Smoke Management
Application Guide

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Rev. D
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Before you start using the Smoke Management Application Guide, it is important to understand the conventions used in this publication.

The following conventions are used to identify special names or text.

- *Italic type* indicates titles of publications, such as the Smoke Management Application Guide.
- Text enclosed in quotation marks indicates important terms or titles of chapters and sections of the manual, such as “How to Use this Publication.”
- Bulleted lists, such as this one, provide you with information. They are also used to indicate alternatives in numbered procedural steps.
- Numbered lists indicate procedures with steps that you must carry out sequentially.
The information in this guide serves to define the intended function of Smoke Control System Equipment and also explain what operational and performance requirements are necessary for equipment listed under the UL listing category of UUKL.

**IMPORTANT:** Smoke control systems must be designed to meet the custom needs of a particular building and its occupants. This document illustrates some basic, common smoke control applications, but is not in lieu of a properly engineered smoke control system, designed by a qualified Fire Protection Engineer.

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Many people are not aware that smoke is the major killer in fires. Smoke can travel to places in buildings that are quite distant from the scene of the fire, threatening life and property. It can fill stairwells and elevator shafts, blocking both evacuation and firefighting. Smoke control systems reduce the number of smoke-related injuries and deaths. In addition, these systems reduce property loss and damage caused by smoke.

Smoke control makes use of powered fans to produce air pressure that can control smoke movement. Air pressure has been used in laboratories for over fifty years to prevent airborne bacteria and poison gases from migrating from one area to another. It has also been used to control the entrance of dust and other contaminants into computer rooms; and used in hospitals to prevent the migration of harmful bacteria into sterile areas.

This chapter gives you an overview of smoke-control systems, including a discussion of the driving forces of smoke movement, the principles of smoke control, and the concepts of smoke control system design.

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A smoke control system can be designed to provide an escape route and/or safe zone. However, all smoke control systems have the following design parameters:

- Air-flow paths through a building and leakage areas.
- Pressure differences across smoke control system boundaries.
- Door or vent openings in the boundary of a smoke control system.
- Airflow through openings in smoke control system boundaries.

The following factors can affect the design of a smoke control system:

**System Flexibility:**
System flexibility means using features that allow for easy adjustment of a particular system to meet the demands of a given situation. For example, during the design and construction of a building, leakage paths can be estimated. Thus, a smoke control system can only be designed to provide theoretical protection from smoke. After the building is completed, the system must be tuned to the actual pressure values. System flexibility is also useful when retrofitting smoke control systems in existing buildings.

**System Control:**
A smoke control system should be designed to automatically activate, preferably by an alarm from a smoke detection system in the fire zone. The advantage of this type of activation is that the system is activated in the earliest stages of a fire. Smoke control systems should be activated after the receipt of alarms from a properly designed smoke detection system.

**Energy Conservation Management:**
Energy conservation methods must be considered when designing a smoke control system. A smoke control system must be designed to override the local heating, ventilation, and air conditioning (HVAC) system, or energy management system in order to implement the desired smoke control operations.

**Use of Fire Suppression Systems:**
Many fire protection schemes use automatic fire suppression systems. However, while the functions of fire suppression and smoke control are both desirable, they are not intended to substitute for each other.

Fire suppression systems are intended to limit the growth rate of a fire. Smoke control systems can provide safe zones and tolerable conditions along exit routes, but can do little to control fire. In addition to the obvious differences between the two systems, the way the systems interact must be considered. For example, pressure differences and air flows are different in the various buildings within a complex that is protected by a fire suppression system. A water spray from a sprinkler might interfere with air flow to a smoke exhaust or an outside air pressure system or a smoke control system could interfere with the performance of a gaseous agent (e.g., Carbon Dioxide or Nitrogen) fire suppression system.

A general guideline is that the gaseous agent fire suppression system takes precedence over the smoke control system. It is also desirable that the smoke control system be able to purge the residual gases and smoke after the fire is extinguished, and replace them with fresh air. This is an important life-safety consideration, since some fire-suppression gases are asphyxiates.
Controlling Smoke Movement

Regardless of the method, the basic concept behind controlling smoke is to use differences in air pressure to minimize the spread of smoke and, if possible, vent it from the building.

You cannot confine smoke by simply closing all access ways (such as doors and vents) to the room that has the fire in it. Even with these passages closed off, smoke can disperse throughout a building via cracks, holes made for pipes and electrical wires, and spaces around doors and windows. Smoke is driven through these small openings by the expanding gases from the fire. Smoke can also be driven onto other floors by the “stack effect,” which causes air to rise in buildings. The stack effect is caused by the difference in the interior and exterior temperature of the building. The figure below shows how smoke can disperse throughout a building:

Figure 1-1. Smoke Infiltrating Rooms Adjacent to the Fire

Continued on next page
Controlling Smoke Movement, *Continued*

Basic Concept

Since smoke is carried by the movement of air, you can stop the spread of smoke throughout the building by lowering the air pressure in the area containing the fire and by raising the air pressure in the surrounding areas and floors. The difference in air pressure (also called the “Air Pressure Differential”) between the smoke-filled area and the surrounding areas acts as a barrier to the smoke, pushing it back into the smoke-filled area. The figure below shows how this works.

![Diagram of air pressure distribution](image)

**Figure 1-2. Applying Positive Air Pressure to Control Smoke**

1. **Lower the air pressure in a smoke-filled area** by controlling the air flow into it and turning ON the exhaust fans from the area to full capacity. This “Negative Air Pressure” technique pulls the smoke out of the area and vents it outside of the building.

2. **Pressurize the areas and floors surrounding the fire** by turning OFF all exhaust systems (including closing any exhaust dampers) and forcing supply air to those areas at full capacity, creating zones of “Positive Air Pressure.” The air in the pressurized areas tends to leak into the smoke zone, using the same cracks and holes that the smoke would use to get out. This positive pressure airflow into the burning room keeps the smoke from spreading.

*Continued on next page*
3. Turn OFF the air inlets and air returns of the areas that are neither being pressurized nor depressurized (i.e., areas far away from the fire). Turning OFF the air return prevents the smoke that is being vented into the return air system from coming into the smoke-free area. In cases where there are large openings (such as an open doorway) between the area on fire and an adjacent area, **smoke can be confined by a large volume of air**. Pumping large amounts of air through the adjacent space creates a constant draft through the opening into the smoke zone (as shown below).

![Figure 1-3. Confining Smoke with a Large Volume of Air](image)

The draft through the open space keeps back the smoke, confining it to the smoke zone. The amount of air required to keep the smoke from penetrating the open space is quite large. Avoid this type of situation when possible.

To contain smoke by using pressure, you must divide the building into “Smoke Control Zones.” A floor or several floors of the building can be considered a single zone or a single floor can be broken into a number of zones. A zone must be separated from other zones by smoke dampers, airtight doors, and smoke-proof barriers.

When a fire occurs, the smoke control system can then pressurize all of the zones around the zone where the fire initiated (called the “Fire Zone”), isolating the smoke to that single zone.

If the smoke control system is non-dedicated, the layout of the smoke control zones should take into consideration the layout of the HVAC system. You should place multiple areas served by the same HVAC controls in the same smoke control zone. Also, the smoke control zones must conform to any fire control zones that have been established, because the smoke detectors are tied into the fire detection system. Also, keeping the smoke control zones and the fire control zones the same makes it easier to coordinate the two systems.
The following forces affect smoke movement:

**Stack Effect:**
When the outside air temperature is colder than the temperature inside a building, there is often an upward movement of air within the building. This air movement is most noticeable in stairwells, elevator shafts, electrical risers, or mail chutes, and is referred to as “Normal Stack Effect.” This phenomenon is most noticeable in tall buildings during winter, but can occur in a single story building as well.

When the outside air temperature is warmer than the temperature inside a building, there is often a downward movement of air within the building. This air movement is referred to as “Reverse Stack Effect.”

In a building with normal stack effect, the existing air currents can move smoke a considerable distance from the fire origin. If the fire is below the neutral plane of the shaft (i.e., an elevation where the hydrostatic pressure inside the shaft equals the hydrostatic pressure outside the shaft), smoke moves with the building air into and up the shaft. Once above the neutral plane, smoke flows out of the shaft into the upper floors of the building.

**Buoyancy:**
Smoke from a high temperature fire has buoyancy due to its reduced density. In a building with leakage in the ceiling of the fire room, this buoyancy-induced pressure can produce smoke movement. In a fire room with only one opening to the building, air flows into the room while hot smoke flows out of the room. If the fire room has open doors or windows, the pressure difference across these openings is negligible because of the large flow areas involved. However, for a tightly-sealed room, the pressure differences due to expansion may be important.

**Wind:**
Wind can also have a pronounced influence on smoke movement within a building. The effect of wind velocity on the air movement within a well-constructed building is minimal. However, the effects of wind can become important for loosely-constructed buildings or buildings with open doors or windows.

Frequently in fires, a window breaks. If the window breaks on the side of the building away from the wind (the leeward side), the negative pressure caused by the wind vents the smoke from the fire room. This can greatly reduce smoke movement within the building. However, if the broken window is on the windward side of the building, the positive pressure of the wind can force the smoke throughout the fire floor, and possibly to other floors as well. This event can endanger lives and hamper firefighters as well. Wind induced pressures can be quite large and can easily dominate building air movement.

Continued on next page
### HVAC System:

Before the development of smoke control systems, HVAC systems were shut down when a fire occurred. This is because an HVAC system frequently transported smoke during building fires.

In the early stages of a fire, HVAC smoke transport can be a good thing. When a fire starts, the HVAC system can transport the smoke to a location where people can smell it and be alerted to the fire (although they may not know where the smoke is coming from). However, as the fire progresses, the HVAC system transports the smoke to every area that it serves, endangering life in all those places. To make matters worse, the HVAC system also supplies air to the fire, which aids combustion.

Although shutting down the HVAC system prevents it from supplying air to the fire, this action does not prevent the movement of smoke through the supply and return air ducts, air shafts, and other building openings due to stack effect, buoyancy, or wind effect.

### “Smoke Movement Management”

“Smoke Movement Management” includes all of the methods that can be used to modify and control smoke movement for the benefit of the building occupants, firefighters, and for the reduction of property damage. The use of barriers, smoke vents, and smoke shafts are traditional methods of smoke management.

#### Barriers:

The effectiveness of barriers in limiting smoke movement depends on the leakage paths in the barrier and on the pressure differential across the barrier. Holes where pipes penetrate floors or walls, cracks around doors, and cracks in walls or between walls and floors are a few of the places where smoke can leak through a barrier. The pressure differential across these barriers depends on wind, buoyancy, stack effect, and the HVAC system.

#### Smoke Vents and Smoke Shafts:

The effectiveness of smoke vents and smoke shafts depends on their distance from the fire, the buoyancy of the smoke, and the presence of other driving forces. In addition, when smoke is sprinkler-cooled the effectiveness of smoke vents and smoke shafts is greatly reduced.

Elevator shafts in buildings have often been used as smoke shafts. The obvious problem with this is that it prevents the elevator from being used for fire evacuation (because of the “piston effect” of an elevator), and frequently allows the smoke to travel between floors. Specially designed smoke shafts which have no leakage can be used to prevent the distribution of smoke to fire-free floors.

In summary, the effectiveness of barriers in a traditional smoke management system is limited to the extent that the barriers are free of leakage paths. Smoke vents and smoke shafts are limited by the fact that the smoke must have sufficient buoyancy to overcome other forces that may be present.

In the last few years, motorized fans have been used to overcome the limitations of the traditional systems. The systems that employ these motorized fans are called “Smoke Control Systems.” These Smoke Control Systems rely on creating air pressure differences and positive or negative airflows to limit and control the movement of smoke and other noxious gases.
Principles of Smoke Control Systems

**System Types**

Two types of smoke-control systems exist – Dedicated and Non-dedicated.

- **Dedicated Smoke Control System:** Is installed in a building for the sole purpose of controlling smoke.
- **Non-dedicated Smoke Control System:** Uses parts of the building HVAC system to control smoke.

In some cases, a building has both non-dedicated and dedicated systems. Non-dedicated systems are used throughout the building for normal areas such as offices and manufacturing facilities. Dedicated systems are used for special areas, such as elevator shafts, stairwells, stairtowers, and other areas that need special smoke-handling techniques.

Smoke Control System products connect to HVAC equipment to form a system for controlling the flow of smoke during a fire condition. Smoke-control systems are designed, installed, and maintained so that a system remains effective and provides a “Tenable Environment” during evacuation of the protected areas. A “Tenable Environment” as defined in NFPA 92A, is an environment in which the quantity and location of smoke is limited or otherwise restricted to allow for ready evacuation through the space.

**Maintaining System Integrity**

A major concern with any emergency signaling system, whether burglary, fire, or smoke control, is maintaining system integrity. This task is traditionally accomplished by electrical supervision of wiring. However because the proper operation of the fans and dampers connected to the output circuits may involve mechanical controls and pneumatic controls, as well as electrically-actuated parts, end-process verification is provided. The end-process verification is provided to alert the firefighter/operator that the fan or damper has operated in response to an automatic or manual command issued during an emergency condition. While end-process verification confirms operation during an emergency condition, system integrity during a non-emergency (normal supervision) conditions is checked differently depending on whether the equipment is non-dedicated or dedicated.

The operability of the non-dedicated smoke-control equipment is verified by the "comfort level" in the areas that are served by the equipment. In other words, if the HVAC equipment is not functioning properly, the building occupants are soon made aware of this and the problem can be solved.

The operability of the dedicated smoke control equipment is verified by an automatic self-test that is performed on a weekly basis.
The smoke control system is usually separate from the fire control system, since they have different goals. The goal of the fire control system is to contain and extinguish the fire as fast as possible. These systems, which halt the fire but not the smoke, are often triggered automatically, relying on the heat of the fire to activate the system. Although smoke control systems are also automatic, you must have manual overrides for the automatic controls.

A smoke control system may also be required to work with gas-based fire extinguishers, such as gaseous agent systems installed in many computer rooms. If the smoke control system tries to vent a room with such a system, it may vent the fire suppressing gas as well. Removing the gas lets the fire continue burning. Also, pressurizing the areas surrounding an extinguisher equipped room reduces the effectiveness of the system. Air forced into the room from the outside by pressure can provide the fire with the oxygen it needs to continue burning. Therefore, gas-based fire extinguishers and smoke control systems should not be active at the same time in the same area.

The smoke control system receives the location of the fire from the fire panel. The fire panel uses a combination of smoke and heat sensors to determine where the fire is located. As defined in NFPA 92A: In the event that signals are received from more than one smoke zone, the smoke control system will operate in the mode determined by the first signal received.

Specific, zoned smoke control strategies should never be triggered by manual pull boxes. The risk of someone pulling a box someplace other than the fire zone is too high for you to trust your smoke control system to this form of activation.

All smoke control systems installed in buildings must be in accordance with the standards adopted by local codes. You can find additional information regarding fire alarm control units in Underwriters Laboratories Standard UL 864 and the National Fire Protection Association (NFPA ®).
# Designing a Smoke Control System

## Basic Goal

The basic goal of the smoke control system is to maintain a tenable environment. A tenable environment allows:

- The building occupants to evacuate safely from the building.
- The firefighters to get quickly to the fire zone.

## How to Begin

The first step to take in designing a smoke control system is to **lay out the smoke control zones**, as previously explained. After the smoke zones are established, address the following design factors:

- The zone-by-zone smoke control plan.
- The amount of pressure needed to contain smoke.
- Proper separation between zones.
- The fans and duct work used in the smoke control system.
- Dampers required for smoke control.
- The air inlets and outlets used in the smoke control system.

## Engineering Responsibility

Smoke control systems must be engineered by qualified personnel. Complete calculations of system designs are the responsibilities of the Engineer of Record and go beyond the scope of this publication. A high level of coordination is required between the engineers, Authority Having Jurisdiction (AHJ), and system designers who are involved in the process.

## Creating the Zone-By-Zone Smoke Control Plan

You must create a smoke control plan for each zone in your building. Each smoke control zone plan consists of the number of steps the smoke control system must take to contain the smoke in the building zone. For each zone, you must decide:

- Whether you should depressurize the zone if a fire occurs.
- If the zone is to be depressurized, by how much you should depressurize it.
- Which adjacent zones should be pressurized and how much pressure is required.

Some zones in a building may need special consideration. As mentioned earlier, zones that have gas fire extinguisher systems should not be vented (depressurized) and the zones surrounding the fire zone with such a system should not be pressurized. You may not be able to pressurize other areas, such as hospital labs or biological research labs, due to the risk of contaminating surrounding areas with germs or toxins from these facilities.

Consider the number of zones surrounding the fire zone that should be pressurized. While, in theory, all you need to do is to pressurize all of the zones immediately surrounding the fire zone, it is possible that smoke can find a way around the pressurized areas and infiltrate distant zones. Thus, depending on the size of the building and the capacity of the smoke control system, you may decide to pressurize more zones.

**Note:** An increase in the number of zones to be pressurized means a corresponding increase in the size of the air supply system.

Make certain to write down the state that all fans, dampers, and other smoke control equipment should be in to control smoke in each zone. Then program this information into the smoke control system.
Since air pressure is what keeps smoke from spreading, the primary design factors are the amount of pressure needed to confine the smoke, and the size of the system used to create this pressure.

For the smoke control system to create a barrier of air pressure between the smoke zone and surrounding zones, the amount of pressure required varies with the height of the ceiling and whether or not the building has a sprinkler system. The table below gives examples of the minimum pressure differential needed to keep smoke out of rooms surrounding the fire site as defined in NFPA 92A.

**Table 1-1. Examples of Fire Zone Minimum Pressure Differential**

<table>
<thead>
<tr>
<th>Sprinkler System</th>
<th>Ceiling Height</th>
<th>Minimum Pressure Differential (in.)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>Any</td>
<td>0.05 in.</td>
</tr>
<tr>
<td>No</td>
<td>9 ft.</td>
<td>0.10 in.</td>
</tr>
<tr>
<td>No</td>
<td>15 ft.</td>
<td>0.14 in.</td>
</tr>
<tr>
<td>No</td>
<td>21 ft.</td>
<td>0.18 in.</td>
</tr>
</tbody>
</table>

* in. = Inches, Water Gauge

Pressure buildup in an area depends on the amount of leakage. Leakage occurs through joints, cracks, openings for pipes and wires, gaps between doors and their door jams, and so forth. The better the zone is sealed off from neighboring zones, the easier it is to maintain the required pressure. Since larger openings, like normally-open doorways, require large amounts of air to maintain pressurization, you should avoid this type of situation.

You must separate smoke zones from one another by “smoke barriers,” which prevent smoke from passing through them. Smoke barriers can be a wall, a floor, or a ceiling. Any openings in the smoke barrier must be closed with a smoke-proof fitting. For example, any duct work going through a smoke barrier must have “smoke dampers” installed. A smoke damper is a damper that prevents smoke from passing through it when fully closed. During a smoke emergency all of the fittings should seal themselves, so that smoke cannot penetrate the barrier.

Since the smoke control zones should be the same as the fire control zones, you usually separate your zones with a “fire-rated partition.” A fire-rated partition is a wall that is built of fire resistant materials and that reaches from floor to ceiling. Different floors should be separated by a “fire-rated ceiling,” a ceiling made of fire-resistant materials. Both fire-rated partitions and fire-rated ceilings are rated for the amount of time they can withstand a fire. Any openings in a fire-rated partition or ceiling must be capable of being sealed with a fire-rated closure, such as a fire-rated door or fire damper.

The fans and duct work used in the smoke control system must be capable of providing the amount of pressure you calculated earlier. In a non-dedicated system, this may mean that you need to install fans that have a higher capacity than the HVAC system normally requires. The ducts must be capable of taking the pressurization (or the depressurization, for the fire zone's return duct) that the smoke control system demands. Both the fans and the ducts should meet local requirements such as those stated in NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.
Selecting the Proper Fans and Duct Work

Fans must be capable of reaching the required pressure setting within 60 seconds. Each fan must also have a pressure monitor so that the smoke control system can receive feedback on the status of the fan to determine whether it is actually working. It is the responsibility of the system designer to select duct work that meets the temperature and fire ratings for the specific application.

In some climates, the outside air can be so cold that drawing it directly inside the building for pressurization can damage the building's interior fixtures or equipment (e.g., freeze pipes or damage temperature-sensitive equipment). In these cases, some sort of pre-heater needs to be installed on the air inlet. The smoke control system does not need to control this air intake heater as closely as one on an HVAC system, since maintaining comfort levels is not an issue. It simply has to make sure the air sent into an area is warm enough to not damage the building's equipment.

Choosing the Proper Dampers

The dampers used to isolate the smoke zone must be smoke dampers. Smoke dampers are dampers that meet the requirements given in UL 555S, Standard for Leakage Rated Dampers for Use in Smoke Control Systems. Following this standard ensures that the dampers are able to block the smoke when they are fully closed. These dampers may be different from those you might use in an HVAC system that does not perform smoke control.

In a smoke control system, the dampers must be able to travel to their desired setting in a maximum time of 75 seconds (see note below). All dampers must be fitted with end-position switches to provide feedback to the smoke control system. These switches let the control system know the position of the dampers, since smoke dampers are usually either fully-closed or fully-open.

Note: Local codes may specify a shorter maximum time.

Dampers sometimes function as both smoke dampers and fire dampers. Fire dampers are dampers that block a fire from penetrating a fire-rated partition via a duct. These dampers are normally open, held in place by a fusible link. The fusible link is a heat-sensitive device that releases the dampers when it is heated to a certain temperature. Once the fusible link releases, the dampers close by the force of gravity. This is required so that fire dampers operate even if the local electric service has failed. The specifications for fire dampers appear in UL 555, Standard for Fire Dampers.

If you want a damper to function as both a smoke damper and a fire damper, it must meet the requirements for both devices. A damper can be operated by an electric motor or pneumatics. However, it must have a fusible link or some other means of automatic closure (like a regular fire damper). Since the control system can override the damper closure if the temperature warrants, the damper needs the fusible link in case the damper’s automatic control is interrupted.

Placing Air Inlets and Outlets

You need to carefully consider the placement of the air inlets and outlets on your building. If you place an outlet that vents smoke too close to an air inlet, the air intake can draw the smoke back into the building. Since smoke rises, the exhausts that vent smoke should be placed well above air inlets. The exhausts should be placed several feet above the roof level to allow space for the smoke to rise and disperse.

Keeping smoke outlets far away from air inlets does not guarantee that the air brought into the building is always smoke free. You may want to place smoke detectors in air inlets that operate during a smoke emergency.

Note: In some cases, smoke detection in the air inlet is required to have the capability of being overridden by the responding authority after the situation has been investigated.

If the detector finds smoke in the incoming air, it alerts the control system. The control system must then decide whether or not to shut down the air inlet.
Most of the systems discussed so far have been non-dedicated systems. Even in a building where the primary smoke control system is non-dedicated, special zones or functions may exist that require a “dedicated” system. The most common example of a dedicated system is a dedicated smoke control system for a stairtower.

A “stairtower” is a stairwell with a ventilation system that is isolated from the main building. The only connection between the building and the stairtower are fire-rated doors on each floor. Since the building occupants should use the stairtower to leave during an evacuation, keeping the stairtower smoke-free is vital.

A stairtower has its own dedicated system that pressurizes the stairtower to keep smoke out. This dedicated system can take several forms, from a fan mounted in the roof of the stairtower, to a duct system that delivers air to each level.

You must pressurize a stairtower enough to keep smoke out. However, if the pressure in the stairtower is too great, then opening the doors leading into the stairtower can be difficult. (See the figure below.)

![Figure 1-4. The Effects of Too Much or Too Little Pressure](image)
The ideal stairtower smoke control system must pressurize the stairway enough to keep the smoke out, but it must not pressurize it so much that the doors cannot be opened. An example of a dedicated smoke control system for a stairtower is shown in the figure below.

![Diagram of Stairtower Pressurization by Multiple Injections](image)

**Figure 1-5. Stairtower Pressurization by Multiple Injections**

The figure above shows stairtower pressurization by multiple injections with a supply fan located at ground level and an exhaust fan located on the building roof.

The table below shows the maximum allowable pressure differential across a door in inches water gauge (in.) based on how wide the door is and how much force the automatic door closing mechanism exerts as defined in NFPA 92A. At the pressures shown in the table, the door requires 30 lbf (pounds of force) to open, the maximum limit suggested by the NFPA *Life Safety Code* (NFPA 101).

<table>
<thead>
<tr>
<th>Door Closer Force (lbf)</th>
<th>32 in.</th>
<th>36 in.</th>
<th>40 in.</th>
<th>44 in.</th>
<th>48 in.</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>0.45</td>
<td>0.40</td>
<td>0.37</td>
<td>0.34</td>
<td>0.31</td>
</tr>
<tr>
<td>8</td>
<td>0.41</td>
<td>0.37</td>
<td>0.34</td>
<td>0.31</td>
<td>0.28</td>
</tr>
<tr>
<td>10</td>
<td>0.37</td>
<td>0.34</td>
<td>0.30</td>
<td>0.28</td>
<td>0.26</td>
</tr>
<tr>
<td>12</td>
<td>0.34</td>
<td>0.30</td>
<td>0.27</td>
<td>0.25</td>
<td>0.23</td>
</tr>
<tr>
<td>14</td>
<td>0.30</td>
<td>0.27</td>
<td>0.24</td>
<td>0.22</td>
<td>0.21</td>
</tr>
</tbody>
</table>

Continued on next page
Table 1-2 assumes a door height of seven feet and a distance from the doorknob to the knob side of the door of three inches. If your door does not meet these requirements, or has opening hardware other than a doorknob, such as panic hardware, then refer to the ASHRAE publication *Design of Smoke Control Systems for Buildings* for a formula to calculate the proper opening force. The door widths in Table 1-2 are only valid for doors that are hinged at one end. For other types of doors, see the ASHRAE document.

Many door closers vary the amount of force as the door opens. They provide less resistance in the early stages of opening the door than they do later, when the door is almost fully open. The force to open the door shown in Table 1-2 represents the force needed to open the door only enough to let air flow through the opening. Once air is able to flow, the force exerted by the difference in air pressure on the door lessens. Therefore, when calculating the force required to open the door, you may need to lower the door closer force.

Stairtower smoke control systems are divided into two categories: “non-compensated” and “compensated.” These categories are illustrated in the figure below, which shows stairtower pressurization by top injection. Non-compensated systems simply turn on a fan to pressurize the stairtower, as shown below in Stairtower A. The fan speed does not change to compensate for doors opening and closing. The more doors that are open, the more the pressure differential between the stairtower and the building drops.

*Figure 1-6. Non-Compensated and Compensated Stairtower Systems*

*Continued on next page*
The building shown in Figure 1-6, Stairtower A has no vent to the outside. Compensated systems adjust the airflow to make up for pressure lost through open doors. A compensated system (Figure 1-6, Stairtower B) can use dampers (or vents) to relieve excess pressure in the stairtower to ensure that the pressure does not go over the maximum limit.

There are a number of ways compensated stairtower smoke control systems can control pressurization. In a basic system with a roof-mounted fan blowing air into the stairtower, pressure can be regulated by varying the speed of the fan, the pitch of the fan blade, the inlet vanes, or the number of fans operating (assuming there is more than one).

More sophisticated systems use ducts to deliver air to several points in the stairtower. The dampers can be controlled to maintain the appropriate pressure in their zone. Duct systems can also use bypass dampers and ducts to control the amount of air flowing from the fan to the outlets. The bypass dampers are opened when the stairtower is at the proper pressure, so that excess air flows into the bypass duct, then back to the air inlet not into the duct system.

The figure below shows a stairtower pressurization system that uses multiple pressure injection dampers mounted in an air pressure duct. In this example, the vents to the building have barometric dampers. While a roof-mounted fan is shown in the figure, the fan can be located at any level. A manually-operated damper may be located at the top of the stairtower to aid the fire department in purging smoke from the building during a fire.

Figure 1-7. Stairtower Pressurization by Multiple Injections (Roof-Mounted Fan)
The figure below shows a bypass pressure control system for stairtower pressurization with the bypass-around supply fan located at ground level. Although a ground-level fan is shown, the fan can actually be placed at any level. The bypass duct dampers are controlled by one or more static pressure sensors located between the stairtower and the building. In addition, a manually-operated damper may be located at the top of the stairtower for smoke purging by the fire department.

There are several ways for a compensated stairtower smoke control system to get rid of excess air pressure to ensure that the stairtower doors can open properly. One or more vents to the building exterior (with dampers) can be used in the stairtower to release excess pressure. These dampers can be barometrically controlled (being forced open by the excess air pressure) or controlled by electric motors or pneumatics as in conventional HVAC systems. In both cases, the dampers must be placed far enough away from the air supply to prevent venting of air that has not yet been able to disperse through the stairtower. Vents can also lead into the building, but you should consider carefully the impact of venting extra pressure into the building before using this type of vent.

You can also use an exhaust fan to vent the excess pressure from the stairtower. Such a fan should be designed to operate only when the stairtower is over-pressurized. It should never be on when the pressure differential between the building and the stairtower is below the lowest limit.
Most elevators do not have smoke protection, fire protection, or other features necessary for them to be considered as a means for fire evacuation. Elevator systems not specifically designed and built for fire evacuation should not be used in fire situations.

The elevator smoke control system is intended to prevent smoke flow to other floors by way of the elevator shaft. Elevator shafts present a special menace with regards to smoke control. An elevator shaft makes a perfect chimney to draw smoke into the upper levels of a building. Since elevators usually have openings on each floor, and the seals on the elevator doors are often poor, the elevator shaft can become a mechanism to spread smoke throughout a building. Smoke control in an elevator shaft is an important consideration in the overall smoke control plan. The problems resulting from smoke migration through elevator shafts are illustrated by the MGM Grand Hotel fire. Although the fire occurred on the ground floor, the smoke from that fire migrated through the elevator shafts to the upper floors resulting in a number of fatalities.

An obvious solution to this problem is to pressurize the elevator shafts, as shown in the figure below. However, pressurizing an elevator shaft presents a number of problems. While the elevator doors can be fitted with improved seals and rubber sweeps, these systems will not totally eliminate air leakage. Also, most elevator shafts are not designed to be pressurized. They often have large openings at the top where the cables feed into the winding room. Shafts are often constructed of porous material that cannot contain the air pressure. And since most shafts are not designed to be inspected after the elevators are installed, finding and repairing cracks that would let smoke infiltrate or pressure escape is difficult.

Even if the shaft is pressurized, another primary problem is caused by the transient pressures produced when an elevator car moves inside the shaft during a smoke emergency. This “piston effect” can pull smoke into a normally pressurized elevator lobby or elevator shaft. For example, an elevator car moving down from the top of the shaft may create a small low air pressure zone near the top of the shaft, which can pull smoke from the fire zone into the shaft.

At the present time, these issues have not been resolved. Pressurizing the elevator shafts so that the elevators can operate during a smoke emergency is still being studied.

**IMPORTANT:** In general, elevators should not be used as an escape route during an evacuation.
The fire detection system is the system that is connected to the smoke or heat detectors. Every smoke zone should have a Listed smoke or heat detector installed in it. The detectors should be located so that they can detect the presence of smoke or fire before it spreads beyond the zone. Once the fire control system detects the fire, it relays to the smoke control system the zone and the type of alarm that was triggered. The smoke control system then takes action.

Never use manual pull stations to initiate specific zoned smoke control. There is no guarantee that the person pulling the alarm is in the same smoke zone as the fire. The automatic smoke control system should take only those actions that are common to all smoke strategies when a manual pull station is activated. For example, the stairtower can be pressurized in response to a manual pull box alarm. Implementing a specific smoke control strategy must wait until the smoke detectors locate the fire zone.

The smoke control system should be able to act on its own in response to detecting smoke. When it detects smoke, the system enacts the planned strategy of the designer. The automatic smoke control system should maintain the strategy to control smoke in the first zone that smoke is detected in. It would be difficult for you to create strategies for controlling smoke in all possible combination of zones.

The automatic smoke control system must have the highest priority over all other automatic control systems in the building. It must override energy management, occupancy schedules, or other controls. The only systems that should be able to automatically override the smoke control system are such safety systems as high pressure limiters.

Considering how unpredictable smoke is, you must have a manual control panel from which the smoke control system can be monitored and overridden. This panel, called a “Firefighter's Smoke Control Station” (FSCS), allows fire-fighting personnel to take manual control of the smoke control system.

The FSCS is a graphic annunciating control panel that gives firefighters information about the state of the smoke control system, as well as manual control over all of its components. The FSCS should be located in a secure room or cabinet to prevent unauthorized personnel from tampering with it. The room or cabinet should be clearly marked so that firefighters can quickly locate the FSCS.

The FSCS panel has a diagram of the building showing the entire smoke control system, along with status lights and override switches for all of the system components. The diagram of the building should include all smoke control zones, all of the ducts leading to and from the zones with arrows indicating the direction of air flow in the ducts, and a clear indication of which zone each piece of equipment serves.

The panel must have controls to activate all fans, dampers, and other equipment related to the smoke control system. These manual controls must be able to override all automatic control of smoke control equipment. In particular, the FSCS must be able to override:

- Hand/off/auto switches.
- Local start/stop switches on fan motor controllers.
- Freeze detection devices.
- Duct smoke detectors.
The FSCS must not override such safety controls as:

- Electrical overload protection.
- Electrical disconnects as required by NFPA 70.
- Other controls in accordance with UL 864.
- Any fire/smoke damper thermal control as required by UL 33, Standard for Heat Responsive Links for Fire Protection Service or UL 555S, Standard for Leakage Rated Dampers for Use in Smoke Control Systems.

In non-dedicated systems, local motor controller hand/off/auto switches can remain in-circuit with the FSCS panel. But, they can remain in-circuit only if the switches are in a locked room accessible only to authorized personnel. Also, if such a switch is thrown, a trouble condition must sound in the building main control center. The indicator lights on the FSCS provide information about the functioning of the system.

The following colors for example are used for FSCS indicators:

- **Green** - Smoke-control fans and other critical-operation devices are running or the dampers are open.
- **Yellow** - Dampers are in the closed position.
- **Orange or Amber** - The equipment has failed.
- **Red** - A fire has been detected in the area.

The FSCS has a lamp test button that turns ON all the panel lights. Use this button regularly to make sure none of the lights has burned out. The FSCS gets information on the status of the smoke control system equipment from proof monitors on the equipment itself. Each fan that has a capacity of over 2,000 cfm should be equipped with an airflow monitor. A proof sensor is required to monitor airflow and the position of the blade or vane in a damper is also required to be monitored. Smoke dampers should be fitted with end-range switches to indicate that they are fully-opened or fully-closed.

All of the failure lights on the FSCS represent the state of the equipment as determined by the proof sensors. The failure light comes on if the piece of equipment is not in the state its control is set for within its trouble indication time. This time is a maximum of 60 seconds for a fan (see note) and a maximum 75 seconds for a damper. If, within that time, the proof sensors do not report that the piece of equipment has responded to the control system command, the FSCS indicates that the piece of equipment has failed.

**Note:** Local codes may require shorter maximum times. The 60 second maximum time for the fan must also account for ramp down time.

During the installation, you should perform “operational tests” that make sure the components and subsystems of the smoke control system are installed correctly. After the installation is done, you must perform “acceptance tests,” to prove that the smoke control system is capable of doing what it was designed to do. The testing procedures are covered in a later chapter of this document.

The following is a list of additional documentation that may aid you in understanding and designing Smoke Control Systems.

- Underwriters Laboratories, Inc., UL 864, Control Units and Accessories for Fire Alarm Systems.
- Underwriters Laboratories, Inc., UL 555, Fire Dampers.
Chapter 2
Smoke Control Design Parameters

Introduction
This chapter presents the general design parameters for Simplex Smoke Control System equipment.

In this Chapter
Refer to the page number listed in this table for information on a specific topic.

<table>
<thead>
<tr>
<th>Topic</th>
<th>See Page #</th>
</tr>
</thead>
<tbody>
<tr>
<td>System Requirements</td>
<td>2-2</td>
</tr>
<tr>
<td>System Design Parameters</td>
<td>2-3</td>
</tr>
</tbody>
</table>
The Simplex Smoke Control System has the following general requirements:

- A smoke control system is a complete system engineered for a particular installation.
- Electrical supervision is required up to the input of the trunk-connected devices involved with the electrical sensing and control of HVAC devices.
- The interconnection of the smoke control equipment to the HVAC equipment, and to other system equipment, is intended to be in accordance with a specific installation diagram that is generated by either the smoke control equipment manufacturer or by another responsible party.

Equipment for Smoke Control Systems is to be listed to Underwriters Laboratories category UUKL per the requirement of UL 864, *Control Units and Accessories for Fire Alarm Systems*. Additionally, system equipment must be in accordance with locally adopted codes such as NFPA 92A and the pertinent building codes.

Some of the smoke control considerations are as follows:

- **Standby Power** - Standby power for Simplex Smoke Control System Equipment is optional, however if the equipment also provides fire alarm service then standby power would be required.
- **Smoke Control Actuating Input Circuits** - The circuits which connect to devices which initiate automatic smoke control must consist of one of the following:
  - A supervised fire alarm initiating circuit of a Fire Alarm Control Unit which is also providing smoke control.
  - A supervised circuit connected to a zone output of a UL Listed Fire Alarm Control Unit.
  - An unsupervised circuit connected to a zone output of a Listed Fire Alarm Control Unit with each unit mounted adjacent (within twenty feet) to the other and the interconnecting wiring run in conduit.
- **Firefighter’s Smoke Control Station** - Each system must also provide a Firefighter’s Smoke Control Station (FSCS) as defined in NFPA 92A. The FSCS provides a complete and easily understood system status, with provisions for manually overriding any smoke control process.

The contents of this document are derived from Standard NFPA 92A *Recommended Practice for Smoke-Control Systems*. Additional construction and reliability concerns, not covered in NFPA 92A, are derived from similar requirements governing Fire Alarm Control Units as found in UL Standard 864. Detailed engineering design information is contained in the ASHRAE publication, *Design of Smoke Management Systems*. 

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### General Requirements

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### Agency Requirements

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<thead>
<tr>
<th>Agency Requirements</th>
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<tbody>
<tr>
<td>Equipment for Smoke Control Systems is to be listed to Underwriters Laboratories category UUKL per the requirement of UL 864, <em>Control Units and Accessories for Fire Alarm Systems</em>. Additionally, system equipment must be in accordance with locally adopted codes such as NFPA 92A and the pertinent building codes.</td>
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</tr>
<tr>
<td>- <strong>Smoke Control Actuating Input Circuits</strong> - The circuits which connect to devices which initiate automatic smoke control must consist of one of the following:</td>
</tr>
</tbody>
</table>
  - A supervised fire alarm initiating circuit of a Fire Alarm Control Unit which is also providing smoke control. |
  - A supervised circuit connected to a zone output of a UL Listed Fire Alarm Control Unit. |
  - An unsupervised circuit connected to a zone output of a Listed Fire Alarm Control Unit with each unit mounted adjacent (within twenty feet) to the other and the interconnecting wiring run in conduit. |
| - **Firefighter’s Smoke Control Station** - Each system must also provide a Firefighter’s Smoke Control Station (FSCS) as defined in NFPA 92A. The FSCS provides a complete and easily understood system status, with provisions for manually overriding any smoke control process. |
| The contents of this document are derived from Standard NFPA 92A *Recommended Practice for Smoke-Control Systems*. Additional construction and reliability concerns, not covered in NFPA 92A, are derived from similar requirements governing Fire Alarm Control Units as found in UL Standard 864. Detailed engineering design information is contained in the ASHRAE publication, *Design of Smoke Management Systems*. |
The means for verifying system integrity during a non-emergency condition varies depending on whether the smoke control system is a “dedicated” or a “non-dedicated” system.

- **Dedicated Smoke Control Components**: Solely used for smoke control functions and are not operated in a non-emergency condition. Dedicated system equipment is therefore required to incorporate an automatic weekly self-test of each smoke control function.

- **Non-dedicated Smoke Control Components**: HVAC components within a building which are operated regularly. The normal “comfort” level associated with the proper operation of the equipment serves as the means of maintaining system integrity.

The weekly self-test consists of the smoke control system automatically commanding the associated function to operate and expecting, within a specified time, that the associated proof sensor will operate. A valid proof sensor operation does not have to be annunciated. However, the lack of an expected proof sensor operation should produce an audible trouble signal and indicate the specific device which did not operate.

Smoke control system equipment must verify that a fan or damper has achieved its required end function during emergency conditions. This end-process verification consists of monitoring fans by vane or pressure differential switches, and dampers by degree-of-opening switches. These monitored switches are further connected back to an input monitoring circuit of the Smoke Control System Equipment, programmed to expect a signal within a specified time after an automatic or manual activation. Annunciation of the end-process verifies that the process operates as intended; if the proof sensors fail to operate, an audible trouble signal is sounded.

Where equipment used for smoke control is also used for normal building operation, control of this equipment must be preempted or overridden as required for smoke control. Automatic activation of systems and equipment for zoned smoke control must have the highest priority over all other sources of automatic control within the building. This equipment includes air supply/return fans and dampers subject to automatic control according to building occupancy schedules, energy management, or other purposes. The following controls **should not be automatically overridden**:

- Static pressure high limits.
- Duct smoke detectors on supply air systems.
Once an automatic activation has occurred, subsequent alarm signals that would normally result in the automatic actuation of a smoke control strategy shall be annunciated only. No fans or dampers should be actuated in response to any subsequent automatic fire alarm signal in order to avoid the possibility of defeating any smoke control strategies that are in process.

Activation of the smoke control system should be by smoke detectors and any other automatic devices located within the zone covered by the specific air conditioning and ventilating system. Manual fire alarm pull boxes should not be used to initiate specific zoned smoke control strategies because such a pull box in an adjacent smoke zone may be pulled, thereby placing the system in an incorrect mode.

It is desirable that the smoke control system be independently controlled from a smoke control center which should have controls capable of overriding all other HVAC systems. A manual command is capable of overriding either fully or partially any automatic activation that may be in process. This is based on the assumption that any manual activation is performed by authorized personnel in response to a known emergency condition.

Since smoke control operation must override any programmed HVAC function, it is considered acceptable for the “Initial Automatic Activation” to override any manual control, initiated by any other operator terminal other than the FSCS, which is currently in place.

NFPA Standard 92A requires that manual control initiated by the FSCS take precedence over automatic control. Therefore, the smoke control system automatic programmed functions do not override a manual FSCS control when a smoke control operation is initiated.

**Example:** When a switch at the FSCS is operated, the control point is activated or deactivated at a priority higher than the automatic smoke control program or any other operator terminal priority. This prevents the automatic smoke control program or manual commands from other operator terminals from overriding commands initiated at the FSCS.
Chapter 3
Smoke Control System Components

Introduction

This chapter presents a general overview of the Simplex Smoke Control System. It describes the UL-listed components used, the features of each component, and the role of these components within the system.

In this Chapter

Refer to the page number listed in this table for information on a specific topic.

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<td>4190 TrueSite™ Workstation System and 24 Point I/O Graphic Interface</td>
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<tr>
<td>Optional and Peripheral System Components</td>
<td>3-5</td>
</tr>
<tr>
<td>Firefighter’s Smoke Control Station</td>
<td>3-7</td>
</tr>
</tbody>
</table>
A typical Simplex smoke control system is shown below:

![Diagram of a Typical Network Smoke Control System]

**Figure 3-1. Typical Network Smoke Control System**

The following major components are used in the Simplex Smoke Control System:

- 4100U/4100ES Control Panel (used as the system controller).
- 4190 TrueSite Workstation System (TSW).
- Firefighter’s Smoke Control Station (FSCS).

These components are described in the following sections.
The 4100U or 4100ES panel serves as the system controller for the Simplex Smoke Control System. It controls the communications between the other system components within the smoke control system. This panel can be used in a dedicated or a non-dedicated smoke control application. The 4100U/4100ES connects to other panels in the following ways:
- The panel can connect to other Simplex Fire Alarm Control Panels via network communications.
- The panel can also connect to the FSCS using Remote Unit Interface (RUI) serial supervised communications channel connections.

The Master Controller provides system control, synchronization, and supervision of all modules, continuously scanning each module for status changes. Features include:
- **Operator Panel** with LCD and operator keys.
- **Battery Charger** for up to 125 Ah Batteries.
  - Batteries up to 50 Ah may be mounted in the bottom of the control cabinet
  - Batteries larger than 50 Ah mount external to main control cabinet
- **Compatible with Lead Acid or NiCad Batteries**
- **System Power Supply** (SPS), Power Limited:
  - Supplies 9 A of alarm current and 5 A of standby current.
  - Two Class A or Class B NACs rated at 3 A each. Supports TrueAlert non-addressable A/V operation without synch cube.
  - One 24 V auxiliary power tap, under software control.
  - Charges 125 Ah batteries per UL 864; 55 Ah batteries per ULC S527.
  - LCD readout of system voltage and current, battery voltage and current, and NAC current.
  - Integral 250 point IDNet™ channel.
  - AC input is 4A @ 120 VAC, 60 Hz; 2A @ 220/230/240 VAC, 60 Hz.
  - Includes one relay, DPDT, 2A @ 32 VDC
  - Landing point and control interface for optional two circuit City Card or three circuit Relay Card. City Card is Reverse Polarity or Local Energy, configurable for alarm, trouble, and supervisory.

**General Operating Specifications**
- **Humidity:** Up to 93% RH, Non-Condensing @ 90° F (32° C) Maximum
- **Temperature:** 32° F to 120° F (0° C to 49° C)
The 4190 TrueSite Workstation (TSW) provides a graphical user workstation within the Simplex Smoke System. You can interact with the smoke control system by entering input through a keyboard, mouse, or touch-screen.

**Note:** If a TSW is used in the system, a Firefighter’s Smoke Control Station must be provided and this station must initiate smoke control commands at the highest priority.

**Graphic Screens:**

TSW graphic screens can provide easily recognizable site plan and floor plan information. The level of detail can be customized for the specific facility to easily and accurately direct the operator to the immediate area of interest.

Icons can be optionally added to identify the exact device of interest and the operator can utilize TSW Pan and Zoom capabilities to move to a specific screen location for more detail.

When a system status change occurs, the screen displays the type and location of the activity. The operator then touches the appropriate screen area (or uses the mouse control) to access a more detailed view of the zone or device.

For example, the figure below shows some of the information available when viewing a point that represents a VESDA® early warning air aspiration smoke detector.

**Figure 3-2. TSW Screen Showing VESDA® Information**

The 24-Point I/O Graphic Interface (4100-7401) has the following features:

- Each of the 24 points can be individually configured as either an input (e.g., switch) or output (e.g., lamp or relay).
- 150 mA output (+24 VDC supervised for LED, incandescent, or relay operation).
- Outputs can be steady, slow pulse, or fast pulse.
- Switch inputs can monitor two position or three position switches.
- Lamp test input.
- Provides supervised monitoring and/or control for smoke control applications.
Optional and Peripheral System Components

The following components may also be used in the Simplex Smoke Control System:

- Network Display Unit (NDU).
- 4010 Fire Alarm Control Panel (FACP).
- LCD Annunciator.

**Note:** The designated FSCS must initiate smoke control commands at the highest priority.

The figure below shows these optional components:

*Figure 3-3. Optional Smoke Control System Components*
In addition to the components previously described, a Simplex Smoke Control System also contains one or more of the following addressable or conventional components:

- Smoke Detection Device
- Duct Smoke Detection Relay
- Individual Addressable Module (IAM, Single or Multi-point)
- Zone Addressable Module (ZAM, Monitor or Control)
- System Accessories (Printer, PC Annunciator, etc.)
The figure below shows a view of a typical Firefighter’s Smoke Control Station (FSCS) used with the Simplex Smoke Control System. FSCS panels are custom designed for each building. See the “FSCS Ordering Information” section later in this chapter.

Figure 3-4. Firefighter’s Smoke Control Station

Continued on next page
The smoke control panel must work completely in conjunction with the fire alarm control panel. This is because the FSCS is used by firefighters to activate and deactivate all smoke control sequences in the event that the fire spreads and for smoke cleanup operations. All switches override the automatic operation, in the event of a conflict with the operation. The FSCS must be able to override any other manual or automatic control that is being used in the system, except when those controls intended to protect against electrical overloads, provide for personal safety, or prevent major system damage.

The design of the controls and status indications must be as simple as possible for firefighter use. Smoke control schemes can sometimes incorporate the simultaneous use of multiple (sometimes over a hundred) air handling units, exhaust fans, and dampers to accomplish the function.

The FSCS graphic must show all fans in excess of 2000 CFM, all dampers or groups of Variable Air Volume (VAV) boxes, and all major ducts. The FSCS graphic must depict the direction of airflow in the ducts. The air handling units, fans, and dampers must be grouped into “systems” or “smoke zones.” These “smoke zones” are determined by the physical layout of the building and the smoke and fire barriers as structurally and architecturally designed, for firefighting purposes.

It may be advantageous to provide one switch for each “system” or “smoke zone.” With the appropriate units interlocked to manage smoke in the affected area, there could be potentially hundreds of H-O-A switches. Fans require a three-position control that provides ON-AUTO-OFF capabilities. Dampers require a three-position control that provides OPEN-AUTO-CLOSE capabilities. The AUTO position can be removed if the piece of equipment can only be controlled by the FSCS.

Smoke Management zones can be provided with a three-position switch, in addition to the required switches, that provides PRESSURIZE-AUTO-EXHAUST capabilities. Status indications are required for each system to positively indicate that a smoke control sequence has been initiated. Fans must have a single green indicator that turns on when the fan proof sensor indicates that the fan is running.

Dampers have three indicators:

- **Yellow**: Turns ON when the damper proof sensor confirms that the damper is closed
- **Green**: Turns ON when the damper proof sensor confirms that the damper is open
- **Amber**: Turns ON to indicate failure.

These indicators must be OFF when the damper is between the open and closed position.

The FSCS must have a Red indicator for each smoke control zone to signal if the zone is currently in an alarm condition.

The FSCS must have Amber/Orange indicators to annunciate equipment faults from each piece of equipment monitored by proof sensors. If fans do not indicate running within 60 seconds, or dampers do not reach the required position within 75 seconds, a fault indication must be annunciated on the FSCS.

**Note:** Confirm actual times with local codes.

The FSCS must have a “master key-switch” to prevent unauthorized personnel from issuing commands. When the key is inserted and turned, all controls on the FSCS are enabled. Alternate command control may be performed by being inside a locked enclosure or other access control means that are accepted by local authority.
The FSCS must have an audible signal that sounds when either a smoke control zone is in alarm or to bring attention to a fault indicator. Operating the key-switch and then pressing the audible silence button is the only method of silencing the FSCS audible signal.

The FSCS must have an “Audible Silence Button.” This momentary push-button is activated only when the master key-switch is ON. This button is used to silence the FSCS audible signal that activated as a result of proof sensors failing to report or annunciation of smoke detection within the FSCS smoke control zones.

The FSCS must have a means to turn OFF equipment fault indicators that were activated as a result of proof sensors failing to report within the required time period. If a “Clear Faults Button” or similar means to clear faults, is used it would be active only when the master key-switch is ON. An alternate means may be by logging in at an authorized level at the Fire Alarm Control Panel and then clearing the faults.

The FSCS must have a “Lamp Test Button.” This momentary push-button is active at all times to turn ON all indicators to allow for visual confirmation of failed indicator LEDs.

**Note:** Refer to Chapter 4 for a list of Simplex Field Wiring Diagrams and Interconnection Diagrams that can assist you in installing the Simplex Smoke Control System.

A Firefighter’s Smoke Control Station (FSCS) consists of a site-specific, customized floor plan or elevation graphic, illuminated status indicators, and switches. The FSCS uses Simplex LED drivers and switch input modules (Models 4100-7401 through -7404 and 4602-7101) that communicate with the 4100U/4100ES FACP by means of a supervised RUI communications channel. The Models 4100-7401 through -7404 and 4602-7101 have been found suitable for use as components internal to a UL-Listed FSCS manufactured by others.

There are several suppliers of UL-listed FSCS. Below are references to two manufacturers known to have UL Listed FSCS equipment utilizing Simplex LED drivers and switch modules when this document was published. Since manufacturer's Listing compliance may change, always verify smoke control system equipment listing compliance of the FSCS before placing your FSCS order:

- The H.R. Kirkland Company Inc.
  4935 Allison Street, Unit 13
  Arvada, CO 80002
  1-303-422-6670
  1-800-247-2303
  Fax: 1-303-420-1856
  www.hrkirkland.com

- Space Age Electronics, Inc.
  406 Lincoln Street
  Marlboro, MA 01752-2195
  1-508-485-0966
  1-800-486-1723
  Fax: 1-508-485-4740
  www.1sae.com

To build an FSCS panel to your project specifications:

- Specify the size requirement of your FSCS.
- Coordinate the FSCS box requirements with the vendor.
- Provide an approved drawing of the desired FSCS graphic.
- Specify the type of Simplex graphic modules to be connected to the FSCS.

**Note:** Graphic vendors provide mating connectors for the graphic interface modules from a Simplex controller.
The Fire Alarm Control Panel connects to all of the smoke detectors, manual pull boxes, fire alarms, etc. within the building. When one of the FACP sensors detects a problem, the FACP informs the smoke control panel which sensor is in alarm condition and what the alarm condition is. The smoke control system receives all alarm information from the FACP. However, the smoke control zones must correspond to the zones of the FACP.
Chapter 4
Installing the Smoke Control System

Introduction

This chapter contains general guidelines for smoke control installations and interconnections. Please refer to the applicable installation documents for component installation instructions. These documents are shipped with the individual components.

All wiring in the Simplex Smoke Control System must comply with the National Electric Code (NFPA 70), the National Fire Alarm Code (NFPA 72), the appropriate Simplex Field Wiring diagrams (refer to the “Field Wiring and Interconnection Diagrams” section of this chapter) and any state or local requirements.

In this Chapter

Refer to the page number listed in this table for information on a specific topic.

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<tr>
<td>Non-Dedicated Smoke Control System Wiring Diagrams</td>
<td>4-10</td>
</tr>
</tbody>
</table>
General Smoke Control Interconnections

Overview

A Simplex Smoke Control System is usually part of a larger Simplex Fire Alarm System. The Simplex Smoke Control System ties into the building air handling equipment, either dedicated, non-dedicated, or both, to form the overall Smoke Management system for the building.

Since Simplex equipment is not the primary control equipment for a building's non-dedicated air handling equipment, the interconnection between the Simplex Smoke Control System and the non-dedicated air handling equipment is critical. This interconnection must be done in such a manner to guarantee that the Smoke Control System takes priority, and that Smoke Control System commands cannot be overridden by other building systems.

Although every application is different, the sections that follow describe some typical methods for interconnecting to air handling elements to insure that Smoke Control System commands take precedence and that accurate monitoring of the air handling system is fed back into the Smoke Control System. Fan and damper control are shown in some detail to illustrate principles that can be extrapolated to other more special purpose applications. These principles should be generally applied to the detailed design of specific engineered smoke control solutions.

Smoke Control System operation is dependent both on the hardware and the control software. The wiring diagrams shown in this chapter, must be used with appropriate programming to create an operational control system.
General Smoke Control Interconnections, *Continued*

The following table lists the UUKL addressable monitor/control devices for the 4100U or 4100ES system.

### Table 4-1. UUKL Addressable Monitor/Control Device List for 4100U/4100ES

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>IDNet™</th>
<th>MAPNET II®</th>
<th>See Doc #</th>
</tr>
</thead>
<tbody>
<tr>
<td>4090-9001</td>
<td>Supervised IAM, single address, single point; IDNet and 4100U/4100ES provide &quot;T&quot; sense (current limited monitoring); MAPNET II and 4100U/4100ES provide simple N.O. Class B monitoring.</td>
<td>✔️</td>
<td>✔️</td>
<td>574-331</td>
</tr>
<tr>
<td>4090-9002</td>
<td>Relay IAM, single address, single point; Form &quot;C&quot; with relay status tracking.</td>
<td>✔️</td>
<td>—</td>
<td>574-184</td>
</tr>
<tr>
<td>4090-9101</td>
<td>Class B monitor ZAM.</td>
<td>✔️</td>
<td>✔️</td>
<td>574-183</td>
</tr>
<tr>
<td>4090-9106</td>
<td>Class A monitor ZAM.</td>
<td>✔️</td>
<td>✔️</td>
<td>574-183</td>
</tr>
<tr>
<td>4090-9118*</td>
<td>Relay IAM with T sense input, single address, dual point, relay and input.</td>
<td>✔️</td>
<td>—</td>
<td>574-874</td>
</tr>
<tr>
<td>4090-9119*</td>
<td>Relay IAM with unsupervised input, single address, dual point, relay and input.</td>
<td>✔️</td>
<td>—</td>
<td>574-875</td>
</tr>
<tr>
<td>4090-9120*</td>
<td>Six point module; four T sense inputs, 2 relays; one address.</td>
<td>✔️</td>
<td>—</td>
<td>574-876</td>
</tr>
<tr>
<td>4100-7401</td>
<td>24 Point I/O Graphic Module.</td>
<td>—</td>
<td>—</td>
<td>841-802</td>
</tr>
<tr>
<td>4100-7402</td>
<td>64/64 LED/Switch Controller.</td>
<td>—</td>
<td>—</td>
<td>841-802</td>
</tr>
<tr>
<td>4100-7403</td>
<td>32 Point LED Module</td>
<td>—</td>
<td>—</td>
<td>841-802</td>
</tr>
<tr>
<td>4100-7404</td>
<td>32 Point Switch Module</td>
<td>—</td>
<td>—</td>
<td>841-802</td>
</tr>
<tr>
<td>4602-7101</td>
<td>Graphic I/O, RCU/SCU (Remote Control Unit/Status Control Unit, selectable operation).</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
</tbody>
</table>

### Table 4-2. MAPNET II UUKL Addressable Monitor/Control Device List for 4100U/4100ES

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>IDNet™</th>
<th>MAPNET II®</th>
<th>See Doc #</th>
</tr>
</thead>
<tbody>
<tr>
<td>2190-9153</td>
<td>Class A Monitor ZAM, surface mount.</td>
<td>—</td>
<td>✔️</td>
<td>574-668</td>
</tr>
<tr>
<td>2190-9154</td>
<td>Class A Monitor ZAM, flush mount.</td>
<td>—</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>2190-9155</td>
<td>Class B Monitor ZAM, surface mount.</td>
<td>—</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>2190-9156</td>
<td>Class B Monitor ZAM, flush mount.</td>
<td>—</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>2190-9159</td>
<td>Class A Signal ZAM, surface mount.</td>
<td>—</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>2190-9160</td>
<td>Class A Signal ZAM, flush mount.</td>
<td>—</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>2190-9161</td>
<td>Class B Signal ZAM, surface mount.</td>
<td>—</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>2190-9162</td>
<td>Class B Signal ZAM, flush mount.</td>
<td>—</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>2190-9163</td>
<td>Control Relay ZAM, surface mount.</td>
<td>—</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>2190-9164</td>
<td>Control Relay ZAM, flush mount.</td>
<td>—</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>2190-9173*</td>
<td>2-Point I/O Module supervised input and relay output; two sequential addresses.</td>
<td>—</td>
<td>✔️</td>
<td>574-995</td>
</tr>
</tbody>
</table>

* Devices designed specifically for Smoke Control Applications.

Note: These are common smoke control system components and do not include other commonly used fire detection components such as pull stations, heat detectors, and initiation and notification appliances.
For wiring details on the devices shown in the following sections, refer to the following reference information shown below:

- MAPNET II/IDNet Devices Field Wiring Diagram ....................... 841-804
- 4020/4100 Graphic Annunciator Field Wiring Diagram ................. 841-802
- 4100ES Fire Alarm System Installation Instructions ..................... 574-848

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General Smoke Control Interconnections, *Continued*
The figure below shows an application diagram for a four-story building. This figure illustrates how the elements of the Smoke Control System are architecturally related, how they fit within the overall Simplex Fire Alarm System, and how they relate to the building air handling systems.

<table>
<thead>
<tr>
<th>Figure Legend</th>
<th>Description</th>
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<tr>
<td>FACP</td>
<td>Fire Alarm Control Panel (e.g., Model 4100U as described in Chapter 3).</td>
</tr>
<tr>
<td>FSCS</td>
<td>Firefighter's Smoke Control Station (as described in Chapter 3).</td>
</tr>
<tr>
<td>TSW</td>
<td>TrueSite Workstation System (e.g., Model 4190 as described in Chapter 3).</td>
</tr>
<tr>
<td>C</td>
<td>Relay IAM with Feedback (e.g., Model 4090-9118).</td>
</tr>
<tr>
<td>M</td>
<td>Supervised IAM (e.g., Model 4090-3001).</td>
</tr>
<tr>
<td>D</td>
<td>HVAC damper, supply or return (as described in Chapter 3).</td>
</tr>
<tr>
<td>DPS</td>
<td>Damper position switch (as described in Chapter 3).</td>
</tr>
<tr>
<td>FAN</td>
<td>Stairtower or elevator shaft pressurization fan.</td>
</tr>
<tr>
<td>S</td>
<td>Other signaling line circuit devices (e.g., smoke detector, pull station, etc.)</td>
</tr>
<tr>
<td>ASW</td>
<td>Air flow sensing switch (as described in Chapter 3).</td>
</tr>
</tbody>
</table>

*Figure 4-1. Four-Story Building Smoke Control Example*
Dedicated Smoke Control System wiring is usually straightforward. The Smoke Control System is the only source for commands to the fans and dampers, and therefore bypass and cut-off relays are not needed. The following sections illustrate some examples of dedicated fan and damper control.

**Overview**

Dedicated Smoke Control System wiring is usually straightforward. The Smoke Control System is the only source for commands to the fans and dampers, and therefore bypass and cut-off relays are not needed. The following sections illustrate some examples of dedicated fan and damper control.

**Damper Control**

Damper control is a basic function of the Simplex Smoke Control System. Interconnections to motorized dampers are shown in Figures 4-2 and 4-3.

The figure below shows dedicated motorized damper control using a 4090-9120 6-Point I/O Module. Both relay outputs are used, one to control opening the damper and the other to control closing it.

The wiring between the 6-Point I/O Module and the control relays is unsupervised, so the module must be mounted within three feet of the relays/dampers in accordance with NFPA 72.

**Note:** The wiring to the limit switches is supervised and limited to 500 ft. (152 m).

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**Figure 4-2. Dedicated Motorized Damper Control Using a 6-Point I/O Module**

Continued on next page
Dedicated damper control using the 4100-7401 24-Point I/O is similar to control using Relay IAMs and 6-Point I/O Modules, except that the 4100-7401 module is used for both control and feedback. This module communicates with the 4100U/4100ES Master over the RUI communications, and offers the added advantage that all I/O is supervised. The figure below shows dedicated motorized damper control using the 4100-7401 24-Point I/O:

Figure 4-3. Dedicated Motorized Damper Control Using the 24-Point I/O Module
Like smoke dampers, fan control is a basic function of the Simplex Smoke Control System. General principles for interconnection to a dedicated fan are shown in Figures 4-4 and 4-5.

In a dedicated fan control application, the 4090-9118 Relay IAM is used to provide inputs to a fan to turn it ON and monitor the feedback from the controller. The wiring between the Relay IAM and the fan is unsupervised, so the IAMs must be mounted within three feet of the controller in accordance with NFPA 72.

**Figure 4-4. Dedicated Fan Control Using a Relay IAM**

Continued on next page
Dedicated fan control using the 4100-7401 24-Point I/O is similar to control using Relay IAMs and 6-Point I/O Modules, except that the 4100-7401 module is used for both control and feedback. This module communicates with the 4100U/4100ES Master over the RUI communications, and offers the added advantage that all I/O is supervised. The figure below shows the equivalent interconnects for applications using a 24-Point I/O Module.

**Figure 4-5. Dedicated Fan Control Using the 24-Point I/O Module**
Non-Dedicated Smoke Control System Wiring Diagrams

Overview

Non-dedicated Smoke Control System wiring adds a layer of complexity, as the Smoke Control System must take control of the fans and dampers from the HVAC system. This introduces the use of bypass and cutoff relays not needed in a Dedicated Smoke Control System. The following sections illustrate some examples of non-dedicated damper and fan control.

Non-Dedicated Damper Control

Damper control and overriding the HVAC control of the damper is a basic function of the Simplex Smoke Control System. Interconnections for dampers are shown in Figures 4-6 through 4-9.

Control of the damper is accomplished using the 4090-9118 Relay IAM. The Relay IAM communicates with the FACP via the Simplex IDNet Signaling Line Circuit (SLC). When commanded by the FACP the Relay IAM activates the smoke control override relay and supplies power to the pressure switch to close the damper.

Continued on next page
Feedback of the closure is accomplished using a 4090-9120 6-Point I/O Module to monitor the closed position limit switch on the damper. The module also communicates with the Simplex FACP via IDNet. Wiring from the module to the control relay is unsupervised, so it must be mounted within three feet of the relay/damper in accordance with NFPA 72.

The figure below shows non-dedicated motorized damper control using the 6-Point I/O Module.

![Non-Dedicated Motorized Damper Control Diagram](image)

**Figure 4-6. Non-Dedicated Motorized Damper Control**

The two relay circuits of the 6-Point I/O Module are used, one to control opening the damper and the other to control closing it. Relays [A] and [B] are activated to close the damper. One output circuit controls Relay [A] to override the Energy Management System (EMS) and provide power to the motor to close the damper. Relay [B] insures that no open power is provided to the motor from the EMS. The other output circuit works in exactly the opposite fashion to control the opening of the damper. The damper position is monitored by the two supervised inputs of the 6-Point I/O Module.

The wiring between the 6-Point I/O Module output circuits and the relays is unsupervised, so the 6-Point I/O Module must be mounted within three feet of the relays/dampers in accordance with NFPA 72. The wiring to the limit switches is supervised, so no such restriction exists with the monitor circuits.
The figure below shows non-dedicated motorized damper control using the 24-Point I/O Module.

Figure 4-7. Non-Dedicated Motorized Damper Control Using the 24-Point I/O Module
Like smoke dampers, fan control and overriding the HVAC control is a basic function of the Simplex Smoke Control System. General principles for interconnection to a non-dedicated fan are shown in Figures 4-8 and 4-9.

In a non-dedicated fan control application, a 4090-9120 6-Point I/O Module is used to provide inputs to a fan controller for smoke control override and monitor the feedback from the controller. The wiring between the module and the fan controller is unsupervised, so the module must be mounted within three feet of the controller in accordance with NFPA 72.

Figure 4-8. Non-Dedicated Fan Control Using a 6-Point I/O Module

Continued on next page
Non-dedicated fan control using the 24-Point I/O is similar to control using a Relay IAM or 6-Point I/O Module, except that the 4100-7401 24-Point I/O Module is used for both control and feedback. This module communicates with the 4100U/4100ES Master over the RUI communications SLC, and offers the added advantage that all I/O is supervised, so no restrictions on module placement are required. The figure below shows the equivalent interconnects for applications using a 24-Point I/O.

Figure 4-9. Non-Dedicated Fan Control Using the 24-Point I/O Module
Chapter 5
Smoke Control System Programs

Introduction

This chapter provides examples of Simplex Smoke Control System programs. These programs are presented to illustrate what can be accomplished with this system. Since every system is unique, your programs will not be identical to these programs. Instead, use these programs as templates when programming the system.

Keep in mind the following smoke control objectives when programming the system:

- Maintain safe fire-free and smoke-free routes to allow sufficient time for the occupants to exit the premises or move to designated safe refuge areas.
- Provide a relatively clear approach to the fire area by firefighters so that the fire (the source of the smoke) can be contained and extinguished as fast as possible.
- If designated safe refuge areas are a part of the life safety design, then the control system must prevent smoke migration into such areas for a prolonged period of time.
- Reduce the amount of fire and smoke damage to the property.

In this Chapter

Refer to the page number listed in this table for information on a specific topic.

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<tr>
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<th>See Page #</th>
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# Smoke Control Program Requirements

<table>
<thead>
<tr>
<th>Introduction</th>
<th>The following paragraphs describe the requirements for the various types of programs that can be implemented using the Simplex Smoke Control System.</th>
</tr>
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</table>
| Emergency Operation | Emergency operation programs have the following functions:  
- Zoned smoke control to activate from automatic devices only.  
- Manual devices may cause any operation that is common to all smoke strategies (e.g. Stairtower Pressurization). |
| Automatic Program | Automatic operation programs have the following functions:  
- The first alarm in sets the operation strategy for smoke control. Subsequent alarms do not change the smoke control strategy operation. The first alarm in sets that zone ON, and the other zones OFF. (See Equations 9, 11, 13, and 15.)  
- The program checks proof sensors and reports equipment operation to the FSCS or, if such proof is not received within a specified time from activation it reports any failure to the FSCS. The delay time to allow sensors to operate is set at ten seconds for conversion in testing. This delay time can be increased to accommodate the time it takes for the equipment to respond. The maximum delay time is 60 seconds for fans (Equations 19 through 24) and 75 seconds for dampers (Equations 25 through 46).  
- Manual operation of the FSCS control switches overrides the automatic program. Manual commands have a higher priority than automatic operations. (See Equations 47 through 74.) |
| Dedicated Smoke Control System Weekly Self-Test | Dedicated smoke control system weekly self-test programs have the following functions:  
- Begins Saturday at 0000 hours if there is no alarm.  
- Run once. Any failures sound an audible fault signal and light an indicator on the FSCS showing the device that failed. In addition, the program displays “Weekly Smoke Control Self-Test Failed (Time & Date).” |
The Custom Control equations in this example are written for 4100U/4100ES based smoke control system, and show how to implement the Dedicated Smoke Control System Weekly Self-Test requirement described on the previous page.

**Note:** The points mentioned are representative of any system. Your system uses different points to provide the Inputs and Outputs. The following equations are provided as reference material. The syntax may be slightly different than that shown. However, the logic and content are the same.

The following list gives the Custom Control program (equation) number followed by a title (or label) for the program.

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<thead>
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<th>Equation No.</th>
<th>Label</th>
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<td>START SELF TEST</td>
</tr>
<tr>
<td>2</td>
<td>TURN ON STAIR PRESSURE FAN</td>
</tr>
<tr>
<td>3</td>
<td>TEST STAIRWELL AIR PRESSURE</td>
</tr>
<tr>
<td>4</td>
<td>RESET STAIR PRESSURE FAN TO OFF</td>
</tr>
<tr>
<td>5</td>
<td>[END-OF-PROGRAM]</td>
</tr>
</tbody>
</table>

**Equation 1: Start Self-Test**

**Label:** START SELF TEST  
**Equation 1**

**COMMENTS:**

**INPUTS:**
- When the day of week is Sat
- AND If Analog: A6 is greater than value: 0 (Cnts)
- AND If Analog: A6 is less than or equal to value: 3 (Cnts)
- AND NOT the ON state of:
  - A0 ANALOG NUMBER OF SYSTEM FIRE ALARMS

**OUTPUTS:**
- TRACK points ON pri=9,9
- P281 UTILITY START SELF TEST PROGRAM

**Equation 2: Turn ON Stair Pressure Fan**

**Label:** TURN ON STAIR PRESSURE FAN  
**Equation 2**

**COMMENTS:**

**INPUTS:**
- The ON state of:
  - P281 UTILITY START SELF TEST PROGRAM

**OUTPUTS:**
- HOLD points ON pri=9,9
- M1-9 CPRESS STAIR PRESS FAN
Equation 3: Test Stairwell Air Pressure

Label: TEST STAIRWELL AIR PRESSURE

COMMENTS:

INPUTS:
The ON state of:
P281 UTILITY START SELF TEST PROGRAM
AND the ON state of:
M1-9 CPRESS STAIR PRESS FAN
DELAY for 10 secs, running timer is A283
AND NOT the ON state of:
M1-42 UTILITY MONITOR STAIR PRESS FAN ON

OUTPUTS:
HOLD points ON pri=9,9
P280 UTILITY STAIR PRESS FAN FAIL

END:

Equation 4: Reset Stair Pressure Fan to OFF

Label: RESET STAIR PRESSURE FAN TO OFF

COMMENTS:

INPUTS:
The ON state of:
P281 UTILITY START SELF TEST PROGRAM
AND the ON state of:
M1-9 CPRESS STAIR PRESS FAN
DELAY for 60 secs, running timer is A284

OUTPUTS:
HOLD points OFF pri=9,9
M1-9 CPRESS STAIR PRESS FAN
P281 UTILITY START SELF TEST PROGRAM
PRINT to All ports/logs/displays
"SELF TEST PROGRAM IS COMPLETE"

END:

Equation 5: End of Program

Label: [END-OF-PROGRAM]

Equation 5
## Smoke Control System Custom Control Equations

### Introduction

The following Custom Control (CC) equations are written for a 4100U/4100ES based smoke control system. Note that the points mentioned are representative of any system. Your system will use different points to provide the Inputs and Outputs.

### Smoke Control System CC Equation Summary

The following “Custom Control Equation Summary” gives the CC equation number followed by a label (title) for the program.

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<tr>
<th>Equation No.</th>
<th>Label</th>
</tr>
</thead>
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<td>1</td>
<td>SET UP NORMAL CONDITIONS AT STARTUP</td>
</tr>
<tr>
<td>2</td>
<td>CLEAR FAULTS ON STARTUP</td>
</tr>
<tr>
<td>3</td>
<td>SET NORMAL CONDITIONS AT RESET</td>
</tr>
<tr>
<td>4</td>
<td>REPORT TROUBLE IF SWITCHES NOT RESET</td>
</tr>
<tr>
<td>5</td>
<td>INITIALIZE NORMAL CONDITIONS AT RESET</td>
</tr>
<tr>
<td>6</td>
<td>NORMAL CONDITIONS COMPLETE AFTER RESET</td>
</tr>
<tr>
<td>7</td>
<td>SMOKE CONTROL INITIATE</td>
</tr>
<tr>
<td>8</td>
<td>SMOKE CONTROL RESET</td>
</tr>
<tr>
<td>9</td>
<td>INITIATE SMOKE ZONE 1</td>
</tr>
<tr>
<td>10</td>
<td>ACTIVATE SMOKE CONTROL ZONE 1</td>
</tr>
<tr>
<td>11</td>
<td>INITIATE SMOKE ZONE 2</td>
</tr>
<tr>
<td>12</td>
<td>ACTIVATE SMOKE CONTROL ZONE 2</td>
</tr>
<tr>
<td>13</td>
<td>INITIATE SMOKE ZONE 3</td>
</tr>
<tr>
<td>14</td>
<td>ACTIVATE SMOKE CONTROL ZONE 3</td>
</tr>
<tr>
<td>15</td>
<td>INITIATE SMOKE ZONE 4</td>
</tr>
<tr>
<td>16</td>
<td>ACTIVATE SMOKE CONTROL ZONE 4</td>
</tr>
<tr>
<td>17</td>
<td>SUPPLY FAN DUCT SMOKE ALARM</td>
</tr>
<tr>
<td>18</td>
<td>STAIR PRESS FAN DUCT SMOKE ALARM</td>
</tr>
<tr>
<td>19</td>
<td>REPORT TBL IF SUPPLY FAN NOT ON</td>
</tr>
<tr>
<td>20</td>
<td>REPORT TBL IF SUPPLY FAN NOT OFF</td>
</tr>
<tr>
<td>21</td>
<td>REPORT TBL IF EXHAUST FAN NOT ON</td>
</tr>
<tr>
<td>22</td>
<td>REPORT TBL IF EXHAUST FAN NOT OFF</td>
</tr>
<tr>
<td>23</td>
<td>REPORT TBL IF STAIR PRESS FAN NOT ON</td>
</tr>
<tr>
<td>24</td>
<td>REPORT TBL IF STAIR PRESS FAN NOT OFF</td>
</tr>
<tr>
<td>25</td>
<td>REPORT TBL IF MAIN EXH DAMPER NOT OPEN</td>
</tr>
<tr>
<td>26</td>
<td>REPORT TBL IF MAIN EXH DAMPER NOT CLOSED</td>
</tr>
<tr>
<td>27</td>
<td>REPORT TBL IF MAIN SUP DAMPER NOT OPEN</td>
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<td>29</td>
<td>REPORT TBL IF MAIN RET DAMPER NOT OPEN</td>
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<td>31</td>
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<td>32</td>
<td>REPORT TBL IF SUP DAMPER 1 NOT CLOSED</td>
</tr>
<tr>
<td>33</td>
<td>REPORT TBL IF SUP DAMPER 2 NOT OPEN</td>
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<tr>
<td>34</td>
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</tr>
<tr>
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<td>REPORT TBL IF SUP DAMPER 3 NOT OPEN</td>
</tr>
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<td>36</td>
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<tr>
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<td>38</td>
<td>REPORT TBL IF SUP DAMPER 4 NOT CLOSED</td>
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<td>40</td>
<td>REPORT TBL IF EXH DAMPER 1 NOT CLOSED</td>
</tr>
<tr>
<td>41</td>
<td>REPORT TBL IF EXH DAMPER 2 NOT OPEN</td>
</tr>
<tr>
<td>42</td>
<td>REPORT TBL IF EXH DAMPER 2 NOT CLOSED</td>
</tr>
<tr>
<td>43</td>
<td>REPORT TBL IF EXH DAMPER 3 NOT OPEN</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Smoke Control System CC Equation Summary</th>
<th>Equation No.</th>
<th>Label</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>44</strong> REPORT TBL IF EXH DAMPER 3 NOT CLOSED</td>
<td><strong>45</strong> REPORT TBL IF EXH DAMPER 4 NOT OPEN</td>
<td><strong>46</strong> REPORT TBL IF EXH DAMPER 5 NOT CLOSED</td>
</tr>
<tr>
<td><strong>47</strong> MANUAL CONTROL SUP AIR DAMPER 1 OPEN</td>
<td><strong>48</strong> MANUAL CONTROL SUP AIR DAMPER 1 CLOSE</td>
<td><strong>49</strong> MANUAL CONTROL SUP AIR DAMPER 2 OPEN</td>
</tr>
<tr>
<td><strong>50</strong> MANUAL CONTROL SUP AIR DAMPER 2 CLOSE</td>
<td><strong>51</strong> MANUAL CONTROL SUP AIR DAMPER 3 OPEN</td>
<td><strong>52</strong> MANUAL CONTROL SUP AIR DAMPER 3 CLOSE</td>
</tr>
<tr>
<td><strong>53</strong> MANUAL CONTROL SUP AIR DAMPER 4 OPEN</td>
<td><strong>54</strong> MANUAL CONTROL SUP AIR DAMPER 4 CLOSE</td>
<td><strong>55</strong> MANUAL CONTROL EXH AIR DAMPER 1 OPEN</td>
</tr>
<tr>
<td><strong>56</strong> MANUAL CONTROL EXH AIR DAMPER 1 CLOSE</td>
<td><strong>57</strong> MANUAL CONTROL EXH AIR DAMPER 2 OPEN</td>
<td><strong>58</strong> MANUAL CONTROL EXH AIR DAMPER 2 CLOSE</td>
</tr>
<tr>
<td><strong>59</strong> MANUAL CONTROL EXH AIR DAMPER 3 OPEN</td>
<td><strong>60</strong> MANUAL CONTROL EXH AIR DAMPER 3 CLOSE</td>
<td><strong>61</strong> MANUAL CONTROL EXH AIR DAMPER 4 OPEN</td>
</tr>
<tr>
<td><strong>62</strong> MANUAL CONTROL EXH AIR DAMPER 4 CLOSE</td>
<td><strong>63</strong> MANUAL CONTROL STAIR PRESS FAN ON</td>
<td><strong>64</strong> MANUAL CONTROL STAIR PRESS FAN OFF</td>
</tr>
<tr>
<td><strong>65</strong> MANUAL CONTROL MAIN SUPPLY FAN ON</td>
<td><strong>66</strong> MANUAL CONTROL MAIN SUPPLY FAN OFF</td>
<td><strong>67</strong> MANUAL CONTROL MAIN RET AIR DAMPER OPEN</td>
</tr>
<tr>
<td><strong>68</strong> MANUAL CONTROL MAIN RET AIR DAMPER CLOSE</td>
<td><strong>69</strong> MANUAL CONTROL MAIN EXHAUST FAN ON</td>
<td><strong>70</strong> MANUAL CONTROL MAIN EXHAUST FAN OFF</td>
</tr>
<tr>
<td><strong>71</strong> MANUAL CONTROL MAIN SUP AIR DAMPER OPEN</td>
<td><strong>72</strong> MANUAL CONTROL MAIN SUP AIR DAMPER CLOSE</td>
<td><strong>73</strong> MANUAL CONTROL MAIN EXH AIR DAMPER OPEN</td>
</tr>
<tr>
<td><strong>74</strong> MANUAL CONTROL MAIN EXH AIR DAMPER CLOSE</td>
<td><strong>75</strong> MANUAL CONTROL CLEAR FAULTS</td>
<td><strong>76</strong> MASTER KEY SWITCH</td>
</tr>
<tr>
<td><strong>77</strong> TURN SONALERT ON</td>
<td><strong>78</strong> TURN SONALERT OFF</td>
<td></td>
</tr>
</tbody>
</table>

[END-OF-PROGRAM]
Smoke Control System Custom Control Equations, Continued

Equation 1: Set Up Normal Conditions at Startup

**Label**: SETUP NORMAL CONDITIONS AT STARTUP  
Equation 1

**COMMENTS:**
**INPUTS:**
The ON state of:
A34  TIMER  SYSTEM STARTUP PULSE TIMER
**OUTPUTS:**
HOLD points ON pri=9,9
M1-10  C PRESS  SUPPLY FAN RELAY
M1-11  C PRESS  EXHAUST FAN RELAY
M1-12  C DAMPER  MAIN OUTSIDE AIR DAMPER
M1-13  C DAMPER  MAIN EXHAUST AIR DAMPER
M1-14  C DAMPER  MAIN RETURN AIR DAMPER
M1-15  C DAMPER  1ST FLOOR SUPPLY AIR DAMPER
M1-16  C DAMPER  2ND FLOOR SUPPLY AIR DAMPER
M1-17  C DAMPER  3RD FLOOR SUPPLY AIR DAMPER
M1-18  C DAMPER  4TH FLOOR SUPPLY AIR DAMPER
M1-19  C DAMPER  1ST FLOOR EXHAUST/RETURN AIR DAMPER
M1-20  C DAMPER  2ND FLOOR EXHAUST/RETURN AIR DAMPER
M1-21  C DAMPER  3RD FLOOR EXHAUST/RETURN AIR DAMPER
M1-22  C DAMPER  4TH FLOOR EXHAUST/RETURN AIR DAMPER
P291  UTILITY  SET NORMAL CONDITIONS AT STARTUP
HOLD points OFF pri=9,9
M1-9  C PRESS  STAIR PRESS FAN

End:

Equation 2: Clear Faults on Startup

**Label**: CLEAR FAULTS ON STARTUP  
Equation 2

**COMMENTS:**
**INPUTS:**
The ON state of:
P291  UTILITY  SET NORMAL CONDITIONS AT STARTUP
DELAY for 30 sec., running timer is A293
**OUTPUTS:**
HOLD points OFF pri=9,9
P260  UTILITY  FL1 SUPPLY AIR DAMPER FAIL
P261  UTILITY  FL2 SUPPLY AIR DAMPER FAIL
P262  UTILITY  FL3 SUPPLY AIR DAMPER FAIL
P263  UTILITY  FL4 SUPPLY AIR DAMPER FAIL
P264  UTILITY  FL1 EXHAUST AIR DAMPER FAIL
P265  UTILITY  FL2 EXHAUST AIR DAMPER FAIL
P266  UTILITY  FL3 EXHAUST AIR DAMPER FAIL
P267  UTILITY  FL4 EXHAUST AIR DAMPER FAIL
P268  UTILITY  MAIN SUPPLY FAN FAIL
P269  UTILITY  MAIN EXHAUST FAN FAIL
P270  UTILITY  MAIN RETURN AIR DAMPER FAIL
P271  UTILITY  MAIN SUPPLY AIR DAMPER FAIL
P272  UTILITY  MAIN EXHAUST AIR DAMPER FAIL
P280  UTILITY  STAIR PRESS FAN FAIL
P291  UTILITY  SET NORMAL CONDITIONS AT STARTUP
HOLD points ON pri=9,9
P290  UTILITY  SET NORMAL CONDITIONS AT RESET

End:
Equation 3: 
Set Normal Conditions at Reset

Label: SETNORMALCONDITIONSATRESET

COMMENTS:

INPUTS:
The ON state of:
A21 TIMER SYSTEM RESET PULSE TIMER

OUTPUTS:
HOLD points ON pr=9,9
P290 UTILITY SETNORMALCONDITIONSATRESET

END:

Equation 4: 
Set Normal Conditions at Reset

Label: SETNORMALCONDITIONSATRESET

COMMENTS:

INPUTS:
OR the UP state of:
8-65 SWITCH Ann 1 Pt 65 Graphic LED/SW Ctrl w/32
8-66 SWITCH Ann 1 Pt 66 Graphic LED/SW Ctrl w/32
8-67 SWITCH Ann 1 Pt 67 Graphic LED/SW Ctrl w/32
8-68 SWITCH Ann 1 Pt 68 Graphic LED/SW Ctrl w/32
8-69 SWITCH Ann 1 Pt 69 Graphic LED/SW Ctrl w/32
8-70 SWITCH Ann 1 Pt 70 Graphic LED/SW Ctrl w/32
8-71 SWITCH Ann 1 Pt 71 Graphic LED/SW Ctrl w/32
8-72 SWITCH Ann 1 Pt 72 Graphic LED/SW Ctrl w/32
8-73 SWITCH Ann 1 Pt 73 Graphic LED/SW Ctrl w/32
8-74 SWITCH Ann 1 Pt 74 Graphic LED/SW Ctrl w/32
8-75 SWITCH Ann 1 Pt 75 Graphic LED/SW Ctrl w/32
8-76 SWITCH Ann 1 Pt 76 Graphic LED/SW Ctrl w/32
8-77 SWITCH Ann 1 Pt 77 Graphic LED/SW Ctrl w/32
8-78 SWITCH Ann 1 Pt 78 Graphic LED/SW Ctrl w/32
8-79 SWITCH Ann 1 Pt 79 Graphic LED/SW Ctrl w/32

OR the DOWN state of:
8-65 SWITCH Ann 1 Pt 65 Graphic LED/SW Ctrl w/32
8-66 SWITCH Ann 1 Pt 66 Graphic LED/SW Ctrl w/32
8-67 SWITCH Ann 1 Pt 67 Graphic LED/SW Ctrl w/32
8-68 SWITCH Ann 1 Pt 68 Graphic LED/SW Ctrl w/32
8-69 SWITCH Ann 1 Pt 69 Graphic LED/SW Ctrl w/32
8-70 SWITCH Ann 1 Pt 70 Graphic LED/SW Ctrl w/32
8-71 SWITCH Ann 1 Pt 71 Graphic LED/SW Ctrl w/32
8-72 SWITCH Ann 1 Pt 72 Graphic LED/SW Ctrl w/32
8-73 SWITCH Ann 1 Pt 73 Graphic LED/SW Ctrl w/32
8-74 SWITCH Ann 1 Pt 74 Graphic LED/SW Ctrl w/32
8-75 SWITCH Ann 1 Pt 75 Graphic LED/SW Ctrl w/32
8-76 SWITCH Ann 1 Pt 76 Graphic LED/SW Ctrl w/32
8-77 SWITCH Ann 1 Pt 77 Graphic LED/SW Ctrl w/32
8-78 SWITCH Ann 1 Pt 78 Graphic LED/SW Ctrl w/32
8-79 SWITCH Ann 1 Pt 79 Graphic LED/SW Ctrl w/32

AND the ON state of:
P290 UTILITY SETNORMALCONDITIONSATRESET

OUTPUTS:
TRACK points ON pr=9,9
P256 TROUBLE FSCS SWITCHES NOT RESET

END:
Smoke Control System Custom Control Equations, Continued

Equation 5: Initialize Normal Conditions at Reset

Label: INITIALIZE NORMAL CONDITIONS AT RESET  Equation 5

COMMENTS:

INPUTS:

The ON state of:
P290 UTILITY SET NORMAL CONDITIONS AT RESET
AND NOT the TROUBLE state of:
P256 TROUBLE FSCS SWITCHES NOT RESET

OUTPUTS:

HOLD points OFF pri=7,9
P275 UTILITY SMOKE CONTROL ALARM INITIATE
P276 UTILITY SMOKE CONTROL ZONE 1 INITIATE
P277 UTILITY SMOKE CONTROL ZONE 2 INITIATE
P278 UTILITY SMOKE CONTROL ZONE 3 INITIATE
P279 UTILITY SMOKE CONTROL ZONE 4 INITIATE

HOLD points ON pri=9,9
M1-10 CPRESS SUPPLY FAN RELAY
M1-11 CPRESS EXHAUST FAN RELAY
M1-12 CDAMPER MAIN OUTSIDE AIR DAMPER
M1-13 CDAMPER MAIN EXHAUST AIR DAMPER
M1-14 CDAMPER MAIN RETURN AIR DAMPER
M1-15 CDAMPER 1ST FLOOR SUPPLY AIR DAMPER
M1-16 CDAMPER 2ND FLOOR SUPPLY AIR DAMPER
M1-17 CDAMPER 3RD FLOOR SUPPLY AIR DAMPER
M1-18 CDAMPER 4TH FLOOR SUPPLY AIR DAMPER
M1-19 CDAMPER 1ST FLOOR EXHAUST/RETURN AIR DAMPER
M1-20 CDAMPER 2ND FLOOR EXHAUST/RETURN AIR DAMPER
M1-21 CDAMPER 3RD FLOOR EXHAUST/RETURN AIR DAMPER
M1-22 CDAMPER 4TH FLOOR EXHAUST/RETURN AIR DAMPER

DASH points OFF pri=9,9
M1-9 CPRESS STAIR PRESS FAN

END:

Equation 6: Normal Conditions Complete After Reset

Label: NORMAL CONDITIONS COMPLETE AFTER RESET  Equation 6

COMMENTS:

INPUTS:

The ON state of:
P290 UTILITY SET NORMAL CONDITIONS AT RESET
AND NOT the TROUBLE state of:
P256 TROUBLE FSCS SWITCHES NOT RESET

DELAY for 10 sec., running timer is A294

OUTPUTS:

HOLD points OFF pri=9,9
P290 UTILITY SET NORMAL CONDITIONS AT RESET

END:
Smoke Control System Custom Control Equations, Continued

### Equation 7: Smoke Control Initiate

**Label:** SMOKE CONTROL INITIATE

**COMMENTS:**

**INPUTS:**

- The ON state of:
  - A0 ANALOG NUMBER OF SYSTEM FIRE ALARMS

**OUTPUTS:**

- TRACK points ON pri=9,9
- P275 UTILITY SMOKE CONTROL ALARM INITIATE
  - PULSE analog: A280, for 2 sec.

**END:**

---

### Equation 8: Smoke Control Reset

**Label:** SMOKE CONTROL RESET

**COMMENTS:**

- Any Fire alarm turn OFF all Pseudos that may be used in testing

**INPUTS:**

- The ON state of:
  - A280 TIMER CUSTOM CONTROL - TIMER

**OUTPUTS:**

- HOLD points OFF pri=9,9
- P260 UTILITY FL1 SUPPLY AIR DAMPER FAIL
- P261 UTILITY FL2 SUPPLY AIR DAMPER FAIL
- P262 UTILITY FL3 SUPPLY AIR DAMPER FAIL
- P263 UTILITY FL4 SUPPLY AIR DAMPER FAIL
- P264 UTILITY FL1 EXHAUST AIR DAMPER FAIL
- P265 UTILITY FL2 EXHAUST AIR DAMPER FAIL
- P266 UTILITY FL3 EXHAUST AIR DAMPER FAIL
- P267 UTILITY FL4 EXHAUST AIR DAMPER FAIL
- P268 UTILITY MAIN SUPPLY FAN FAIL
- P269 UTILITY MAIN EXHAUST FAN FAIL
- P270 UTILITY MAIN RETURN AIR DAMPER FAIL
- P271 UTILITY MAIN SUPPLY AIR DAMPER FAIL
- P272 UTILITY MAIN EXHAUST AIR DAMPER FAIL

**END:**

---

### Equation 9: Initiate Smoke Zone 1

**Label:** INITIATE SMOKE ZONE 1

**COMMENTS:**

- An alarm in Zone 1 turns ON smoke control for zone 1, turns others OFF

**INPUTS:**

- The DETECT state of:
  - M1-1 FIRE 1ST FLOOR SMOKE

**OUTPUTS:**

- HOLD points ON pri=8,8
- P276 UTILITY SMOKE CONTROL ZONE 1 INITIATE
- HOLD points OFF pri=7,7
- P277 UTILITY SMOKE CONTROL ZONE 2 INITIATE
- P278 UTILITY SMOKE CONTROL ZONE 3 INITIATE
- P279 UTILITY SMOKE CONTROL ZONE 4 INITIATE

**END:**
Smoke Control System Custom Control Equations, *Continued*

---

**Equation 10:**
**Activate Smoke Control Zone 1**

Label: **ACTIVATE SMOKE CONTROL ZONE 1**  
Equation 10

**COMMENTS:**
The 5 second delay allows points that may be ON in test to be turned OFF prior to being turned ON by this smoke control equation.

**INPUTS:**
The ON state of:
- P276     UTILITY  SMOKE CONTROL ZONE 1 INITIATE
- DELAY for 5 sec., running timer is A256

**OUTPUTS:**
- HOLD points OFF pri=8,9
- M1-20    CDAMPER  2ND FLOOR EXHAUST/RETURN AIR DAMPER
- M1-21    CDAMPER  3RD FLOOR EXHAUST/RETURN AIR DAMPER
- M1-22    CDAMPER  4TH FLOOR EXHAUST/RETURN AIR DAMPER
- M1-14    CDAMPER  MAIN RETURN AIR DAMPER
- M1-15    CDAMPER  1ST FLOOR SUPPLY AIR DAMPER
- HOLD points ON pri=9,9
- M1-11    CPRESS   EXHAUST FAN RELAY
- M1-13    CDAMPER  MAIN EXHAUST AIR DAMPER
- M1-19    CDAMPER  1ST FLOOR EXHAUST/RETURN AIR DAMPER
- M1-15    CDAMPER  1ST FLOOR SUPPLY AIR DAMPER
- M1-9     CPRESS   STAIR PRESS FAN

**END:**

---

**Equation 11:**
**Initiate Smoke Zone 2**

Label: **INITIATE SMOKE ZONE 2**  
Equation 11

**COMMENTS:**

**INPUTS:**
The DETECT state of:
- M1-2     FIRE     2ND FLOOR SMOKE

**OUTPUTS:**
- HOLD points ON pri=8,8
- P277     UTILITY  SMOKE CONTROL ZONE 2 INITIATE
- HOLD points OFF pri=7,7
- P276     UTILITY  SMOKE CONTROL ZONE 1 INITIATE
- P278     UTILITY  SMOKE CONTROL ZONE 3 INITIATE
- P279     UTILITY  SMOKE CONTROL ZONE 4 INITIATE

**END:**
**Smoke Control System Custom Control Equations, Continued**

---

**Equation 12: Activate Smoke Control Zone 2**

**Label: ACTIVATE SMOKE CONTROL ZONE 2**  
**Equation 12**

**Comments:**

**Inputs:**

The ON state of:

- P277 UTILITY SMOKE CONTROL ZONE 2 INITIATE

**Delay for 5 sec., running timer is A285**

**Outputs:**

- HOLD points OFF pri=8,9
- M1-14 CDAMPER MAIN RETURN AIR DAMPER
- M1-19 CDAMPER 1ST FLOOR EXHAUST/RETURN AIR DAMPER
- M1-21 CDAMPER 3RD FLOOR EXHAUST/RETURN AIR DAMPER
- M1-22 CDAMPER 4TH FLOOR EXHAUST/RETURN AIR DAMPER
- M1-16 CDAMPER 2ND FLOOR SUPPLY AIR DAMPER

**HOLD points ON pri=9,9**

- M1-11 CPRESS EXHAUST FAN RELAY
- M1-13 CDAMPER MAIN EXHAUST AIR DAMPER
- M1-16 CDAMPER 2ND FLOOR SUPPLY AIR DAMPER
- M1-20 CDAMPER 2ND FLOOR EXHAUST/RETURN AIR DAMPER
- M1-9 CPRESS STAIR PRESS FAN

**End:**

---

**Equation 13: Initiate Smoke Zone 3**

**Label: INITIATE SMOKE ZONE 3**  
**Equation 13**

**Comments:**

**Inputs:**

The DETECT state of:

- M1-3 FIRE 3RD FLOOR SMOKE

**Outputs:**

- HOLD points ON pri=8,8
- P278 UTILITY SMOKE CONTROL ZONE 3 INITIATE
- HOLD points OFF pri=7,7
- P276 UTILITY SMOKE CONTROL ZONE 1 INITIATE
- P277 UTILITY SMOKE CONTROL ZONE 2 INITIATE
- P279 UTILITY SMOKE CONTROL ZONE 4 INITIATE

**End:**
Smoke Control System Custom Control Equations, Continued

Equation 14: Activate Smoke Control Zone 3

Label: Activate Smoke Control Zone 3

COMMENTS:
INPUTS:
The ON state of:
P278  UTILITY  SMOKE CONTROL ZONE 3 INITIATE
DELAY for 5 sec., running timer is A286
OUTPUTS:
HOLD points OFF pri=8,9
M1-14  CDAMPER  MAIN RETURN AIR DAMPER
M1-19  CDAMPER  1ST FLOOR EXHAUST/RETURN AIR DAMPER
M1-20  CDAMPER  2ND FLOOR EXHAUST/RETURN AIR DAMPER
M1-22  CDAMPER  4TH FLOOR EXHAUST/RETURN AIR DAMPER
M1-17  CDAMPER  3RD FLOOR SUPPLY AIR DAMPER
HOLD points ON pri=9,9
M1-11  CPRESS  EXHAUST FAN RELAY
M1-13  CDAMPER  MAIN EXHAUST AIR DAMPER
M1-17  CDAMPER  3RD FLOOR SUPPLY AIR DAMPER
M1-21  CDAMPER  3RD FLOOR EXHAUST/RETURN AIR DAMPER
M1-9  CPRESS  STAIR PRESS FAN
END:

Equation 15: Initiate Smoke Zone 4

Label: Initiate Smoke Zone 4

COMMENTS:
INPUTS:
The DETECT state of:
M1-4  FIRE  4TH FLOOR SMOKE
OUTPUTS:
HOLD points ON pri=8,8
P279  UTILITY  SMOKE CONTROL ZONE 4 INITIATE
HOLD points OFF pri=7,7
P276  UTILITY  SMOKE CONTROL ZONE 1 INITIATE
P277  UTILITY  SMOKE CONTROL ZONE 2 INITIATE
P278  UTILITY  SMOKE CONTROL ZONE 3 INITIATE
END:
Equation 16: Activate Smoke Control Zone 4

Label: ACTIVATE SMOKE CONTROL ZONE 4

COMMENTS:
INPUTS:
The ON state of:
P279 UTILITY SMOKE CONTROL ZONE 4 INITIATE
DELAY for 5 sec., running timer is A287
OUTPUTS:
HOLD points OFF pri=8,9
M1-14 CDAMPER MAIN RETURN AIR DAMPER
M1-19 CDAMPER 1ST FLOOR EXHAUST/RETURN AIR DAMPER
M1-20 CDAMPER 2ND FLOOR EXHAUST/RETURN AIR DAMPER
M1-21 CDAMPER 3RD FLOOR EXHAUST/RETURN AIR DAMPER
M1-18 CDAMPER 4TH FLOOR SUPPLY AIR DAMPER
HOLD points ON pri=9,9
M1-11 CPRESS EXHAUST FAN RELAY
M1-13 CDAMPER MAIN EXHAUST AIR DAMPER
M1-18 CDAMPER 4TH FLOOR SUPPLY AIR DAMPER
M1-22 CDAMPER 4TH FLOOR EXHAUST/RETURN AIR DAMPER
M1-9 CPRESS STAIR PRESS FAN
END:

Equation 17: Supply Fan Duct Smoke Alarm

Label: SUPPLY FAN DUCT SMOKE ALARM

COMMENTS:
INPUTS:
The DETECT state of:
M1-6 FIRE ROOF TOP SUPPLY DUCT SMOKE DET
OUTPUTS:
HOLD points OFF pri=9,9
M1-10 CPRESS SUPPLY FAN RELAY
END:

Equation 18: Stair Press Fan Duct Smoke Alarm

Label: STAIR PRESS FAN DUCT SMOKE ALARM

COMMENTS:
INPUTS:
The DETECT state of:
M1-5 FIRE STAIR SUPPLY DUCT SMOKE DET
OUTPUTS:
HOLD points OFF pri=9,9
M1-9 CPRESS STAIR PRESS FAN
END:
Equation 19:
Report TBL if Supply Fan Not ON

Label: REPORT TBL IF SUPPLY FAN NOT ON

COMMENTS:

INPUTS:
The ON state of:
M1-10 CPRESS SUPPLY FAN RELAY
DELAY for 10 sec., running timer is A264
AND NOT the ON state of:
M1-41 UTILITY MONITOR SUPPLY FAN ON

OUTPUTS:
HOLD points ON pri=9,9
P268 UTILITY MAIN SUPPLY FAN FAIL

END:

Equation 20:
Report TBL if Supply Fan Not OFF

Label: REPORT TBL IF SUPPLY FAN NOT OFF

COMMENTS:

INPUTS:
NOT the ON state of:
M1-10 CPRESS SUPPLY FAN RELAY
DELAY for 10 sec., running timer is A292
AND NOT the ON state of:
M1-50 UTILITY MONITOR SUPPLY FAN OFF

OUTPUTS:
HOLD points ON pri=9,9
P268 UTILITY MAIN SUPPLY FAN FAIL

END:

Equation 21:
Report TBL if Exhaust Fan Not ON

Label: REPORT TBL IF EXHAUST FAN NOT ON

COMMENTS:

INPUTS:
The ON state of:
M1-11 CPRESS EXHAUST FAN RELAY
DELAY for 10 sec., running timer is A263
AND NOT the ON state of:
M1-43 UTILITY MONITOR EXHAUST FAN ON

OUTPUTS:
HOLD points ON pri=9,9
P269 UTILITY MAIN EXHAUST FAN FAIL

END:

Equation 22:
Report TBL if Exhaust Fan Not OFF

Label: REPORT TBL IF EXHAUST FAN NOT OFF

COMMENTS:

INPUTS:
NOT the ON state of:
M1-11 CPRESS EXHAUST FAN RELAY
DELAY for 10 sec., running timer is A291
AND NOT the ON state of:
M1-44 UTILITY MONITOR EXHAUST FAN OFF

OUTPUTS:
HOLD points ON pri=9,9
P269 UTILITY MAIN EXHAUST FAN FAIL

END:
Smoke Control System Custom Control Equations, Continued

Equation 23: Report TBL if Stair Press Fan Not ON

Label: REPORT TBL IF STAIR PRESS FAN NOT ON

COMMENTS:

INPUTS:
The ON state of:
  M1-9  CPRESS  STAIR PRESS FAN
DELAY for 10 sec., running timer is A265
AND NOT the ON state of:
  M1-42  UTILITY  MONITOR STAIR PRESS FAN ON

OUTPUTS:
  HOLD points ON pri=9,9
  P280  UTILITY  STAIR PRESS FAN FAIL

END:

Equation 24: Report TBL if Stair Press Fan Not OFF

Label: REPORT TBL IF STAIR PRESS FAN NOT OFF

COMMENTS:

INPUTS:
  NOT the ON state of:
  M1-9  CPRESS  STAIR PRESS FAN
DELAY for 10 sec., running timer is A290
AND NOT the ON state of:
  M1-47  UTILITY  MONITOR STAIR PRESS FAN OFF

OUTPUTS:
  HOLD points ON pri=9,9
  P280  UTILITY  STAIR PRESS FAN FAIL

END:

Equation 25: Report TBL if Main EXH Damper Not Open

Label: REPORT TBL IF MAIN EXH DAMPER NOT OPEN

COMMENTS:

INPUTS:
The ON state of:
  M1-13  CDAMPER  MAIN EXHAUST AIR DAMPER
DELAY for 10 sec., running timer is A262
AND NOT the ON state of:
  M1-51  UTILITY  MONITOR MAIN EXHAUST AIR DAMPER OPEN

OUTPUTS:
  HOLD points ON pri=9,9
  P272  UTILITY  MAIN EXHAUST AIR DAMPER FAIL

END:

Equation 26: Report TBL if Main EXH Damper Not Closed

Label: REPORT TBL IF MAIN EXH DAMPER NOT CLOSED

COMMENTS:

INPUTS:
  NOT the ON state of:
  M1-13  CDAMPER  MAIN EXHAUST AIR DAMPER
DELAY for 10 sec., running timer is A281
AND NOT the ON state of:
  M1-52  UTILITY  MONITOR MAIN EXHAUST AIR DAMPER CLOSED

OUTPUTS:
  HOLD points ON pri=9,9
  P272  UTILITY  MAIN EXHAUST AIR DAMPER FAIL

END:
Smoke Control System Custom Control Equations, *Continued*

---

**Equation 27:**
Report TBL if Main SUP Damper Not Open

Label: REPORT TBL IF MAIN SUP DAMPER NOT OPEN  
**Equation 27**

**COMMENTS:**
**INPUTS:**
The ON state of:
M1-12 CDAMPER MAIN OUTSIDE AIR DAMPER
DELAY for 10 sec., running timer is A266
AND NOT the ON state of:
M1-48 UTILITY MONITOR OUTSIDE AIR DAMPER OPEN
**OUTPUTS:**
HOLD points ON pri=9,9
P271 UTILITY MAIN SUPPLY AIR DAMPER FAIL
**END:**

---

**Equation 28:**
Report TBL if Main SUP Damper Not Closed

Label: REPORT TBL IF MAIN SUP DAMPER NOT CLOSED  
**Equation 28**

**COMMENTS:**
**INPUTS:**
NOT the ON state of:
M1-12 CDAMPER MAIN OUTSIDE AIR DAMPER
DELAY for 10 sec., running timer is A267
AND NOT the ON state of:
M1-49 UTILITY MONITOR OUTSIDE AIR DAMPER CLOSED
**OUTPUTS:**
HOLD points ON pri=9,9
P271 UTILITY MAIN SUPPLY AIR DAMPER FAIL
**END:**

---

**Equation 29:**
Report TBL if Main RET Damper Not Open

Label: REPORT TBL IF MAIN RETDAMPER NOT OPEN  
**Equation 29**

**COMMENTS:**
**INPUTS:**
The ON state of:
M1-14 CDAMPER MAIN RETURN AIR DAMPER
DELAY for 10 sec., running timer is A268
AND NOT the ON state of:
M1-45 UTILITY MONITOR MAIN RETURN AIR DAMPER OPEN
**OUTPUTS:**
HOLD points ON pri=9,9
P270 UTILITY MAIN RETURN AIR DAMPER FAIL
**END:**

---

**Equation 30:**
Report TBL if Main RET Damper Not Closed

Label: REPORT TBL IF MAIN RETDAMPER NOT CLOSED  
**Equation 30**

**COMMENTS:**
**INPUTS:**
NOT the ON state of:
M1-14 CDAMPER MAIN RETURN AIR DAMPER
DELAY for 10 sec., running timer is A269
AND NOT the ON state of:
M1-46 UTILITY MONITOR MAIN RETURN AIR DAMPER CLOSED
**OUTPUTS:**
HOLD points ON pri=9,9
P270 UTILITY MAIN RETURN AIR DAMPER FAIL
**END:**
Smoke Control System Custom Control Equations, Continued

Equation 31: Report TBL If SUP Damper 1 Not Open

Label: REPORT_TBL Tổ SUP DAMPER 1 NOT OPEN Equation 31

COMMENTS:

INPUTS:
The ON state of:
M1-15  CDAMPER  1ST FLOOR SUPPLY AIR DAMPER
DELAY for 10 sec., running timer is A257
AND NOT the ON state of:
M1-25  UTILITY  MONITOR FLR 1 SUPPLY AIR DAMPER OPEN

OUTPUTS:
HOLD points ON pri=9.9
P260  UTILITY  FL1 SUPPLY AIR DAMPER FAIL

END:

Equation 32: Report TBL If SUP Damper 1 Not Closed

Label: REPORT_TBL IF SUP DAMPER 1 NOT CLOSED Equation 32

COMMENTS:

INPUTS:
NOT the ON state of:
M1-15  CDAMPER  1ST FLOOR SUPPLY AIR DAMPER
DELAY for 10 sec., running timer is A282
AND NOT the ON state of:
M1-29  UTILITY  MONITOR FLR 1 SUPPLY AIR DAMPER CLOSED

OUTPUTS:
HOLD points ON pri=9.9
P260  UTILITY  FL1 SUPPLY AIR DAMPER FAIL

END:

Equation 33: Report TBL If SUP Damper 2 Not Open

Label: REPORT_TBL IF SUP DAMPER 2 NOT OPEN Equation 33

COMMENTS:

INPUTS:
The ON state of:
M1-16  CDAMPER  2ND FLOOR SUPPLY AIR DAMPER
DELAY for 10 sec., running timer is A270
AND NOT the ON state of:
M1-26  UTILITY  MONITOR FLR 2 SUPPLY AIR DAMPER OPEN

OUTPUTS:
HOLD points ON pri=9.9
P261  UTILITY  FL2 SUPPLY AIR DAMPER FAIL

END:

Equation 34: Report TBL If SUP Damper 2 Not Closed

Label: REPORT_TBL IF SUP DAMPER 2 NOT CLOSED Equation 34

COMMENTS:

INPUTS:
NOT the ON state of:
M1-16  CDAMPER  2ND FLOOR SUPPLY AIR DAMPER
DELAY for 10 sec., running timer is A271
AND NOT the ON state of:
M1-30  UTILITY  MONITOR FLR 2 SUPPLY AIR DAMPER CLOSED

OUTPUTS:
HOLD points ON pri=9.9
P261  UTILITY  FL2 SUPPLY AIR DAMPER FAIL

END:
Smoke Control System Custom Control Equations, Continued

**Equation 35:**
Label: REPORT TBL IF SUP DAMPER 3 NOT OPEN  
COMMENTS:  
The ON state of:  
M1-17 CDAMPER 3RD FLOOR SUPPLY AIR DAMPER  
DELAY for 10 sec., running timer is A272  
AND NOT the ON state of:  
M1-27 UTILITY MONITOR FLR 3 SUPPLY AIR DAMPER OPEN  
OUTPUTS:  
HOLD points ON pri=9,9  
P262 UTILITY FL3 SUPPLY AIR DAMPER FAIL  
END:

**Equation 36:**
Label: REPORT TBL IF SUP DAMPER 3 NOT CLOSED  
COMMENTS:  
NOT the ON state of:  
M1-17 CDAMPER 3RD FLOOR SUPPLY AIR DAMPER  
DELAY for 10 sec., running timer is A273  
AND NOT the ON state of:  
M1-31 UTILITY MONITOR FLR 3 SUPPLY AIR DAMPER CLOSED  
OUTPUTS:  
HOLD points ON pri=9,9  
P262 UTILITY FL3 SUPPLY AIR DAMPER FAIL  
END:

**Equation 37:**
Label: REPORT TBL IF SUP DAMPER 4 NOT OPEN  
COMMENTS:  
The ON state of:  
M1-18 CDAMPER 4TH FLOOR SUPPLY AIR DAMPER  
DELAY for 10 sec., running timer is A274  
AND NOT the ON state of:  
M1-28 UTILITY MONITOR FLR 4 SUPPLY AIR DAMPER OPEN  
OUTPUTS:  
HOLD points ON pri=9,9  
P263 UTILITY FL4 SUPPLY AIR DAMPER FAIL  
END:

**Equation 38:**
Label: REPORT TBL IF SUP DAMPER 4 NOT CLOSED  
COMMENTS:  
NOT the ON state of:  
M1-18 CDAMPER 4TH FLOOR SUPPLY AIR DAMPER  
DELAY for 10 sec., running timer is A275  
AND NOT the ON state of:  
M1-32 UTILITY MONITOR FLR 4 SUPPLY AIR DAMPER CLOSED  
OUTPUTS:  
HOLD points ON pri=9,9  
P263 UTILITY FL4 SUPPLY AIR DAMPER FAIL  
END:
Smoke Control System Custom Control Equations, Continued

Equation 39: Report TBL if EXH Damper 1 Not Open

Label: REPORT TBL IF EXH DAMPER 1 NOT OPEN  
Comments:  
Inputs:  
The ON state of:  
M1-19   CDAMPER   1ST FLOOR EXHAUST/RETURN AIR DAMPER  
Delay for 10 sec., running timer is A258  
And not the ON state of:  
M1-33   UTILITY   MONITOR FLR 1 EXHAUST AIR DAMPER OPEN  
Outputs:  
Hold points ON pri=9,9  
P264   UTILITY   FL1 EXHAUST AIR DAMPER FAIL  
End:

Equation 40: Report TBL If EXH Damper 1 Not Closed

Label: REPORT TBL IF EXH DAMPER 1 NOT CLOSED  
Comments:  
Inputs:  
Not the ON state of:  
M1-19   CDAMPER   1ST FLOOR EXHAUST/RETURN AIR DAMPER  
Delay for 10 sec., running timer is A276  
And not the ON state of:  
M1-37   UTILITY   MONITOR FLR 1 EXHAUST AIR DAMPER CLOSED  
Outputs:  
Hold points ON pri=9,9  
P264   UTILITY   FL1 EXHAUST AIR DAMPER FAIL  
End:

Equation 41: Report TBL If EXH Damper 2 Not Open

Label: REPORT TBL IF EXH DAMPER 2 NOT OPEN  
Comments:  
Inputs:  
The ON state of:  
M1-20   CDAMPER   2ND FLOOR EXHAUST/RETURN AIR DAMPER  
Delay for 10 sec., running timer is A277  
And not the ON state of:  
M1-34   UTILITY   MONITOR FLR 2 EXHAUST AIR DAMPER OPEN  
Outputs:  
Hold points ON pri=9,9  
P265   UTILITY   FL2 EXHAUST AIR DAMPER FAIL  
End:

Equation 42: Report TBL If EXH Damper 2 Not Closed

Label: REPORT TBL IF EXH DAMPER 2 NOT CLOSED  
Comments:  
Inputs:  
Not the ON state of:  
M1-20   CDAMPER   2ND FLOOR EXHAUST/RETURN AIR DAMPER  
Delay for 10 sec., running timer is A259  
And not the ON state of:  
M1-38   UTILITY   MONITOR FLR 2 EXHAUST AIR DAMPER CLOSED  
Outputs:  
Hold points ON pri=9,9  
P265   UTILITY   FL2 EXHAUST AIR DAMPER FAIL  
End:
Smoke Control System Custom Control Equations, *Continued*

**Equation 43:**
Report TBL IF EXH Damper 3 Not Open

Label: REPORT TBL IF EXH DAMPER 3 NOT OPEN  
Comments:
Inputs:
The ON state of:
M1-21 CDAMPER 3RD FLOOR EXHAUST/RETURN AIR DAMPER
DELAY for 10 sec., running timer is A278
AND NOT the ON state of:
M1-35 UTILITY MONITOR FLR 3 EXHAUST AIR DAMPER OPEN
Outputs:
HOLD points ON pri=9,9
P266 UTILITY FL3 EXHAUST AIR DAMPER FAIL
End:

**Equation 44:**
Report TBL If EXH Damper 3 Not Closed

Label: REPORT TBL IF EXH DAMPER 3 NOT CLOSED  
Comments:
Inputs:
NOT the ON state of:
M1-21 CDAMPER 3RD FLOOR EXHAUST/RETURN AIR DAMPER
DELAY for 10 sec., running timer is A260
AND NOT the ON state of:
M1-39 UTILITY MONITOR FLR 3 EXHAUST AIR DAMPER CLOSED
Outputs:
HOLD points ON pri=9,9
P266 UTILITY FL3 EXHAUST AIR DAMPER FAIL
End:

**Equation 45:**
Report TBL IF EXH Damper 4 Not Open

Label: REPORT TBL IF EXH DAMPER 4 NOT OPEN  
Comments:
Inputs:
The ON state of:
M1-22 CDAMPER 4TH FLOOR EXHAUST/RETURN AIR DAMPER
DELAY for 10 sec., running timer is A279
AND NOT the ON state of:
M1-36 UTILITY MONITOR FLR 4 EXHAUST AIR DAMPER OPEN
Outputs:
HOLD points ON pri=9,9
P267 UTILITY FL4 EXHAUST AIR DAMPER FAIL
End:

**Equation 46:**
Report TBL If EXH Damper 4 Not Closed

Label: REPORT TBL IF EXH DAMPER 4 NOT CLOSED  
Comments:
Inputs:
NOT the ON state of:
M1-22 CDAMPER 4TH FLOOR EXHAUST/RETURN AIR DAMPER
DELAY for 10 sec., running timer is A261
AND NOT the ON state of:
M1-40 UTILITY MONITOR FLR 4 EXHAUST AIR DAMPER CLOSED
Outputs:
HOLD points ON pri=9,9
P267 UTILITY FL4 EXHAUST AIR DAMPER FAIL
End:
Smoke Control System Custom Control Equations, Continued

Equation 47: Manual Control SUP AIR Damper 1 Open

Label: MANUAL CONTROL SUP AIR DAMPER 1 OPEN  Equation 47

COMMENTS:
INPUTS:
The UP state of:
  8-66 SWITCH  Ann 1 Pt 66 Graphic LED/SW Ctrl w/32
AND the ON state of:
P273 UTILITY  MASTER KEY SWITCH ENABLE
OUTPUTS:
  HOLD points ON pri=5,9
  M1-15  CDAMPER  1ST FLOOR SUPPLY AIR DAMPER
END:

Equation 48: Manual Control SUP Air Damper 1 Close

Label: MANUAL CONTROL SUP AIR DAMPER 1 CLOSE  Equation 48

COMMENTS:
INPUTS:
The DOWN state of:
  8-66 SWITCH  Ann 1 Pt 66 Graphic LED/SW Ctrl w/32
AND the ON state of:
P273 UTILITY  MASTER KEY SWITCH ENABLE
OUTPUTS:
  HOLD points OFF pri=5,9
  M1-15  CDAMPER  1ST FLOOR SUPPLY AIR DAMPER
END:

Equation 49: Manual Control SUP Air Damper 2 Open

Label: MANUAL CONTROL SUP AIR DAMPER 2 OPEN  Equation 49

COMMENTS:
INPUTS:
The UP state of:
  8-68 SWITCH  Ann 1 Pt 68 Graphic LED/SW Ctrl w/32
AND the ON state of:
P273 UTILITY  MASTER KEY SWITCH ENABLE
OUTPUTS:
  HOLD points ON pri=5,9
  M1-16  CDAMPER  2ND FLOOR SUPPLY AIR DAMPER
END:

Equation 50: Manual Control SUP Air Damper 2 Close

Label: MANUAL CONTROL SUP AIR DAMPER 2 CLOSE  Equation 50

COMMENTS:
INPUTS:
The DOWN state of:
  8-68 SWITCH  Ann 1 Pt 68 Graphic LED/SW Ctrl w/32
AND the ON state of:
P273 UTILITY  MASTER KEY SWITCH ENABLE
OUTPUTS:
  HOLD points OFF pri=5,9
  M1-16  CDAMPER  2ND FLOOR SUPPLY AIR DAMPER
END:
## Smoke Control System Custom Control Equations, Continued

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<td></td>
<td>8-70 SWITCH Ann 1 Pt 70 Graphic LED/SW Ctrl w/32</td>
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<td></td>
<td></td>
<td>AND the ON state of:</td>
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<td></td>
<td></td>
<td>P273 UTILITY MASTER KEY SWITCH ENABLE</td>
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<td></td>
<td>OUTPUTS:</td>
<td>HOLD points ON pri=5,9</td>
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<td></td>
<td></td>
<td>M1-17 CDAMPER 3RD FLOOR SUPPLY AIR DAMPER</td>
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<td>END:</td>
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<tr>
<td><strong>Equation 52:</strong> Manual Control SUP Air Damper 3 Close</td>
<td>Label: MANUAL CONTROL SUP AIR DAMPER 3 CLOSE</td>
<td>Comments:</td>
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<tr>
<td></td>
<td>INPUTS:</td>
<td>The DOWN state of:</td>
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<td>8-70 SWITCH Ann 1 Pt 70 Graphic LED/SW Ctrl w/32</td>
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<td>AND the ON state of:</td>
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<td>P273 UTILITY MASTER KEY SWITCH ENABLE</td>
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<td>OUTPUTS:</td>
<td>HOLD points OFF pri=5,9</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>M1-17 CDAMPER 3RD FLOOR SUPPLY AIR DAMPER</td>
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<td>END:</td>
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<tr>
<td><strong>Equation 53:</strong> Manual Control SUP Air Damper 4 Open</td>
<td>Label: MANUAL CONTROL SUP AIR DAMPER 4 OPEN</td>
<td>Comments:</td>
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<td></td>
<td>INPUTS:</td>
<td>The UP state of:</td>
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<td></td>
<td>8-72 SWITCH Ann 1 Pt 72 Graphic LED/SW Ctrl w/32</td>
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<td>AND the ON state of:</td>
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<td>P273 UTILITY MASTER KEY SWITCH ENABLE</td>
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<td></td>
<td>OUTPUTS:</td>
<td>HOLD points ON pri=5,9</td>
<td></td>
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<td></td>
<td></td>
<td>M1-18 CDAMPER 4TH FLOOR SUPPLY AIR DAMPER</td>
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<td></td>
<td>END:</td>
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<tr>
<td><strong>Equation 54:</strong> Control SUP Air Damper 4 Close</td>
<td>Label: MANUAL CONTROL SUP AIR DAMPER 4 CLOSE</td>
<td>Comments:</td>
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<td></td>
<td>INPUTS:</td>
<td>The DOWN state of:</td>
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<td></td>
<td></td>
<td>8-72 SWITCH Ann 1 Pt 72 Graphic LED/SW Ctrl w/32</td>
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<td>AND the ON state of:</td>
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<td>P273 UTILITY MASTER KEY SWITCH ENABLE</td>
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<td></td>
<td>OUTPUTS:</td>
<td>HOLD points OFF pri=5,9</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>M1-18 CDAMPER 4TH FLOOR SUPPLY AIR DAMPER</td>
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<td></td>
<td>END:</td>
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</tbody>
</table>
Smoke Control System Custom Control Equations, *Continued*

---

**Equation 55:**

Manual Control EXH Air Damper 1 Open

Label: MANUAL CONTROL EXH AIR DAMPER 1 OPEN

**COMMENTS:**

**INPUTS:**
- The UP state of:
  - 8-67 SWITCH Ann 1 Pt 67 Graphic LED/SW Ctrl w/32
- AND the ON state of:
  - P273 UTILITY MASTER KEY SWITCH ENABLE

**OUTPUTS:**
- HOLD points ON pri=5,9
- M1-19 CDAMPER 1ST FLOOR EXHAUST/RETURN AIR DAMPER

**END:**

---

**Equation 56:**

Manual Control EXH Air Damper 1 Close

Label: MANUAL CONTROL EXH AIR DAMPER 1 CLOSE

**COMMENTS:**

**INPUTS:**
- The DOWN state of:
  - 8-67 SWITCH Ann 1 Pt 67 Graphic LED/SW Ctrl w/32
- AND the ON state of:
  - P273 UTILITY MASTER KEY SWITCH ENABLE

**OUTPUTS:**
- HOLD points OFF pri=5,9
- M1-19 CDAMPER 1ST FLOOR EXHAUST/RETURN AIR DAMPER

**END:**

---

**Equation 57:**

Manual Control EXH Air Damper 2 Open

Label: MANUAL CONTROL EXH AIR DAMPER 2 OPEN

**COMMENTS:**

**INPUTS:**
- The UP state of:
  - 8-69 SWITCH Ann 1 Pt 69 Graphic LED/SW Ctrl w/32
- AND the ON state of:
  - P273 UTILITY MASTER KEY SWITCH ENABLE

**OUTPUTS:**
- HOLD points ON pri=5,9
- M1-20 CDAMPER 2ND FLOOR EXHAUST/RETURN AIR DAMPER

**END:**

---

**Equation 58:**

Manual Control EXH Air Damper 2 Close

Label: MANUAL CONTROL EXH AIR DAMPER 2 CLOSE

**COMMENTS:**

**INPUTS:**
- The DOWN state of:
  - 8-69 SWITCH Ann 1 Pt 69 Graphic LED/SW Ctrl w/32
- AND the ON state of:
  - P273 UTILITY MASTER KEY SWITCH ENABLE

**OUTPUTS:**
- HOLD points OFF pri=5,9
- M1-20 CDAMPER 2ND FLOOR EXHAUST/RETURN AIR DAMPER

**END:**

---
Smoke Control System Custom Control Equations, *Continued*

---

**Equation 59:**
Control EXH Air Damper 3 Open

Label: MANUAL CONTROL EXH AIR DAMPER 3 OPEN

**COMMENTS:**
**INPUTS:**
The UP state of:
- 8-71 SWITCH Ann 1 Pt 71 Graphic LED/SW Ctrl w/32
AND the ON state of:
- P273 UTILITY MASTER KEY SWITCH ENABLE

**OUTPUTS:**
- HOLD points ON pri=5,9
- M1-21 CDAMPER 3RD FLOOR EXHAUST/RETURN AIR DAMPER

---

**Equation 60:**
Manual Control EXH Air Damper 3 Close

Label: MANUAL CONTROL EXH AIR DAMPER 3 CLOSE

**COMMENTS:**
**INPUTS:**
The DOWN state of:
- 8-71 SWITCH Ann 1 Pt 71 Graphic LED/SW Ctrl w/32
AND the ON state of:
- P273 UTILITY MASTER KEY SWITCH ENABLE

**OUTPUTS:**
- HOLD points OFF pri=5,9
- M1-21 CDAMPER 3RD FLOOR EXHAUST/RETURN AIR DAMPER

---

**Equation 61:**
Manual Control EXH Air Damper 4 Open

Label: MANUAL CONTROL EXH AIR DAMPER 4 OPEN

**COMMENTS:**
**INPUTS:**
The UP state of:
- 8-73 SWITCH Ann 1 Pt 73 Graphic LED/SW Ctrl w/32
AND the ON state of:
- P273 UTILITY MASTER KEY SWITCH ENABLE

**OUTPUTS:**
- HOLD points ON pri=5,9
- M1-22 CDAMPER 4TH FLOOR EXHAUST/RETURN AIR DAMPER

---

**Equation 62:**
Manual Control EXH Air Damper 4 Close

Label: MANUAL CONTROL EXH AIR DAMPER 4 CLOSE

**COMMENTS:**
**INPUTS:**
The DOWN state of:
- 8-73 SWITCH Ann 1 Pt 73 Graphic LED/SW Ctrl w/32
AND the ON state of:
- P273 UTILITY MASTER KEY SWITCH ENABLE

**OUTPUTS:**
- HOLD points OFF pri=5,9
- M1-22 CDAMPER 4TH FLOOR EXHAUST/RETURN AIR DAMPER

---
Smoke Control System Custom Control Equations, *Continued*

**Equation 63:** Manual Control Stair Press Fan ON

**Comments:**

**Inputs:**

The UP state of:
- 8-65 Switch Ann 1 Pt 65 Graphic LED/SW Ctlr w/32
AND the ON state of:
- P273 Utility Master Key Switch Enable

**Outputs:**

- HOLD points ON pri=8,9
- M1-9 CPRESS STAIR PRESS FAN

**END:**

**Equation 64:** Manual Control Stair Press Fan OFF

**Comments:**

**Inputs:**

The DOWN state of:
- 8-65 Switch Ann 1 Pt 65 Graphic LED/SW Ctlr w/32
AND the ON state of:
- P273 Utility Master Key Switch Enable

**Outputs:**

- HOLD points OFF pri=8,9
- M1-9 CPRESS STAIR PRESS FAN

**END:**

**Equation 65:** Manual Control Main Supply Fan ON

**Comments:**

**Inputs:**

The UP state of:
- 8-74 Switch Ann 1 Pt 74 Graphic LED/SW Ctlr w/32
AND the ON state of:
- P273 Utility Master Key Switch Enable

**Outputs:**

- HOLD points ON pri=8,9
- M1-10 CPRESS SUPPLY FAN RELAY

**END:**

**Equation 66:** Manual Control Main Supply Fan OFF

**Comments:**

**Inputs:**

The DOWN state of:
- 8-74 Switch Ann 1 Pt 74 Graphic LED/SW Ctlr w/32
AND the ON state of:
- P273 Utility Master Key Switch Enable

**Outputs:**

- HOLD points OFF pri=8,9
- M1-10 CPRESS SUPPLY FAN RELAY

**END:**

---

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Smoke Control System Custom Control Equations, Continued

Equation 67: Manual Control Main RET Air Damper Open

LABEL: MANUAL CONTROL MAIN RET AIR DAMPER OPEN

COMMENTS:

INPUTS:
The UP state of:
8-75 SWITCH Ann 1 Pt 75 Graphic LED/SW Ctrl w/32
AND the ON state of:
P273 UTILITY MASTER KEY SWITCH ENABLE

OUTPUTS:
HOLD points ON pri=8,9
M1-14 CDAMPER MAIN RETURN AIR DAMPER

END:

Equation 68: Manual Control Main RET Air Damper Close

LABEL: MANUAL CONTROL MAIN RET AIR DAMPER CLOSE

COMMENTS:

INPUTS:
The DOWN state of:
8-75 SWITCH Ann 1 Pt 75 Graphic LED/SW Ctrl w/32
AND the ON state of:
P273 UTILITY MASTER KEY SWITCH ENABLE

OUTPUTS:
HOLD points OFF pri=8,9
M1-14 CDAMPER MAIN RETURN AIR DAMPER

END:

Equation 69: Manual Control Main Exhaust Fan ON

LABEL: MANUAL CONTROL MAIN EXHAUST FAN ON

COMMENTS:

INPUTS:
The UP state of:
8-76 SWITCH Ann 1 Pt 76 Graphic LED/SW Ctrl w/32
AND the ON state of:
P273 UTILITY MASTER KEY SWITCH ENABLE

OUTPUTS:
HOLD points ON pri=8,9
M1-11 CPRESS EXHAUST FAN RELAY

END:

Equation 70: Manual Control Main Exhaust Fan OFF

LABEL: MANUAL CONTROL MAIN EXHAUST FAN OFF

COMMENTS:

INPUTS:
The DOWN state of:
8-76 SWITCH Ann 1 Pt 76 Graphic LED/SW Ctrl w/32
AND the ON state of:
P273 UTILITY MASTER KEY SWITCH ENABLE

OUTPUTS:
HOLD points OFF pri=8,9
M1-11 CPRESS EXHAUST FAN RELAY

END:
### Equation 71: Manual Control Main SUP Air Damper Open

**Label:** MANUAL CONTROL MAIN SUP AIR DAMPER OPEN   \hspace{1cm} **Equation 71**

**COMMENTS:**

**INPUTS:**
- The UP state of:
  - 8-77 SWITCH Ann 1 Pt 77 Graphic LED/SW Ctrl w/32
- AND the ON state of:
  - P273 UTILITY MASTER KEY SWITCH ENABLE

**OUTPUTS:**
- HOLD points ON pri=8,9
- M1-12 CDAMPER MAIN OUTSIDE AIR DAMPER

**END:**

### Equation 72: Manual Control Main Sup Air Damper Close

**Label:** MANUAL CONTROL MAIN SUP AIR DAMPER CLOSE   \hspace{1cm} **Equation 72**

**COMMENTS:**

**INPUTS:**
- The DOWN state of:
  - 8-77 SWITCH Ann 1 Pt 77 Graphic LED/SW Ctrl w/32
- AND the ON state of:
  - P273 UTILITY MASTER KEY SWITCH ENABLE

**OUTPUTS:**
- HOLD points OFF pri=8,9
- M1-12 CDAMPER MAIN OUTSIDE AIR DAMPER

**END:**

### Equation 73: Manual Control Main EXH Air Damper Open

**Label:** MANUAL CONTROL MAIN EXH AIR DAMPER OPEN   \hspace{1cm} **Equation 73**

**COMMENTS:**

**INPUTS:**
- The UP state of:
  - 8-78 SWITCH Ann 1 Pt 78 Graphic LED/SW Ctrl w/32
- AND the ON state of:
  - P273 UTILITY MASTER KEY SWITCH ENABLE

**OUTPUTS:**
- HOLD points ON pri=8,9
- M1-13 CDAMPER MAIN EXHAUST AIR DAMPER

**END:**

### Equation 74: Manual Control Main EXH Air Damper Close

**Label:** MANUAL CONTROL MAIN EXH AIR DAMPER CLOSE   \hspace{1cm} **Equation 74**

**COMMENTS:**

**INPUTS:**
- The DOWN state of:
  - 8-78 SWITCH Ann 1 Pt 78 Graphic LED/SW Ctrl w/32
- AND the ON state of:
  - P273 UTILITY MASTER KEY SWITCH ENABLE

**OUTPUTS:**
- HOLD points OFF pri=8,9
- M1-13 CDAMPER MAIN EXHAUST AIR DAMPER

**END:**
Smoke Control System Custom Control Equations, Continued

**Equation 75:** Manual Control Clear Faults

**Label:** MANUAL CONTROL CLEAR FAULTS

**Comments:**

**Inputs:**
- The UP state of:
  - 8-80 SWITCH Ann 1 Pt 80 Graphic LED/SW Ctlr w/32
- AND the ON state of:
  - P273 UTILITY MASTER KEY SWITCH ENABLE

**Outputs:**
- HOLD points OFF pri=9,9
- P260 UTILITY FL1 SUPPLY AIR DAMPER FAIL
- P261 UTILITY FL2 SUPPLY AIR DAMPER FAIL
- P262 UTILITY FL3 SUPPLY AIR DAMPER FAIL
- P263 UTILITY FL4 SUPPLY AIR DAMPER FAIL
- P264 UTILITY FL1 EXHAUST AIR DAMPER FAIL
- P265 UTILITY FL2 EXHAUST AIR DAMPER FAIL
- P266 UTILITY FL3 EXHAUST AIR DAMPER FAIL
- P267 UTILITY FL4 EXHAUST AIR DAMPER FAIL
- P268 UTILITY MAIN SUPPLY FAN FAIL
- P269 UTILITY MAIN EXHAUST FAN FAIL
- P270 UTILITY MAIN RETURN AIR DAMPER FAIL
- P271 UTILITY MAIN SUPPLY AIR DAMPER FAIL
- P272 UTILITY MAIN EXHAUST AIR DAMPER FAIL
- P280 UTILITY STAIR PRESS FAN FAIL

**Equation 76:** Master Key-Switch

**Label:** MASTER KEY SWITCH

**Comments:**

**Inputs:**
- The UP state of:
  - 8-81 SWITCH Ann 1 Pt 81 Graphic LED/SW Ctlr w/32

**Outputs:**
- TRACK points ON pri=8,9
- P273 UTILITY MASTER KEY SWITCH ENABLE

**End:**
**Smoke Control System Custom Control Equations, Continued**

---

**Equation 77:**

**Turn SONALERT ON**

**COMMENTS:**

**INPUTS:**

- OR the ON state of:
  - P260  UTILITY  FL1 SUPPLY AIR DAMPER FAIL
  - P261  UTILITY  FL2 SUPPLY AIR DAMPER FAIL
  - P262  UTILITY  FL3 SUPPLY AIR DAMPER FAIL
  - P263  UTILITY  FL4 SUPPLY AIR DAMPER FAIL
  - P264  UTILITY  FL1 EXHAUST AIR DAMPER FAIL
  - P265  UTILITY  FL2 EXHAUST AIR DAMPER FAIL
  - P266  UTILITY  FL3 EXHAUST AIR DAMPER FAIL
  - P267  UTILITY  FL4 EXHAUST AIR DAMPER FAIL
  - P268  UTILITY  MAIN SUPPLY FAN FAIL
  - P269  UTILITY  MAIN EXHAUST FAN FAIL
  - P270  UTILITY  MAIN RETURN AIR DAMPER FAIL
  - P271  UTILITY  MAIN SUPPLY AIR DAMPER FAIL
  - P272  UTILITY  MAIN EXHAUST AIR DAMPER FAIL
  - P280  UTILITY  STAIR PRESS FAN FAIL

- AND NOT the ON state of:
  - P290  UTILITY  SET NORMAL CONDITIONS AT RESET

**OUTPUTS:**

- HOLD points ON pri=9,9
- P293  UTILITY  PIEZO ACTIVATE

**END:**

---

**Equation 78:**

**Turn SONALERT OFF**

**COMMENTS:**

**INPUTS:**

- The UP state of:
  - 8-82  SWITCH  SILENCE SWITCH
- And the ON state of:
  - P273  UTILITY  MASTER KEY SWITCH ENABLE

**OUTPUTS:**

- HOLD points OFF pri=8,9
- P293  UTILITY  PIEZO ACTIVATE

**END:**

---

Label: [END-OF-PROGRAM]
Chapter 6
Glossary of Terms

Introduction

This chapter contains a glossary to terms that are used in this publication

In this Chapter

Refer to the page number listed in this table for information on a specific topic.

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<td>Glossary of Terms</td>
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</table>
Glossary of Terms

Glossary

**Acceptance Tests** – Tests designed to prove a smoke control system is capable of doing what is designed to do.

**AHJ** – The “Authority Having Jurisdiction” is the organization, office, or individual responsible for approving equipment, an installation, or a procedure.

**Alarm Service** – The service required following the receipt of an alarm signal.

**Alarm Signal** – A signal indicating an emergency requiring immediate action, as an alarm for fire from a manual box, a waterflow alarm, an alarm from an automatic fire alarm system, or other emergency signal.

**Alarm System** – A combination of compatible initiating devices, control panels, and notification appliances designed and installed to produce an alarm signal in the event of fire.

**Annunciator** – A unit containing two or more identified targets or indicator lamps in which each target or lamp indicates the circuit, condition, or location to be annunciated.

**Auxiliarized Local System** – A local system that is connected to the municipal alarm facilities.

**Auxiliarized Proprietary System** – A proprietary system that is connected to the municipal alarm facilities.

**Auxiliary Protective Signaling System** – A connection to the municipal fire alarm system to transmit an alarm of fire to the municipal communications center. Fire alarms from an auxiliary alarm system are received at the municipal communications center on the same equipment and by the same alerting methods as alarms transmitted from municipal fire alarm boxes located on streets.

**Auxiliary Trip Relay** – A relay used to operate a municipal master box from an auxiliarized control panel.

**Bell, Single Stroke** – A bell whose gong is struck only once each time operating energy is applied.

**Bell, Vibrating** – A bell that rings continuously as long as operating power is applied.

**Box (or Station), Fire Alarm** – (1) Non-coded. A manually operated device that, when operated, closes or opens one or more sets of contacts and generally locks the contacts in the operated position until the box is reset. (2) Coded. A manually operated device in which the act of pulling a lever causes the transmission of not less than three rounds of coded alarm signals. Similar to the non-coded type, except that instead of a manually operated switch, a mechanism to rotate a code wheel is utilized. Rotation of the code wheel, in turn, causes an electrical circuit to be alternately opened and closed, or closed and opened, thus surrounding a coded alarm that identifies the location of the box. The code wheel is cut for the individual code to be transmitted by the device and can operate by clockwork or by an electric motor. Clockwork transmitters can be pre-wound or can be wound by the pulling of the alarm lever. Usually the box is designed to repeat its code four times and automatically come to rest. Pre-wound transmitters must sound a trouble signal when they required rewinding. Solid state electronic coding devices are also used in conjunction with the fire alarm control unit to produce coded sounding of the audible signaling appliances.

**Break-glass Box (or Station)** – A break-glass box is one in which it is necessary to break a special element in order to operate the box.

Continued on next page
**Bypass Pressure Control System** – The bypass-around supply fan can actually be placed at any level. The bypass duct dampers are controlled by one or more static pressure sensors located between the stairtower and the building. In addition, a manually operated damper may be located at the top of the stairtower for smoke purging by the Fire Department.

**CC** – Custom Control.

**Central Station System** – A system, or group of systems, in which the operations of circuits and devices are signaled automatically to, recorded in, maintained, and supervised from an approved central station having competent and experienced observers and operators who, upon receipt of a signal, take the required action. Such systems are controlled and operated by a person, firm, or corporation whose principal business is the furnishing and maintaining of supervised signaling service.

**Channel** – A path for signal transmission between two or more stations or channel terminations. A channel can consist wire, radio waves, or equivalent means of signal transmission.

**Chimes** – A single stroke or vibrating-type audible signal appliance that has a xylophone-type striking bar.

**Circuit Interface** – A functional assembly that interfaces one or more of its initiating device circuits with a signaling line circuit in a manner that permits the central supervising station to indicate the status of each of its individual initiating device circuits.

**Circuit** – The conductors or radio channel, and associated equipment used to perform a definite function in connection with an alarm system.

**Coded Signal** – A signal pulsed in a prescribed code for each round of transmission. A minimum of three rounds and a minimum of three impulses are required for an alarm signal.

**Combination Detector** – A device that either (1) responds to more than one of the fire phenomena such as smoke, heat, flame, and fire gas or (2) employs more than one operating principle to sense one of these phenomena. Typical examples are (1) a combination of heat detector with a smoke detector, or (2) a combination rate-of-rise and fixed temperature heat detector.

**Combination System** – A local protective signaling system for fire alarm, supervisory, or guard tour supervisory service whose components may be used in whole or in part in common with a non-fire signaling system such as a paging system, a burglar alarm system, a musical program system, or a process monitoring service system, without degradation of or hazard to the protective signaling system.

**Communication Channel** – A signaling channel (usually leased from a communication utility company) having two or more terminal locations and a suitable information handling capacity depending on the characteristics of the system used. One terminal location is at the central supervising station and the other terminal location or locations are sources from which are transmitted alarm signals, supervisory signals, trouble signals, and such other signals as the central supervising station is prepared to receive and interpret.

**Compensated System** – Adjust the airflow to make up for pressure lost through open doors. A compensated system can use dampers (or vents) to relieve excess pressure in the stairtower to ensure that the pressure does not go over the maximum limit.
Control Unit – A device with the control circuits necessary to (a) furnish power to a fire alarm system; (b) receive signals from alarm initiating devices and transmit them to audible alarm notification appliances and accessory equipment; and (c) electrically supervise the system installation wiring and primary (main) power. The control unit can be contained in one or more cabinets in adjacent or remote locations.

Dedicated Smoke Control Components – Solely used for smoke control functions and are not operated in a non-emergency condition. Dedicated system equipment is therefore required to incorporate an automatic weekly self-test or each smoke control function.

Dedicated Smoke Control System – Installed in a building for the sole purpose of controlling smoke.

Delinquency Signals – A signal indicating the need of action in connection with the supervision of guards or system attendants.

Duct System – Use bypass dampers and ducts to control the amount of air flowing from the fan to the outlets. The bypass dampers are opened when the stairtower is at the proper pressure, so that excess air flows not into the duct system, but into the bypass duct and back to the air inlet.

Emergency Voice/Alarm Communication Systems – A system that provides dedicated manual or automatic, or both, facilities for originating and distributing voice instructions, as well as alert and evacuating signals pertaining to a fire emergency to the occupants of a building.

EOL Device – End of Line Device. A device used to terminate a supervised circuit.

EOLR – End of Line Resistor.

EP Damper Control – Electrical to Pressure Damper Control. This type of damper control may not be commonly used due to lack of full damper position sensing.

FACP – Fire Alarm Control Panel.

Fault – An open, ground, or short condition on any line(s) extending from a control unit, which could prevent normal operation.

FDM – Frequency Division Multiplexing. A signaling method characterized by the simultaneous transmission of more than one signal in a communication channel. Signals from one or multiple terminal locations are distinguished from one another by virtue of each signal being assigned to a separate frequency or combination of frequencies.

Fire Dampers – Dampers that block a fire from penetrating a fire rated partition via a duct. These dampers are normally-open, held in place by a fusible link. The specifications for fire dampers appear in UL Standard 555, Standard for Fire Dampers.

Fire Suppression System – Limits the growth rate of a fire, but does not eliminate or limit smoke.

Fire-Rated Ceiling – A ceiling made of fire-resistant materials.

Fire-Rated Partition – A fire partition is a wall that is built of fire resistant materials and that reaches from floor to ceiling.

Flame Detector – A device that detects infrared, or ultraviolet, or visible radiation produced by a fire.

FSCS – Firefighter’s Smoke Control Station. A graphic annunciating control panel that gives firefighters information about the state of the smoke control system as well as manual control over all of its components.

Ground Fault Detector – Detects the presence of a ground condition on system wiring.

Continued on next page
Ground Fault – A condition in which the resistance between a conductor and ground reaches an unacceptably low level.

Heat Detector – A device which detects abnormally high temperature or rate-of-temperature rise.

Horns – An audible signal appliance in which energy produces a sound by imparting motion to a flexible component that vibrates at some nominal frequency.

HVAC system – Heating, ventilation, and air conditioning system.

IDC – Initiating Device Circuit.

Initiating Device – A manually or automatically operated device, the normal intended operation of which results in a fire alarm or supervisory signal indication from the control unit. Examples of alarm signal initiating devices are thermostats, manual boxes, smoke detectors, and waterflow switches. Examples of supervisory signal initiating devices are water level indicators, sprinkler-system valve-position switches, pressure supervisory transmitters, and water temperature switches.

Initiating Device Circuit – A circuit to which automatic or manual signal initiating devices such as fire alarm boxes, fire detectors, and waterflow alarm devices are connected.

Labeled – Equipment or materials to which has been attached a label, symbol or other identifying mark of an organization acceptable to the “Authority Having Jurisdiction” and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

Leg Facility – That part of a signaling line circuit connecting each protected building to the trunk facility or directly to the central supervising station.

Listed – Equipment or materials included in a list published by an organization acceptable to the “Authority Having Jurisdiction” and concerned with product evaluation, that maintains periodic inspection of production of listed equipment or materials and whose listing states either that the equipment or material meets appropriate standards or has been tested and found suitable for use in a specified manner.

Local Alarm System – A local system sounding an alarm as the result of the manual operation of a fire alarm box or the operation of protection equipment or systems, such as water flowing in a sprinkler system, the discharge of carbon dioxide, the detection of smoke, or the detection of heat.

Local Energy Auxiliary Alarm System – An auxiliary alarm system that employs a locally complete arrangement of parts, initiating devices, relays, power supply, and associated components to automatically trip a municipal transmitter or master box over electric circuits that are electrically isolated from the municipal system circuits.

Local Supervisory System – A local system arranged to supervise the performance of guard tours, or the operative condition of automatic sprinkler systems or other systems for the protection of life and property against the fire hazard.

Local System – A local system is one that produces a signal at the premises protected.

Maintenance – Repair service, indicating periodic inspections and tests, required to keep the protective signaling system and its component parts in an operative condition at all times, together with replacement of the system of its components, when for any reason they become undependable of inoperative.
Master Box – A municipal fire alarm box that may also be operated by remote means.

Multiplexing – A signaling method characterized by the simultaneous or sequential transmission, or both, and reception of multiple signals in a communication channel including means for positively identifying each signal.

Municipal Communications Center – The building or portion of a building used to house the central operating part of the fire alarm system; usually the place where the necessary testing, switching, receiving, retransmitting, and power supply devices are located.

Municipal Fire Alarm Box – A specially manufactured enclosure housing a manually operated transmitter used to send an alarm to the municipal communications center.

Municipal Transmitter – A specially manufactured enclosure housing a transmitter that can only be tripped remotely, used to send an alarm to the municipal communications center.

NDU – Network Display Unit.

Negative Air Pressure Technique – Pulls the smoke out of the area and vents it outside of the building.

Non-coded Signal – Signal from any notification appliance that is energized continuously.

Non-Compensated System – Simply turn on a fan to pressurize the stairtower. The fan speed does not change to compensate for doors opening and closing. The more doors that are open, the more the pressure differential between the stairtower and the building drops.

Non-Dedicated Smoke Control Components – Consists of HVAC components within a building which are operated regularly. The normal “comfort” level associated with the proper operation of the equipment serves as the means of maintaining system integrity.

Non-Dedicated Smoke Control System – Uses parts of the HVAC system to control smoke.

Normal Stack Effect – An upward movement of air within the building.

Notification Appliance – Any audible or visible signal employed to indicate a fire, supervisory, or trouble condition. Examples of audible signal appliances are bells, horns, sirens, electronic horns, buzzers, and chimes. A visible indicator consists of a lamp, target, meter deflection, or equivalent.

Notification Appliance Circuit – A circuit or path directly connected to a notification appliance(s) such as bell, horns, chimes, or others.

NPU – Networking Processing Unit.

Operational Tests – Test that make sure the components and subsystems of the smoke control system are installed correctly.

Paging System – A system intended to page one or more persons such as by means of voice over loudspeaker stations located throughout the premises or by means of coded audible signal or visual signals similarly distributed, or by means of lamp annunciators located throughout the premises.

Permanent Visual Record (Recording) – Immediately readable, not easily alterable print, slash, punch, etc., listing all occurrences of status change.

Piston Effect – Transient pressures produced when an elevator car moves inside the shaft during a smoke emergency. This “piston effect” can pull smoke into a normally pressurized elevator lobby or elevator, shaft.
Proprietary Protective Signaling System – An installation of protective signaling systems that serve contiguous and noncontiguous properties under one ownership from a central supervising station located at the protected property, where trained, competent personnel are in constant attendance. This includes the central supervising station, power supplies, signal-initiating devices, initiating device circuits, signal notification appliances, equipment for the automatic, permanent visual recording of signals, and equipment for the operation of emergency building control services.

Protective Signaling Systems – Electrically operated circuits, instruments, and devices, together with the necessary electrical energy, designed to transmit alarm, supervisory, and trouble signals necessary for the protection of life and property.

Rectifier – An electrical device without moving parts that changes alternating current to direct current.

Remote Station Protective Signaling System – An installation using supervised dedicated circuits, installed to transmit alarm, supervisory, and trouble signals from one or more protected premises to a remote location at which appropriate action is taken.

Repeater Facility – Equipment needed to relay signals between the protected premises and the central supervising action.

Reverse Stack Effect – Downward movement of air within the building.

RUI – Remote Unit Interface communications

SLC – Signaling Line Circuit (Path). A circuit or path (channel or trunk and leg) over which multiple signals are transmitted and received.

Smoke Barriers – Barriers that prevent smoke from passing through them.

Smoke Control System – A system that employs motorized fans to create air pressure differences and positive or negative airflows to limit and control the movement of smoke and other noxious gases. Provides safe zones and tolerable conditions along exit routes but can do little to control fire.

Smoke Control Zones – A zone must be separated from other zones by smoke dampers, airtight doors, and smoke-proof barriers.

Smoke Damper – (1) A damper that prevents smoke from passing through when fully closed. (2) Dampers that meet the requirements given in UL 555S, Standard for Leakage Rated Dampers for Use in Smoke Controls Systems. (3) In a smoke control system, the damper must be fitted with the end-position switches to provide feedback to the smoke control system.

Smoke Detector – A device that detects visible or invisible particles of combustion.

Spacing – A horizontal measured dimension relating to the allowable coverage of fire detectors.

Stairtower – A stairwell with a ventilation system that is located from the main building.

Supervision Service – The service required to monitor performance of guard patrols and the operative condition of automatic sprinkler system and of other systems for the protection life and property.

Supervision – The term supervised refers to monitoring of the circuit, switch, or device in such a manner that a trouble signal is received when a fault that would prevent normal operation of the system occurs.
**Glossary**

**Supervisory Signal** – A signal indicating the need of action in connection with the supervision of guard tours, sprinkler and other extinguishing system standards and designated as such by the Authority Having Jurisdiction.

**System Flexibility** – Using features that allow for easy adjustment of a particular system to meet the demands of a given situation.

**Tenable Environment** – As defined by the NFPA, an environment in which the quantity and location of smoke is limited or otherwise restricted to allow for ready evacuation though the space.

**Transmitter** – A system component to which initiating devices or groups of initiating devices are connected. The component transmits signals to the central supervising station indicating the status of the initiating devices and the initiating device circuits.

**Trouble Signal** – An audible signal indicating trouble of any nature, such as a circuit break or ground, occurring in the devices or wiring associated with a protective signaling system.

**TSW** – TrueSite Workstation System. The 4190 TSW provides a graphical user workstation within the Simplex Smoke System.

**Visible Signal** – A visible signal is the response to the operation of an initiating device by one or more direct or indirect visible notification appliances. For a direct visible signal, the sole means of notification is by illumination of the area surrounding the visible signaling appliance.

**Waterflow Switch** – An assembly approved for the service and so constructed and installed that any flow of water from a sprinkler system equal to or greater than that from a single automatic sprinkler of the smallest orifice size installed on the system will result in activation of this switch and subsequently indicate an alarm condition.

**Zone** – A designed area of a building. Commonly, zones within a building are annunciated to rapidly locate a fire.
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