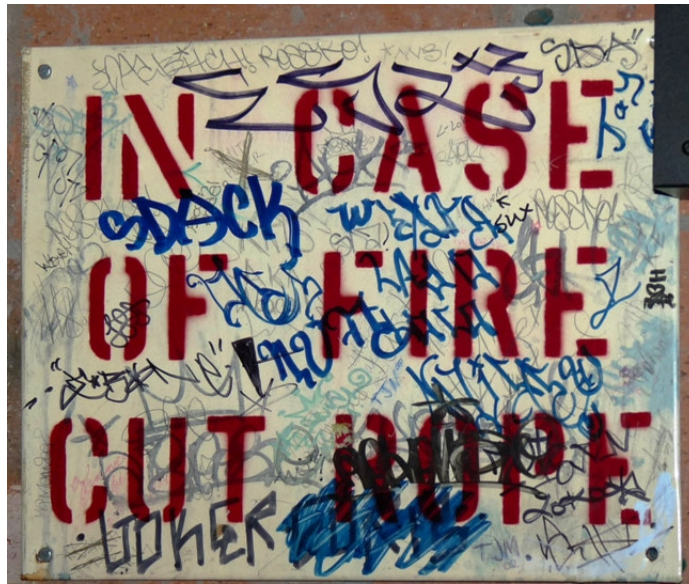
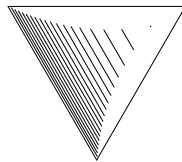


SMOKE AND FIRE CONTROL SYSTEMS FOR AUDITORIUMS AND THEATRES



Courtesy of

Teqniqal Systems, LLC



By
Erich Friend
Theatre Consultant

June 3, 2009

Copyright © 2009 – All Rights Reserved Worldwide



To be effective, the fire and smoke containment system for a stage must do three things:

- Starve the fire (deprive it of oxygen).
- Vent the toxic gases.
- Prevent the spread of fire to other parts of the building.

To achieve these goals several things must occur:

- The Fire Curtain must *fully* deploy.
- All Doors connecting to the stage must be closed.
- All Air Vents / Ducts that interconnect the stage to other areas of the building must have the fire dampers closed.
- The Smoke Vents above the stage must open.

Additional actions that can further reduce the likelihood of injury and building damage:

- Activate the Fire Alarm.
- Activate the Sprinkler System in the area of the fire.

A model Fire and Smoke Control System provides both sensors to monitor the status of each of these systems, and a means to remotely activate them. This is called **Pro-Active Response**. Additional means to activate the system would include:

- Pull Stations to manually send an alarm to the Fire Alarm Control Panel (FACP).
- Smoke Detectors and/or Rate-of-Rise Heat Detectors.
- Water-Flow Sensors to detect if the Sprinkler System was activated.
- Smoke Vent Position Sensors.
- Fire Curtain Position Sensors.
- Door Position Sensors (Personnel Doors and Scenery Loading Doors - Overhead or Hinged).

This way, if any one of the Fire and Smoke Control System components is activated, then the FACP will command all of the other Fire and Smoke Control systems to become functional. Additional outputs from the FACP may activate other systems:

- Magnetic Door Releases.
- Electro-Thermal Fusible Links on Smoke Vents, Fire Curtains, and Overhead Doors.
- Visual Annunciation Systems (Strobes).
- Video Annunciation Systems (Digital Signage / Video Displays).
- Audible Warning Systems (Horns / Buzzers).
- Audible Annunciation Systems (Pre-recorded Voice Message Repeater).
- Production System Overrides (Lights, Sound, Video, Rigging).
- Emergency Egress Lighting.
- E-Mail / Pager / Telephone Auto-dialer Alerts.

Seems simple enough, doesn't it? So, why do so few theatres have systems that actually work this way?



Why do Smoke and Fire Control Systems fail?

There are a variety of reasons for failure, but the primary one is that they are not coordinated to perform their task effectively. Typically each system, smoke vents, fire curtain, sprinkler system, and doors operate in their own, completely independent from each other. This creates a system that is **RE-Active**, rather than one that is **PRO-Active**. One component of the system reacts to the stimulus (manual activation or sensor activation) and the remaining systems don't do anything until they, too, sense that a reaction is needed. This can prolong the activation of full protection indefinitely. A smoldering fire may cause extensive smoke damage throughout a facility before it is contained and extinguished. Smoke can contaminate carpets, wall finishes, seating upholstery, and stage draperies resulting in a very expensive clean-up of what could have been a fairly minor incident.

Other failures are typically due to:

- Improper design and/or installation of the system.
- Lack of Maintenance.
- Improper Maintenance.
- Accidental damage to the system.
- Deliberate defeating or bypassing of the system.

When systems are ill-conceived from the outset it is usually due to the designer / specifier not fully understanding the task at hand. Many Fire and Smoke Control Systems are designed by engineers that can design a system to meet the 'letter of the law' but don't necessarily grasp the subtle workings of theatres, stage crews, and the nature of show production. Doors, Fire Curtains, and Smoke Vents are not only Smoke and Fire Control devices; they are also actively used in day-to-day operations. Therefore, the way these systems operate under manual control must be closely coordinated with the Fire Alarm System as both a source of an alarm signal and as a device activated by the Fire Alarm System. Manual Operation of the equipment shouldn't create a false-alarm scenario either, as that would cause much confusion for all.

Poorly designed or missing smoke vent operators can also result in unnecessary damage to a stage. If a fuseable link mechanically fails (separates) due to high winds or low frequency rumbles from a thunder storm, then the smoke hatches can open accidentally in the middle of a downpour. If the hatches are not equipped with a simple means of manually closing them, then they may allow a significant amount of rain water to leak in onto the stage, draperies, and lighting instruments.

Systems that are broken are also common. Wires break, sensors fail, and sometimes old equipment just ceases to work. Lack of Periodic Maintenance can be resolved by getting the system components that require scheduled testing and/or inspection entered into the building maintenance logging system so that reminders are generated on a regular basis.

Improper maintenance can create its own set of hazards – not only does the equipment not work as it should, but it places all of the occupants of the building unknowingly at-risk. Common make-do fixes are using hardware that is not rated for overhead lifting for stage rigging and fire curtain components, not changing oil and hydraulic fluid in fire curtain decent dampers, and replacing batteries in emergency systems with products that are not rated for life-safety applications.



Accidental Damage to Smoke and Fire Control Systems can include paint or glue getting into Fire Alarm Pull Stations, smoke and heat sensors being painted-over or covered by scenery, or materials being dropped into the machinery that operates the fire curtain or smoke vents.

By far the most common and egregious violations of Fire and Smoke Control Systems are due to willful modifications of the systems by personnel. Whether or not they know what they are doing is violating the integrity of the Life Safety Systems is usually unknowable, but the results are the same. There is generally a poor level of understanding regarding the operation of the Stage Fire and Smoke Control Systems, so it is common that students, instructors, visiting performers and their crews, and even the Maintenance Department may not be fully cognizant of the dangers they bring to the theatre environment when making changes to the building.

Common ‘modifications’ found in theatres:

○ Doors:

- Adding kick-down door props to fire doors (“for convenience”).
- Placing Chairs, Flag Pole Bases, Tool Boxes, Microphone Stands, or Stage Rigging Counterweights in front of Fire Doors to hold them open.
- Chaining doors shut (“to keep-out unwanted persons”).
- Chaining / wiring doors open (“we were tired of the constant opening and closing”).
- Removing fire doors (they were “in the way”).
- Removing Automatic Closers from doors (“the door prop wouldn’t work with it attached”).
- Taping-over the latch so the lock won’t work and/or so the crash-bar won’t have to be pressed to open the door.
- Adding Locking Bars and/or Deadbolts to doors to keep them closed.
- Removing Crash-Bars and installing Keyed Deadbolts to doors to limit access.
- EXIT signs covered (“because the Director doesn’t want the audience to see them”).
- Backstage exit doors without EXIT signs (because “they know their way around backstage”).
- Overhead doors with EXIT signs.
- Overhead doors without Fusible Link releases.

○ Fire Curtains

- Placing Microphone Stands, Prop Spears, or Flag Poles inside the Fire Curtain Smoke Pocket.
- Fire Curtain missing.
- Smoke Pocket missing.
- Smoke Pocket has a conduit or open wiring running right across the travel path of the curtain.
- Never tested in ?? years.
- Release mechanism missing.
- Operation Signage missing, hidden, or obscured with graffiti.
- “Cut Line” tool missing or inadequate to perform task.
- Scenery, Choral Risers, Platforms, Tables, Sloped (“Raked”) Stages, and Orchestra Shell Towers that span the travel path of the Fire Curtain thus preventing it from sealing to the stage.
- Fire Curtain counterweight carriage and/or decent damper “tied-off” to prevent curtain from deploying.



- Smoke Vents
 - Chained-down to gridiron deck (“to keep them from blowing open”).
 - Padlocked (“to keep the students from climbing out onto the roof”).
 - Completely tar-papered and entombed in hot tar (“to keep the rain out”).
 - Manual release lines tied in knots or removed (“to keep them from being opened”).
- Fire Alarm Control Panel (FACP)
 - FACP not located in same building as Theatre, or located in a part of building not accessible during normal operating hours of the Theatre.
 - No way to separately control / monitor smoke detectors to allow for special effects smoke use.
 - No one available with FACP key and authorization to use it.

What can you do to make your theatre safer in the event of a fire?

1. **Reduce the Fuel Load.** Less to burn makes it easier to control.
 - ▽ Require that all costumes, scenery, props, furniture, and drapes be treated with a recognized fire retardant or intumescent paint and that they be fabricated from fire retardant materials.
 - ▽ Don't use the stage for storage. Keep separate spaces for storage of costumes, scenery, props, and other production equipment.
2. **Keep Fire Doors Closed at all times.** The fewer ways for air to get onto the stage without relying on the Fire Alarm System's reaction to a fire condition, the better.
 - ▽ Do not prop them open.
 - ▽ Only use magnetic release door holders when you really need the door left open, not just “all the time.”
 - ▽ Whenever the stage is not in-use, deploy the fire curtain – that's one less thing to be closed in an emergency. This can pro-actively prevent catastrophic smoke damage to the audience chamber in the event of a long-term smoldering fire.
3. **Maintain your Systems.**
 - ▽ Make sure that each sub-system can operate on its own and does not bind-up, jam, or otherwise do an incomplete job. Document your tests.
 - ▽ Make sure that each sub-system communicates with the FACP so that it works in a coordinated manner.
4. **Test your systems regularly.** Coordinate efforts with your local fire department so that a ‘false trip’ doesn't catch them off-guard and possibly cost you a fine.

Follow-up Resources:

NFPA: www.nfpa.org
ESTA: www.esta.org
USITT: www.usitt.org

Good Books:

Stage Rigging Handbook (3rd Edition) - Jay O. Glerum – ISBN 0-8093-2741-4 –or- 978-0-8093-2741-6

Practical Health and Safety Guidelines for School Theater Operations - Assessing the Risks in Middle, Junior, and Senior High Schools – Dr. Randall Davidson – ISBN 0-9774525-0-6

Heads! & Tales – Bill Sapsis – ISBN 978-0-9797039-0-4

The Health & Safety Guide for Film, TV, & Theater - Monona Rossol – ISBN 1-58115-071-7