**(ADDED TO PAPER)**

**Installations of Fire Alarm systems used today**

When building commercial buildings there are many different companies that provide fire safety systems. These systems come in many different configurations with different components that can be added to provide different features. The key task for all of these different systems is to identify an emergency in a timely manner and give notice to all of the buildings’ occupants of this emergency. Advanced systems also allergy the fire emergency organizations so fire fighters can address the emergency as quickly as possible. These fire alarm systems provide a way of identifying a developing fire emergency through both manual methods and automated methods. These systems then all have the task of alerting all building occupants that they need to evacuate the building and remove themselves from danger. After these two basic tasks have been completed, the stage of optional and additional processes can be added. This is where the different companies and components come in. A common function is the transmission of an emergency notification signal to the fire department and other emergency response organizations. More advances systems may even shut down electrical processes throughout the building, air conditioning equipment and other systems that may be more vulnerable to fire emergencies or deemed dangerous and may make fires worse. Automatic suppression systems such as water sprinklers can also be added. Below we will describe these different components that can be added to current fire alarm safety systems.

**Fire Alarm System Components H3**

**Control Panels H4**

Today’s systems generally have a central control panel. The control panel is responsible to keeping track of the various alarm input devices that are installed throughout the building. This includes both manual and automatic sensors. The control panel also has the task of sending signals to the various output devices installed throughout the building. These output devices can include bells, warning lights, emergency telephone calls, and horns. Control panels can range greatly in complexity. They could be as simple as panels with only one area to keep track of with inputs and outputs all from this one zone. They could also be very complicated controlling very advanced systems encompassing multiple floors of multiple buildings throughout an industrial complex. When choosing a control panel, the decision comes down to deciding between two general fire alarm systems. These are conventional systems and addressable systems. These two systems are covered in a later section of this document.

**Fire Sensors and Detectors H4**

The first and most basic type of fire detectors available are manual sensors. People have the ability to sense many different aspects of a fire emergency. This includes heat and flames themselves in addition to smoke and odors. This is also obviously the cheapest way of detecting if there is a fire emergency because advanced sensors and systems do not need to be purchases. For this reason, most fire alarm systems that can be purchased today come with the installation of manual alarm devices. These devices are used by whoever detects the fire emergency.

Unfortunately, there are the obvious risks associated with only using human input for fire detection. A person needs to be present at the time of the emergency in order for this system to be of any use. The person needs to also remember to pull the alarm in the event of an emergency. A person’s ability to act in the event of an emergency in not something that would want to be relied on. Lastly, this system relies on a person’s ability to detect an emergency in a timely manner. For these reasons, a large assortment of automatic fire emergency detection devices has been developed. These devices are meant to mimic a person’s natural senses. There are devices that mimic a person’s sense of touch by measuring heat. There are also devices that mimic a person’s sense of smell by measuring chemicals, smoke and odors. Flame detectors are also made to mimic a person’s sense of sight. A current and effective installation of a fire system would use these types of devices in order to best detect emergencies and protect building inhabitants. These manual fire detection systems are generally connected directly to manual alarm stations. Pull switches are connected directly to alarm systems so that users to not have to scream throughout a large commercial building. The key issue with these systems, as discussed earlier, is that this is not an effective system if the structure is unoccupied. These systems also open the building up to false alarms by kids that are looking to have fun or criminals.

The first type of automated sensor used in commercial buildings was the thermal detector. These units are usually set to go off when a room reaches a designated temperature. This temperature is commonly set between 135 and 165 degrees Fahrenheit. Temperature alarms also can go off rate of change of temperature instead of a preset temperature. These types of alarms go off when the temperature of a room heats up an abnormally fast rate. Thermal detectors can be highly reliable and resistant to false positive alarms. The temperature of a room rarely heats up to a high temperature or heats up at a abnormally fast rate if there is not an emergency present in the room. These alarms do have a major downside however. Since these alarms do not function until a certain heat condition has been reaches, this provides for the opportunity of a lot of damage to the room before the sensor goes off.

The second type of automated sensor used in commercial buildings is the smoke detector. These devices are effective because they are designed to detect smoke which usually occurs in the early stages of a fire emergency. Most of these devices use a type of light sensing system that detects if there is smoke by sensing the disruption in a light beam caused by smoke. Smoke alarms are usually installed in the same manner as thermal detectors. They are usually installed either on ceilings or high on walls in hallways. Because of a smoke detectors ability to detect a fire in its early stages, they can allow enough time for fire emergency personnel and response teams to reach a fire emergency in a timely manner. This can help to prevent damage to the building as well as help to get occupants out of the building before it is too late. For this reason, they are usually preferred over thermal detectors when choosing between the two systems. There does exist downsides to smoke detectors, however. They are usually more expensive to install in high quantities throughout an entire building. When it comes to fire safety, however, cost should take a back seat to people’s lives. The other disadvantage to smoke detectors is that they are prone to false positives. They can go off because of a simple cigarette or burned food when cooking. A professional installer should be able to install these devices to limit the chance of false readings.



The last type of automated sensor that is used in commercial installations of fire alarm systems is the flame detector. Just how the thermal sensor imitates the sense of touch and the smoke detector imitates the sense of smell, the flame detector imitates a person’s sense of sight. These devices use line of sight to detect flames and operate on either infrared or ultraviolet signals. These devices look for a high level of radiant energy and alerts a fire alarm panel of an emergency. These devices are very reliable as there are very few things that could produce the radiant energy of a fire without there actually being a fire. These devices are usually installed in high priority manufacturing environments. The major disadvantage to these systems is that they can be very expensive to install and labor intensive to keep operating at top efficiency. Another major disadvantage is that they must be looking directly at the place where a fire will occur. For these reasons, flame detectors are generally relegated strictly to manufacturing environments where corporations need the high quality systems in areas where fires can be expected.

Figure 1X3302 Multispectrum Infrared Hydrogen Flame Detector from Det-Tronics

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**Audio Output Devices for Fire Alarm Systems**

After the actual emergency detection devices, the other devices that are connected to the control panel and fire alarm system are the output devices. These include any alarms, buzzers and alerts that are connected to the system. The primary goal for these devices are to alert the occupants of a building when an emergency takes place to exit the building.

The most common type of sounding device available for these systems are bells. These are suitable for most building types and configurations. Horns are used when a loud signal is especially important. These would be used in buildings were concealing the device or placing it in a faraway location is necessary such as those that are architecturally sensitive. Chimes are a quieter version of sound output devices. These devices are used where a soft tone is needed such as hospitals, old age homes, and theaters. The last type of sound output device are speakers. These are used in complex buildings that may be multistory. Speakers are especially important for building that have a complex evacuation procedure or may need phased stages of evacuation. Speakers output a voice signal that tell occupants exactly what they need to do. They could also be used to relay emergency PA announcements to occupants such as weather alerts or dangerous outside situations.

Another category for output devices that are part of the fire detection systems used today are visual alerting systems. These type of devices are necessary for buildings that have loud ambient sounds that could muffle or overtake the sound of audio alarms provided by the system. These would be especially useful in buildings such as factories or manufacturing plants with loud machinery. Devices that can be considered visual alerting systems would include strobe lights and flashing signals. Visual alerting systems are also especially useful in buildings that would have occupants who could be hearing impaired such as hospitals and old age homes. Many government operated buildings are also mandated to include visual devices such as these.

Emergency response notifications are another type of output device that was especially useful. The most common application for these type of devices is an telephone signal that automatically alerts emergency response centers in the area such as 911. These centers would that contact the appropriate department such as the fire department, paramedics, and police. These devices could also be used to contact private monitoring centers that are part of the company that is using the fire detecting system. Many operations such as theme parks have in house emergency management teams meant to respond to alerts like this before public authorities are able to respond.

The last type of output signal for fire detection systems that the control panel would be connected to are specifically designed systems to shut down power and electrical equipment throughout a building. These types of systems are used to mitigate further damage and danger caused by fire spreading to expensive and sometimes dangerous systems. These systems could also turn on fans used for migrating smoke throughout the building as well as keeping it in other parts. Included in the above type of output system would be fire sprinklers. Water is the obvious first response to putting out fire emergencies so it has become a logical standard for most commercial systems. These systems directly apply water to burning areas causing the cooling process to start. While these systems often do not completely put out a fire, they are extremely important in mitigating damage and preventing fires from spreading to other areas of the building. A properly installed system would detect a fire emergency and set off the sprinkler alarms within minutes of a fire emergency starting. These types of systems are most useful within the early stages of a fire when they are easy to control and contained within a small area. These types of devices are critical for keeping a fire contained until official fire response teams arrive to take care of the emergency. They are also especially important during times of low occupancy where people are not present to help put out the fire. Another reason why these types of devices have become a staple in commercial fire alarm systems is that because a building without this type of system has a higher chance of large damage, insurance companies often offer lower premiums to companies who install this system. Most types of sprinkler systems come with the thermal detection and alarms built in to reduce the complexity of installation of the system. An effective fire detection would reduce the amount of separate electrical controlled devices as this would increase the amount of electrical wires flowing through a building that could cause increased damage in a fire emergency.

The fire detection for these types of devices usually include a type of seal that melts due to high heats. As fires heat up the room, the seals covering the sprinkler systems start to release opening up the water valves in a similar way to just turning on a hose. Most situations only require two sprinklers to contain a fire emergency but in areas that have a high change of chemical emergencies, a much higher amount of sprinklers are necessary. The major downside to a fire sprinkler system is that they can be very expensive to install within a building. They require water piping systems to go through every room where they are to be installed. This is extremely expensive to install in building that are already erected. Because of this, they are usually installed during construction of the building itself. There have been many advancements to these types of systems over the years. In addition to implementing the fire detection and alarms right into the sprinklers themselves, these systems have also been able to detect when the fire has been put out and turn themselves off. These systems use the same thermal sensors that detect the emergency in the first place to detect when the temperature has cooled to a safe temperature.