BALANCING AIR FLOW WITH FIRE & SMOKE DAMPERS

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FIRE & SMOKE & BALANCING REQUIREMENTS

Air handling systems must be balanced to obtain the correct pressures to establish design flow in all floors and zones. Fire and/or smoke dampers are required in barrier walls. This requires two dampers in modern systems - the fire smoke barrier damper and the balancing damper.

A new type of actuator that meets UL555 (fire) and UL555S (smoke) and has a potentiometer for balancing allows one damper to do both jobs.

Typical duct system with required pressures for delivery of necessary volume of air to each floor is shown in Figure 1. Each floor requires 4000 cfm (1.9 m^3/s) design flow. Balancing is required in both variable air volume (VAV) and constant volume systems to set correct flow at design. Zone balancing dampers may exist also to balance local take-offs.

In the VAV system, actuated zone dampers will adjust the flow to meet space temperature requirements while maintaining a minimum flow that is based on the ventilation requirement and a maximum flow based on cooling requirements. Noise can result if the zone boxes are required to take excessive pressure drop to maintain correct volumes.

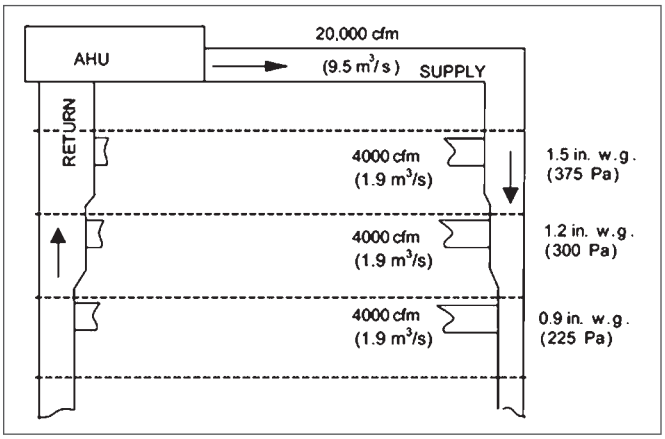

Figure 1

Duct area is reduced as lower volumes are to be carried into the zones. This helps adjust flow but precise balancing cannot be achieved due to field modifications of duct runs from design and inevitable variations between calculated and actual pressure losses.

Balancing dampers set the final flows to meet the design requirements. Here we consider only the main fire and smoke dampers, although there may be other local dampers to maintain compartmentation and protect corridors used for egress in case of fire.

In Figure 2 the locations for the fire and smoke dampers and the floor balancing dampers are shown. Typically the dampers are above the ceilings or below the floors where space constraints exist.

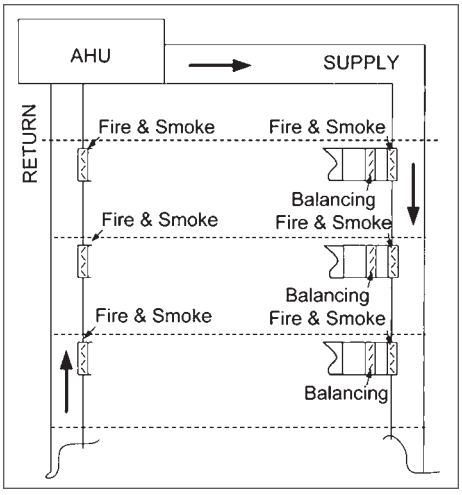

Figure 2

Shafts are protected by fire and smoke rated walls and are required to have fire &/or smoke dampers by most codes (IBC 2006). A combination fire and smoke damper is required where the floor duct leaves the shaft and passes through a rated wall. Lessons learned in past fires show that smoke is quickly transported out of the area where a fire starts to other areas via shafts, elevator hoist ways, chases, stairwells, and unsealed holes in walls.

Figure 3

In many applications, the balancing damper is on the Return Air side.

At one time two separate dampers were required at the shaft exit - a fire damper and a smoke damper. See Figure 3. The damper industry provided a combination damper that saved space and money and became the standard for any damper controlling smoke. See Figure 4.

An extra balancing damper was required, typically located just outside the shaft. This is a standard control

damper without actuator and with a hand lockable quadrant. The balancer sets it for the correct flow volume.

Figure 4, Ruskin FSD60FA-BAL. Corridor fire & smoke & balancing damper with 3-postion FSAF24-BAL actuator.

FSAF24-BAL (-S)

A new type of actuator is now available that allows one damper to do the job that once took three. A fire and smoke combination damper is controlled by an actuator which is 3-postion, the mid position being an adjustable balancing position.

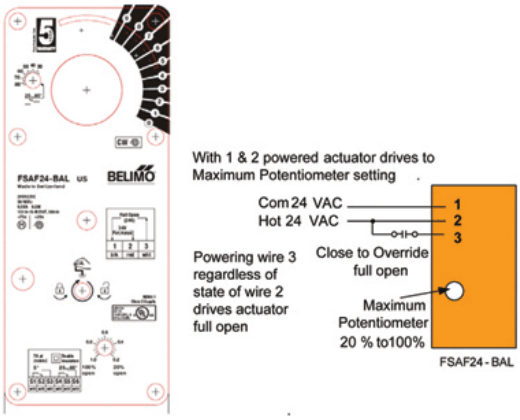

Figure 5

Normal fire and smoke actuators are 2-postion. They are either full open or full closed. The FSAF24-BAL has a Maximum potentiometer that sets the balancing position. In case of fire (sensed by the thermal temperature limit) or smoke (sensed by either a local smoke detector or an area smoke detector and alarm system relay), the damper actuator springs full closed.

A 100% full open mode is provided also for smoke management systems. If a Fire Fighters' Smoke Control Panel switch is set to Open, the damper actuator drives 100% open, overriding the Maximum balanced position.

The Maximum potentiometer is adjustable from 20% to 100% open for balancing. See Figure 5.

The FSAF24-BAL & any smoke damper or combination fire & smoke damper becomes a fully adjustable balancing damper also.

CONTAINMENT DAMPERS

Figure 6 shows the smoke detector and temperature sensor wiring for about 85% of fire & smoke dampers installed in the Americas.

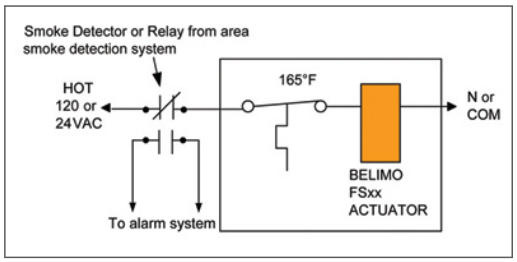

Figure 6

If smoke is detected, power is cut to the actuator and the damper springs closed. If the temperature inside the duct rises to 165°F, the damper springs closed. Sometimes 185°F is specified and if steam coils are close to the damper, 210°F may be used to avoid nuisance trips.

ENGINEERED SMOKE CONTROL SYSTEM DAMPERS

Figure 7 shows the typical wiring for a Reopenable F&S damper in an engineered smoke control system. About 15% of dampers are applied in this type of application in stairwells, zone pressurization, performing stages, subbasements, or other smoke control systems.

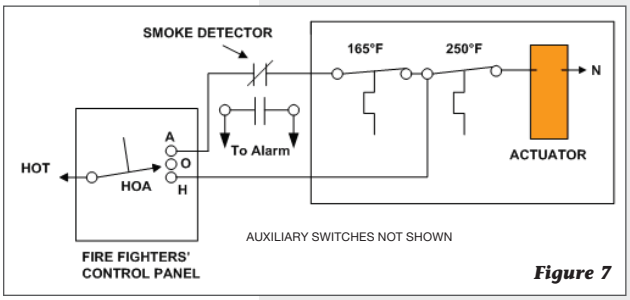

Figure 7

Continued on page 10

NEW BOOK RELEASE

Dampers and Airflow Control

by Laurence G. Felker & Travis L. Felker

Dampers and Airflow Control written by Laurence G. Felker (Product Manager of Belimo) and Travis Felker is the first book of its kind. It bridges the gap between mechanical design and final damper control. This book covers not only theoretical aspects of application design but also practical aspects of existing applications, and the material applies to both new and retrofit projects.

Among the topics discussed are new ASHRAE damper testing data, realistic but simplified pressure drop calculations, damper installations, and methods for economizers and minimum outdoor-air control. Tactics to linearize system airflow using damper response curves are also discussed, and new methods—not found in existing literature—are presented to characterize damper response to fit a process. Additional topics include torque, linkages, structural support, actuation, and engineered damper assemblies.

Dampers and Airflow Control is written for building systems designers and contractors and provides sound examples and best practices to achieve good airflow control.

To purchase visit:
http://www.ashrae.org/dampersandairflow

PRESSURE INDEPENDENT VALVE TECHNOLOGY EARNS WINGS AT EGLIN AFB [CONTINUED]

Belimo. "We tend to think of larger equipment like chillers and pumping systems as being central to these projects, but the savings could not occur without accurate, consistent flow control. It's exciting to know that Belimo is playing such an important role in 'greening' federal agencies."

BELIMO MEETS TOUGH DELIVERY CHALLENGE

Timing is everything in a large scale military renovation such as the one at Eglin. In this particular case, the desired delivery for the Belimo PICCVs left very little room for error. The plan was to keep operations in all buildings served by Building 42 going as usual, therefore installations would take place on weekends, one building floor at a time. While control valves are typically considered a longer lead item, there were delays in ordering the valves, and Belimo literally had just days to turn the PICCV order around.

"I'm convinced that Belimo jumped through hoops to get the valves in on time," said Spencer O'Quinn. "This was a major part of this overall project. We got the valves installed and literally finished everything a week later."

Matt Woods, of System Specialists, Inc. was equally impressed. "It was a very, very tight shipping schedule. I'm talking about days not weeks and everything came in perfectly. Belimo really went above and beyond the call of duty to meet the base's needs." ■

BALANCING AIR FLOW WITH FIRE & SMOKE DAMPERS [CONTINUED]

Figure 8 shows the installation of a fire and smoke damper used as a balancing damper also. The actuator is a FSAF24-BAL actuator. A number of correct wiring methods are possible. Signaling switches to the smoke control panel are typically required; not shown here.

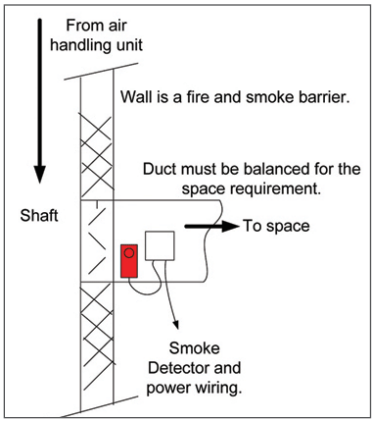

Figure 8

COST COMPARISONS

The cost of dampers varies with exact type and size of damper and size of project with larger projects costing less.

The cost of a 24" x 24" damper with a fire and smoke actuator is about $400 installed. The cost of a 24" x 24" balancing damper without actuator is about $ 120 installed. That makes the total cost of the dampers about $520.

Actuators and dampers are not priced using the same methods, so this is approximate. The BAL actuator is about $110 more in cost than a small FSLF for a 24" x 24" damper. So, it is about an even break on price.

Dampers up to 12 sq.ft. would use the FSNF series actuators and are about $65 less than the BAL actuator. A 12 sq.ft. balancing damper is roughly $250, so with larger dampers the savings is substantial. Again, these numbers are rough approximations due to different pricing practices in projects and make and model variations.

The consulting engineer or contractor can get optional pricing for the BAL actuator to compare what is best for a particular project where price is the only issue.

Where space constraints exist, only one damper is installed. The FSAF is trivially taller than the FSLF.

SUMMARY

Shaft take-offs to floor and zones are installed in fire and smoke rated walls and a fire and smoke damper is required in or very near the wall. The goal is to protect people from the effects of toxic smoke that is generated in fires both before and after activation of sprinklers if they are present (NIST & NFPA 2001).

Balancing all supply ducts is required to maintain proper air volume or inlet static pressure for VAV boxes.

Rather than installing two dampers - a combination fire and smoke damper and a separate balancing damper - one damper can be installed for both purposes.

In general, for ducts 4 sq.ft. or less, the cost is equal. For dampers up to 12 sq.ft. a good cost savings exists since the extra cost for the actuator is less than that of a damper itself and installation labor is saved. Space savings occurs and may matter in some projects. ■

IBC 2009. International Building Code 2009. http://www.iccsafe.org.

NIST & NFPA 2001. International Study of the sublethal effects of fire smoke on survivability and health, Gann et al., Fire Research Division, National Institute of Standards and Technology and John Hall, Fire Analysis & Research Division, NFPA,Fire Protection Research Foundation, Quincy MA, August 2001.