



Smoke Control Systems - Best Practices for the Engineer of Record

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Smoke control systems can be one of the most confusing and difficult assets to manage for owners. They are generally not well understood outside the realm of the specialized professionals who design, install, and commission them. Even well-funded owners with HVAC subject matter experts and/or highly credentialed facility managers can still manage to miss the mark on proper inspection, testing, and maintenance for these systems.

So, what is the fire protection design professional to do? There are some simple ways fire protection engineers can set up the owner for success and keep smoke control systems reliable and functional long past the final acceptance test. FPEs should comply with the documentation requirements of NFPA 92, ensure reliability engineering concepts during design phase, utilize the final acceptance testing as a training opportunity, and consider offering or recommending annual inspection, testing, and maintenance (ITM) services.

NFPA 92, Standard for Smoke Control Systems, details required documentation for all smoke control systems designed in accordance with the standard. Chapter 7 of NFPA 92 requires that a detailed design report and operations and maintenance manual shall be generated by the designer during the design process.

From Section 7.2.2 of NFPA 92 (2021 Edition), the detailed design report includes:

1. System purpose
2. System design objectives
3. Design approach
4. Design assumptions (building height, ambient conditions, reliance on other fire protection systems, leakage, etc.)
5. Location of smoke zone(s)
6. Design pressure differences
7. Building use limitations that arise out of the system design
8. Design calculations
9. Fan and duct specifications
10. Damper specifications
11. Detailed inlet or exhaust inlets site information
12. Detailed method of activation
13. Smoke control system operation logic

14. System commissioning procedures

By providing the owner this information future asset managers, FPEs, or AHJs that encounter the facility later down the road will not have to guess at the design or intent of the system. Or hunt down locations of exhaust outlets or makeup air inlets, damper locations, etc. when a building renovation affects the smoke zones.

Additionally, NFPA 92 requires an operations and control manual be provided to the owner and AHJ. The operations and maintenance manual is required to provide all information on the operations and maintenance of the smoke control system to ensure the proper operation of the system over the life of the building. From Section 7.3.1 of NFPA 92, it shall include:

1. The procedures used in the initial commissioning of the system as well as the measured performance of the system at the time of commissioning
2. The testing and inspection requirements for the system and system components and the required frequency of testing
3. The critical design assumptions used in the design and limitations on the building and its use that arise out of the design assumptions and limitations
4. The purpose of the smoke control system

The O&M manual will provide the minimum viable amount of information to the owner and AHJ for a smoke control system, and ensuring digital and hard copies are provided is an important responsibility for the engineer of record. Specifying a document cabinet in the fire control room or near the smoke control panel is considered best practice, with final documentation (with notes and test measurements) inserted at the end of acceptance testing.

In addition to meeting required minimums of the NFPA 92 standard, special consideration should be given to the reliability of the smoke control design. Does it require only a few dampers to operate, or does it require tens or hundreds? Are dampers accessible from the ground or roof, or would lifts or rigging be required for repairs? Is the graphic control panel intuitive?

Many of these considerations will require a back and forth with the mechanical designer on the project, to ensure simple and reliable exhaust and makeup air, and provide a system with the optimal number of possible failure points.

When it comes time to perform the acceptance testing, whatever it may look like for the specific facility, FPEs should consider involving as many representatives from the owner as reasonable. Facility managers, building engineers, construction or project managers, and other owner's representatives can benefit from witnessing the testing. It will familiarize them with the test procedures, and the FPE or commissioning professional can explain the purpose of different measurements and sequences as they happen. Additionally, owner's reps will see the locations of the different components of the system that will receive maintenance in accordance with the ITM requirements. Acceptance testing is an opportunity for the owner's reps, and the engineer of record should communicate its value and encourage participation.

Depending on the specific facility, the staff and capabilities of the owner, and the complexity of the smoke control system, recommending a service contract for the ITM of the smoke control system may be the best course of action. Smoke control systems touch many disparate engineering disciplines

(mechanical, electrical, fire alarm, passive fire protection) that even well-staffed and sophisticated owners can often run into issues with finding or hiring personnel qualified to test and maintain them. The fire protection engineer of record should consider keeping a list of local service companies that provide smoke control ITM services or consider offering a service contract to direct semi-annual and annual testing themselves in accordance with NFPA 3, Recommended Practice for Commissioning of Fire Protection and Life Safety Systems.

Smoke control systems are often a vital part of a facility's fire and life safety functionality. A properly designed, tested, and maintained smoke control system should allow the facility to safely operate to the full extent of its expected life. But without proper commissioning and maintenance, the complex systems can quickly and silently fall into disrepair. Fire protection engineers can implement the best practices of providing required documentation, simplifying design for reliability, training owners during the testing phase, and recommending ITM services when appropriate, to improve the overall life and performance of the smoke control systems they design.