

Safety Related Alarm Systems for Buses/Motorhomes

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When we started our safety-related business for the RV market, a major factor was seeing the results of many disastrous bus and motorhome fires in wrecking yards and on the internet. As we travel to trade shows and do our related seminars, we never fail to hear horror stories about accidents and fires. This convinces us that there is a need for safety-related products. This article will detail some alarm systems that can help detect serious causes of major RV damage or personal injury.

This article will cover three types of safety related alarm systems:

- An alarm system to detect engine and generator fires
- An alarm system to monitor tire pressure of bus/motorhome and towed vehicle (“toad”)
- Interior alarm systems to detect intrusion, smoke/fire and carbon monoxide

Each of these systems provides information and audible alarms to warn of impending problems. These problems can be minor, but, for the most part, they can be a serious threat to our safety and health. The secret to each of the alarm systems is the early detection and warning.

As we discuss each system, I will give the reader ballpark costs.

Engine/Generator Fire Detection System

There have been several studies that suggest that engine fires in buses and motorhomes are much more prevalent than one would expect. In my February 2004 Bus Conversion magazine article, I list two studies that were done in Finland involving commercial bus fires. The statistics are cited in the article (also on our website), but one of the most prevalent causes was engine compartment fires. Recently I have obtained the database on recreational vehicle fires from the Oregon State Fire Marshal. I suspect that other states keep this type of data, but The Oregon State Fire Marshal data seems to be held in high respect in the industry. Summary of the data is shown in Table 1.

Year	<u>2003</u>	<u>2002</u>	<u>2001</u>	<u>2000</u>	<u>1999</u>	<u>Total</u>
All Reported Recreational Vehicle Fires	183	202	181	197	200	963
Fires Involving Motorhomes Only	108	115	90	95	107	515
Fires In "Engine/Wheel area"	53	50	37	33	41	214

Table 1.

Oregon Fire Marshal Data

The numbers are remarkable in my opinion and certainly demonstrate that RV-related fires are much more prevalent than most of us would guess. The number of fires in the engine and wheel area of motorhome is, again, remarkable.

Based on my early observations of numerous bus/and motorhomes damaged by fires, I observed that a disproportionate number of fires in these vehicles were in the engine compartment. The data cited above is confirmation of those observations.

I decided I wanted some sort of detection system to give me a heads up on a potential fire in the engine compartment of our bus ('85 Eagle 10). I searched for some sort of device for this need, and came up empty handed. I did determine that all modern commercial buses have to have a fire warning system in the engine compartment by regulation, but these systems seem to be integrated into the electronics of the bus and are not available in the aftermarket.

As a result of not finding an engine fire detection system available in the market, I decided to develop a system. That system has evolved into a rather sophisticated device that monitors and displays the engine and generator compartment temperatures. The unit has two levels of alarms. The first level is established by the driver based on a history of engine or generator compartment temperature under worst case conditions. This "first alert" alarm is used to give an initial warning that the temperature needs to be monitored closely. If the temperature continues to rise, there is cause for concern and the driver should pull over at the first opportunity to investigate the situation. If the temperature reaches a pre-established temperature, an aggressive alarm is sounded, warning the driver that there is an extreme probability that a fire has been detected. The system is designed to be as fail safe as possible and can even detect and display open and short circuit wiring conditions.

The temperature sensors are very small thermistors and are wired into the engine and generator compartments. They have a very fast response to temperature change. In fact, one of the early beta testers reported that he could see the slight temperature rise in the generator compartment temperature when his air conditioner was running. He was using the capability of the system to trouble shoot a suspected over-temperature condition in the generator compartment and was able to trace the problem to another source.

Photo 1. shows this system. More details are available on our website.



Photo 1. Engine and Generator Fire Detection system

The cost of this system is in the \$300 range.

Tire Pressure Monitor/Alarm Systems

A major concern to me is to avoid a blowout of a tire. In the case of a car tire blowout, the consequences can be anywhere from startling to disastrous. In the case of our buses or large motorhomes, the consequences are multiplied significantly. In addition to the horrors of a possible accident, a blowout of the size tires we use can do significant damage to our buses! It is just something we should do everything in our power to avoid.

Obviously, the first thing we should do is run good quality tires that are rated for the axle loads imposed. As a part of the effort to run good tires, we should pay attention to the age of the tire. The bus bulletin boards have many threads where it is stated that there are industry recommendations that suggest that tires should be replaced if they are more than seven years old. In spite of considerable research, I have not been able to find the actual documentation, but it does make good sense. We have all heard of truckers that have tires that have been recapped more than once. That makes it sound like the tire is "old". Indeed, with the mileage that truckers put on, a twice recapped tire could be less than five years old. In any case, we should do everything within our means to run good tires.

Having worked for a company that used to make tires, I have some knowledge of tire failure mechanisms. In addition, I have done quite a bit of research subsequent to my retirement. The general consensus is that most blowouts are the result of running the tire overloaded and/or under-inflated. Either of these conditions will cause a temperature rise in the tire and will destroy the bonding of the components. An unpredictable blowout (not caused by overloading or under-inflation) is usually caused by hitting some foreign object in the road.

An excellent study of commercial truck tire failures can be found at:

http://www.umtri.umich.edu/cntbs/doc/UMTRI_2000_28.pdf

This report has a "Government Accession No." of: DOT HS 809 172. In this report a study is cited where it is estimated that 86% of tire blowouts are the result of under-inflation. Also, in this report tire inflation monitoring systems are favorably mentioned as a blow out prevention tool.

So what can we do to minimize a tire problem. Obviously run the best tires that were designed for our application. This means that we need to make sure the tire rating exceeds its load by a good margin and that the tire is inflated for that rating. Next, we need to check the tire pressures often and also do a quick "walk around" at each rest stop on our journey. These "walk arounds" should include feeling the temperature of each tire and hub. Unless you have been braking heavily, the tire and hub temperature should be comfortable to the touch (140 degrees or less). An infrared temperature measuring device can be used to determine the temperatures without getting your hands dirty. I do this "walk around" religiously on both the motorhome and the "toad" at each stop.

However, I am always concerned that an unseen problem could occur between stops (i.e. nail in the tire resulting in a slow leak or hitting something in the road that could cause a slow leak).

To satisfy my desire to be as safe as I can be, I researched tire pressure monitor systems. There seem to be two different types on the market. They both use radio frequency (RF) sensors, mounted on the tire valve stem, that send a signal to a receiver mounted close to the driver.

One alarm system utilizes sensors with a specific pressure range that must be selected for the tire pressure. This unit does not display tire pressure, but does announce an alarm if any of the sensors go out of range. I have not tested this unit, but various posts on RV type forums suggest it functions as advertised.

The second type is more to my liking. Being an engineer, I like to see actual tire pressures at each location. The second type of monitor/alarm uses a sensor that has a range from 10 PSI to 150 PSI and the monitor can display the tire pressure at each location upon demand. Photo 2 shows the tire monitor and Photo 3 shows the sensor that is screwed on each tire valve stem. I have tested this unit and find it very useful and “comforting”. It has two levels of alarm. The first alarm sounds when a tire pressure drops more than 12.5% below the initial tire pressure (usually the cold inflation pressure which is automatically set in the system during the initial installation). The second level of alarm (more dramatic annunciation to get your attention) is set for 25% below the initial pressure. This unit also allows you to set a mode to measure only the bus/motorhome or only the toad if you wish. I am convinced that unit provides the best protection and we have added it to our product line. It is used extensively in the commercial truck industry.



Photo 2. Recreational Vehicle Tire pressure monitor



Photo 3. Tire pressure sensor mounted on valve stem.

The cost of tire monitor/alarm systems varies from \$500 to \$800 for a 12 tire system (bus/motorhome and toad tires). This seems like a lot of money, but one tire blowout can result replacement costs and damage costs that could easily pay for the system. Details on the system can be found on our web site.

Interior Alarm Systems

The basic system

The basic function of most house-type or car-type alarm systems is to detect intrusion. However, house-type systems can be expanded to include detection of other hazards such as smoke/fire and carbon monoxide. While a simple car-type alarm system could be adapted to our buses/motorhomes, they are really not suited for detecting hazards.

A good interior alarm system gives good protection for both “home and away” situations. The protection includes both intrusion and hazardous conditions. It is possible that such a system will allow the owner to benefit from some insurance savings.

When one looks for an interior system the options can be staggering. The first consideration is the quality level of the system. There are two different levels of systems available: consumer and professional. The consumer-level is the type of system a person would buy at Radio Shack or some similar store. These are about half the cost of a professional system. With internet shopping, professional-level systems are available to the public. A good professional starter system starts at about \$500, while a consumer system will cost around \$300. A typical starter kit is described at my web site: <http://rvsafetysystems.com> Photo 4. shows a basic system with carbon monoxide and propane detectors.



Photo 4. Interior alarm system showing system console, siren, smoke detector, motion detector, CO detector, Propane detector and two small magnetic switches

The next consideration is wired vs. wireless systems. To me, this is a no brainer. Even if we are in the construction stages of our bus, we could not possibly plan for all the various options available with alarm systems. Wireless technology is very well proven and makes it very simple to install a complex system.

Yet another consideration is the programming capability of the alarm system. With a typical professional system, the programming capabilities are almost unlimited and should be far greater than the needs we would have with our buses.

Lastly, it is quite important to make sure the system is UL listed. While most of us don't have a full understanding of the UL listing process, it does assure us that a system meets all applicable standards.

The heart and brains of the alarm system is the system console. This is the “traffic cop” for all of the detection devices. The typical system console is designed to handle various numbers of detection devices. Complex systems can have more than 50 channels. For our needs, a 12 or 24 channel unit should be plenty and they are readily available. As noted above, the programming options of a professional level system are almost unlimited. We will not have enough space here to describe all of the options. I will mention a few fun things later in this article. Most professional-level system consoles have what is termed a “supervised

system”. This is a very important function. While the system console immediately detects alarms, it also checks each device every few minutes and makes sure the device is working properly and that its battery has sufficient charge. Any abnormalities are reported on the console and the owner can quickly see which device is not working or has a low battery.

A professional-level system can accept a large number of detection devices. With wireless technology, it is best to select a manufacture that has all of the devices you think you might need in their product line, so that there will not be any communication issues.

Detection Devices

Detection devices can include:

- Smoke detectors
- Carbon Monoxide detectors
- Propane detectors
- Intrusion devices
 - Magnetic door and window switches
 - Passive Infrared Motion Detectors
 - Glass Break detectors
 - Panic buttons

Smoke detectors, carbon monoxide detectors and propane detectors are often stand-alone devices, but they do not have to be. If they are capable of sending a signal to a system console, they can trigger an alarm when the owner is not in the vehicle and this will notify neighbors that a problem exists. In addition, having them be a part of the alarm system assures that a loud annunciation is made and that there is no difficulty hearing the alarm. The smoke and gas-type detectors will also be stand alone devices with their own annunciation systems. By having them integrated into an alarm system, you have the extra protection utilizing the full capabilities of the system.

Smoke detectors, carbon monoxide detectors and propane detectors are often commodity products. You can buy them rather inexpensively at most major chains or RV parts stores. Here again, there is a significant difference between consumer-level and professional-level product. Consumer-level devices have major cost constraints and the owner suffers as a result. Consumer-level devices are generally reliable in providing warning. The problem is that they give a large number of false alarms. For example, have you ever put the kitty litter box close to the propane detector? Or how about those FMCA rallies where we are parked close to each other and running our generators – lots of false carbon monoxide alarms. Or how about when we cook and the smoke detector goes off? In each case, the consumer-level alarms are set to go off at low levels since their circuitry is not very sophisticated. In contrast, professional-level devices are designed to provide excellent warning capabilities while guarding against false alarms.

In the case of smoke detectors, there are two types available. The consumer level is typically “ionization” since they are less costly to manufacturer. They do a good job of detecting flash fires, but are prone to false alarms if installed close to a kitchen area where some of the cooking processes give off particles that look like particles from combustion. In our buses, it is almost impossible to locate a smoke detector where it

will not see the normal products of cooking. The other type of smoke detector is “photoelectric”. These are more costly, and a bit harder to find in a consumer store. They are best at detecting smoldering fires and generally do not have false alarms from cooking. Since each type of smoke detector has a process that detects different kinds of fire (flash versus smoldering), it is often recommended that both types be installed for the best protection. That recommendation is quite valid for a home application, but is not as important in a Bus/motorhome application. Since an RV is a very confined space, either type of detection device will provide early warning. The photoelectric type detection device does not have a tendency to give false alarms, and is my recommendation as the single best unit. In addition, a carbon monoxide detector is an effective fire detection system since CO is a product of combustion. This is especially true in the confined area of an RV.

Regardless of whether an alarm system is installed or not, **it is imperative that every RV have a smoke detector, a carbon monoxide detector and a propane detector.** Even if it is a stand-alone consumer-level device, it could save your life! By regulation, these devices must be installed in all new recreational vehicles and are equally important in older vehicles to provide safety for the occupants. Some bus conversions have been designed without propane on board (all electric). Obviously, this design would not require a propane detector.

I have been emphasizing that professional smoke/gas detection devices are quite robust and have very minimal tendency to give false alarms and they should be the device of choice. The added cost of these devices is not exorbitant. Each of the smoke/gas detection devices cost between \$60 and \$100. Given the long life and reliability of these units, I believe that is a good value.

The intrusion devices listed above are mostly self-explanatory. Simple magnetic switches are easy to install and can even be used to detect opening of bays and engine compartments, if desired. Probably the only device that needs special consideration is the motion detector. Again, professional-level devices are very discriminating, but they don't know the difference between a burglar and a pet. If you have pets, and want intrusion protection, you will probably need to avoid a motion detector and rely on other devices.

System Options

Professional-level systems (and some consumer level systems) offer many options for controlling the system and determining how the system functions. For example, one of the most useful options is a remote “key chain” device. A two-button device allows many programming options. For my installation, I have chosen to use the left button to arm/disarm the alarm system, and the right button to turn two interior lights on. These functions can be done at a reasonable distance from the RV. Turning on the interior lights is done through a “dry contact” relay in the system console in combination with a “power relay” with one or more lights wired to the power relay.

One option that I did not really appreciate at first, is a voice option. This option announces every system activity and can be very helpful in determining the system status – even in the dark.

There are a large number of other options on the more advanced system, but most of them are not needed on RVs.

Announcing the alarm

There are two reasons to have an alarm annunciation. The first is to warn you, and perhaps others, of a serious problem. The second is to scare off an intruder.

Many system consoles have a rather loud alarm annunciation. This would be sufficient to notify anyone inside of the RV that a problem exists. Most are loud enough to get an intruder's attention.

All alarm systems can annunciate an alarm via one or more exterior devices – usually sirens. Care should be taken when choosing this option. A false alarm, especially in your absence will not make friends in a campground!

My decision was to use an exterior siren so that my bus will be protected in my absence and then use a robust system that will make a false alarm an extremely remote probability. In both my home system and the bus system, I have chosen to use an interior siren as well. There is no doubt that a very loud siren, in a confined space, will deter all but the most brazen intruder.

Most systems are capable of dialing an alarm monitoring service, or one or more phone numbers of your choosing. Unless you are connected to a hard-wired phone system this option is not applicable to an RV application. I have investigated hardware to connect the system to a cell phone for dialing out and have not found anything that works. It is possible that some sort of radio frequency/pager system can be developed, but I have not found an off-the-shelf system.

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