-up alarm. Sometimes, the electrical power connection to the back-up alarm terminals is made using a quick-connect type connector because of the low cost and ease of use when the IUV is being assembled at the manufacturing plant. Unfortunately, these benefits for the manufacturer also make it easy later on for the IUV operator to pull off the power wires to the alarm. Using screw terminals or even soldering the power wires to the alarm terminals would be a step up in protection. Another level of protection would be to make the back of the alarm inaccessible so that the power connections are not easily tampered with. However, the most determined person can still cut wires or use a screw driver to damage the back-up alarm device so that it will not sound. Therefore, the most effective

methods to prevent tampering with the alarm are proper training, and proper selection & use of the alarm so that the operator does not have any motivation to disconnect or disable the alarm.

### Future Technology & Other Ideas

There are companies working on more system wide solutions to help prevent injuries and deaths in IUV applications. These systems may use a combination of audible warning, visual warning, GPS systems, laser detection systems, RFID, etc. However, because of the ability of audible alarm designers to put more intelligence into their alarms, there is much more that can be done on the audible alarm portion of these systems. Here are some ideas that are possible with today's technology:

1. Why not only have the back-up alarm only sound when a pedestrian is near. Systems are coming into play that can look for objects and pedestrians in the path of travel. We can take advantage of these systems by having the back-up alarm communicate with them. Another idea would be to put an RFID tag on all people that go into an area shared with IUV's. The IUV back-up alarm could sense the RFID tags and only issue warning sounds when the RFID tags are sensed.
2. As mentioned before, it is now possible to vary the beeping pattern or frequency in back-up alarms. This can help keep pedestrians from blocking out the sound.
3. With today's electronic technology becoming smarter, smaller, and lower in cost over time, there are nearly no limits on what can be done. For example, when the audible sound is issued by the back-up alarm, the alarm could also issue a wireless signal that contains the exact sound frequency and pulse rate of the alarm. This signal could be used by smart head-phones to make the sound much softer to the wearer of the head-phones.

### In Conclusion:

While back-up alarms in IUV's are used extensively for safety and liability reasons, they are not always used effectively. There are a number of simple actions that can be taken to reduce the complaints and problems that are sometimes encountered with back-up alarm use. Two of these actions involve making sure that the back-up alarm is not any louder than required and also directing the sound backwards where it is needed the most. With the ability to put more and more complex electronics into back-up alarms at reasonable costs, there is also the opportunity to be creative and be more proactive in preventing the accidents between IUV's and pedestrians.

For more information, contact:

Mallory Sonalert Products, Inc.  
317-612-1000 (ph)  
[info@mallory-sonalert.com](mailto:info@mallory-sonalert.com) (email)  
[www.mallory-sonalert.com](http://www.mallory-sonalert.com) (website)