July 2015

# Fire and Smoke Dampers: Best Practice Design Tips

## An AMCA International White Paper

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June 2015

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# Fire and Smoke Dampers: Best Practice Design Tips

## How to minimize risk and cost

## ABSTRACT

**Fire and smoke dampers reduce fire severity and spread, enable fire suppression systems to operate more effectively, and limit property damage. But most importantly, they save lives. This white paper illustrates why fire and smoke dampers are a vital part of a total fire protection plan, and it includes practical design tips to help engineers reduce risk and minimize cost.**

A fire/smoke damper undergoing UL hose stream testing.
*Image courtesy of Nailor Industries*

### FIRE AND SMOKE DAMPERS: CONSIDER THEM ESSENTIAL

Fire and smoke dampers are essential components of a complete fire protection plan and can be used in penetrations of fire resistive construction above code required minimums, such as in fully sprinklered buildings where ducts are used for HVAC systems and where fire barrier walls have a required fire resistance rating of one hour or less. This best practice approach strengthens compartmentation and enhances building resiliency during a fire event.

### ENSURE COMPARTMENTATION WITH FIRE AND SMOKE DAMPERS

A total fire protection plan — which includes compartmentation, detection and alarm systems, suppression systems and egress — integrates active and passive life safety strategies. Compartmentation divides a building into cells using fire-resistive construction, and it significantly reduces fire damage and smoke migration. In buildings that have air movement systems, fire and smoke dampers maintain compartment integrity. Decades of UL certification testing and use demonstrate this effectiveness.

During a high-rise building fire event, effective fire and smoke compartmentation becomes critical when occupants are either defending in place against smoke intrusion by fortifying doors, windows and vents or when they retreat to designated safe locations, such as stairwells. Risks to firefighter and rescue personnel can be reduced by following a best practice design approach above code-mandated minimums.

*Read more about damper types and function in "Fire Dampers and Smoke Dampers: The Difference is Important," an article from AMCA inmotion.*[1]

Compartmentation is an essential part of a total fire protection plan.

## BUILD IN REDUNDANCY FOR HIGH-CONSEQUENCE APPLICATIONS

Redundant life-safety systems are especially important during high-consequence fire events. Even if not required by code, fire and smoke dampers should be specified for the following applications, where

- sprinkler effectiveness may be inhibited by obstructions
- behind-wall or above-ceiling fire risk is high (data centers, closets, media rooms with electrical cabling behind a wall or above the ceiling)
- space function has a high fire risk (welding activity, high-voltage machines, trash, storage, boiler/furnace rooms)
- adjacent buildings or outside activities are not covered by sprinklers
- sprinkler interruption is possible or would cause a catastrophic loss (unreliable water supply, user error, poor maintenance practices)
- fully-sprinklered buildings with HVAC duct systems where compartmentation is critical (health care, high-rise, other defend-in-place occupancies)

## USE BOTH ACTIVE AND PASSIVE FIRE PROTECTION SYSTEMS

Sprinklers, no doubt, are an important component of a total fire protection plan. However, requiring passive fire protection such as fire and smoke dampers in addition to the active protection provided by sprinklers ensures that no single methodology is relied upon as the only means of defense.

Passive and active fire protection measures combine to ensure no single methodology is relied upon as the only means of defense.

Depending on the study, automatic sprinkler system reliability ranges from 81–99%,[2] which may not be sufficiently effective for all facility types and occupant profiles. In addition, it is not uncommon for sprinkler systems to be shut off.[3] They are not always maintained properly and can suffer water supply interruptions. When this happens, fire protection systems rely on other active and passive methodologies to protect building occupants and property from the risk of fire and smoke.

*Read more about the sprinkler reliability debate in these articles:*
*"Reliability of Automatic Sprinkler Systems"* [2]
*"U.S. Experience with Sprinklers"* [3]
*"Dampers: An Essential Component of Fire Protection Design"* [4]

## SUMMARY: BALANCE RISK AND COST

We have defined best practices and given practical examples in this paper of how to balance risk and cost, but ultimately it comes down to the fire protection engineer making an informed decision about how best to protect occupants and property in the event of fire.

Regardless of code requirements, there are applications where fire and smoke dampers are essential. They provide a complementary and necessary capability that can significantly improve safety and reduce financial risk. Including both active and passive fire protection measures ensures that no single methodology is relied upon as the only means of defense. To introduce unnecessary and preventable risk to occupants, facilities and their operations is not a common sense approach. Following best practices, as described here, will significantly reduce the consequences of a fire while lowering life-cycle costs.

## DESIGN TIP #1:
## SPECIFY DYNAMIC RATED FIRE DAMPERS

Static rated fire dampers are designed and tested to close when the HVAC system fan cycles off during an alarm. Dynamic rated fire dampers are designed and tested to close when the HVAC system fan remains on during an alarm.

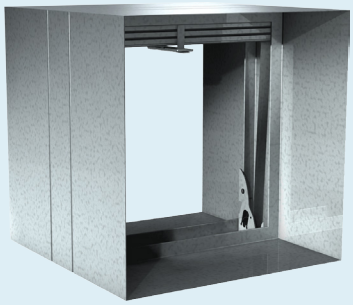
When a fan cycles off, it can take up to 20 minutes for air to stop flowing. Specify dynamic rated fire dampers to ensure dampers will close under elevated temperature and airflow conditions. The difference in cost is small compared to the benefit of safe operation.

## DESIGN TIP #2:
## SELECT THE APPROPRIATE FIRE DAMPER CONSTRUCTION TYPE

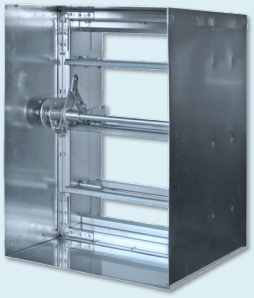
There are basically two types of fire dampers: curtain type and multi-blade type.

A curtain-type fire damper has a temperature-sensitive fusible link that releases an interlocking blade stack to close under gravity or with a spring assist. Sleeve transitions can remove the blade stack from the airstream and provide a 100% free area opening for applications with sensitive static pressure requirements.

Multi-blade fire dampers are similar in construction to control dampers and feature blades, either triple-vee or airfoil type, located in the airstream. As a result, they typically have a greater restriction to airflow than a curtain-type fire damper for the same size duct. However, multi-blade fire dampers can be used in applications where the system design velocities exceed typical curtain-type fire damper closure ratings and are especially suited for applications that feature larger openings, as multi-blade fire dampers generally have larger UL size listings when compared to curtain-type fire dampers.



Curtain-type
fire damper
*Image courtesy of Greenheck*



Multi-blade type
fire damper
*Image courtesy of Nailor Industries*

*Learn more in "Fire Dampers and Smoke Dampers: The Difference is Important"* [1]

## DESIGN TIP #3:
## SPECIFY BALANCING TYPE COMBINATION FIRE/SMOKE DAMPERS

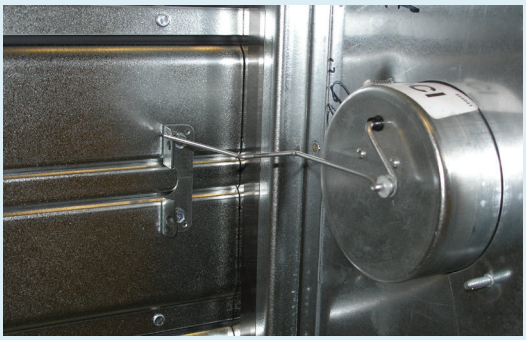
VAV systems require balanced supply ducts that maintain proper air volume and inlet static pressure. Specify a balancing type combination fire/smoke damper at shaft penetrations that can do double duty: balance VAV volume and pressure and provide fire and smoke protection. One balancing type combination fire/smoke damper can replace up to three dampers — a manual balancing damper, a smoke damper and a fire damper — reducing both first and ongoing maintenance costs.

Balancing type combination fire/smoke damper
*Image courtesy of Ruskin*

## DESIGN TIP #4:
## REDUCE TESTING COSTS WITH POSITION-INDICATING SWITCHES

Fire and smoke dampers need to be tested periodically as a code requirement and as part of routine maintenance activities to ensure operation. Actuated dampers that have position-indicating switches wired to remote indicating lights or building automation systems can be tested remotely, providing cost savings over fusible link dampers that do not have position-indicating switches. There are several advantages of dampers with position-indicating switches:

- Reduced time and labor costs for testing and maintenance
- The ability to test more frequently due to ease of access
- In healthcare applications, an elimination of the need to break the ceiling plane, reducing the need to obtain an above-ceiling work permit. This mitigates infection risk and testing costs.

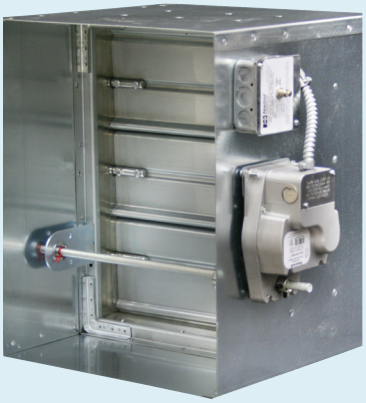


A typical damper position-indicating switch assembly
*Image courtesy of Greenheck*

*Learn more in "Increasing Use of Remote Testing for Fire/Smoke Dampers for Health Care,"[5] an article from AMCA inmotion.*

## DESIGN TIP #5:
## SPECIFY FACTORY FABRICATED SLEEVES/TRANSITIONS

Factory-supplied sleeves are made to fit each damper shipped and are fabricated with the appropriate caulking, gauges, fasteners and spacing required by the manufacturer's UL-approved installation instructions. Factory-supplied sleeves have the following advantages:



- Direct shipping to job site shortens delivery time and reduces handling and damage
- Reduces installation and material costs
- More reliable than site-constructed sleeves; meets UL-approved installation instructions

Combination fire/smoke damper with factory sleeve
*Image courtesy of Nailor*

## DESIGN TIP #6:
## SPECIFY CLASS I LEAKAGE RATED FIRE AND SMOKE DAMPERS

A building's envelope and compartments must be relatively airtight to maintain proper pressure relationships during a smoke control cycle. Class I dampers are the lowest leaking dampers approved by UL and are available from almost all damper manufacturers who offer a UL-approved product. When comparing cost between Class I and Class II dampers of similar construction type, the cost difference is negligible, yet the amount of smoke leakage allowed for a Class II damper is 2.5 times greater. Low leakage Class I dampers provide the highest level of protection against the migration of smoke, and they ensure that appropriate pressure differentials can be achieved.

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## RESOURCES

"What Engineers Need to Know About Fire/Smoke Dampers" Arlington Hts., IL: AMCA Int'l, 2014. Accessed 6/25/2015. **tinyurl.com/firesmokecompendium**

AMCA International Headquarters and Laboratory **www.amca.org**

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