ORR® Protection
Mission Critical Fire Protection Experts®

POWER GENERATION

Clean Agent & CO_2 Fire Suppression:
Enclosure Integrity Testing to Ensure Extinguishment

Gaseous fire extinguishing agents include Carbon Dioxide (CO_2), FM-200™, 3M™ NOVEC 1230™, ECARO-25®, ANSUL® SAPPHIRE®, ANSUL® INERGEN®, Kidde® Argonite, and PROINERT®. For these systems, there are two time periods that are important: the discharge time (how long it takes for gas to be discharged into the protected space and build an extinguishing concentration) and the agent retention time (the time the agent stays in the space at or near the extinguishing concentration in order to ensure extinguishment). The NFPA 2001 Standard on Clean Agent Fire Extinguishing Systems requires a minimum concentration of 85% of the adjusted minimum design concentration be held at the highest level of combustibles for a minimum period of 10 minutes. The NFPA 12 Standard on Carbon Dioxide Extinguishing Systems requires a 30% concentration be maintained on all rotating electrical equipment for a minimum period of 20 minutes.

Clean agent system installations require an enclosure integrity test to be performed (commonly referred to as a door fan test). The test calculates the hold time of the agent in the space and for over-pressurization problems during discharge. Discharge testing of CO_2 systems is required for acceptance testing, but door fan tests are helpful for CO_2 systems as well. Door fan tests can predict the performance of the live discharge test and are more readily performed than a discharge test.

A door fan test measures the air leaks of an enclosure. During the test, a large fan is temporarily installed in the doorway of the enclosure with the rest of the door opening sealed. The test uses the fan to blow air into the space (pressurization) and pull air out of the space (depressurization). The fan speed is adjusted to achieve four different room pressures during the test and leakage measurements are taken at each point. The airflow and pressure readings obtained from the testing and specifics about the enclosure and fire suppression system are entered into a computer program for fire suppression enclosure testing. This program calculates the equivalent leakage area (ELA) for the enclosure, the retention time of the fire suppression agent, and the maximum pressure developed in the enclosure during the discharge.

During a real fire system discharge, the gaseous agent is more dense than normal air (meaning it is heavier than air). After the discharge stops, the agent will begin to leak out of any penetrations below the ceiling of the space, lowering the concentration of the agent. The performance goal for a system is to have few enough leaks that the agent doesn't drop below the target concentration at the height of the equipment being protected before trained responders can arrive to the scene and deal with the situation. The door fan test helps to calculate an estimate of when that time will be based on the measurements taken and the design specifics of the room.

More complicated door fan tests can also be performed if needed when there are suspended ceilings installed in the room. Some rooms have trouble obtaining passing results, but if there is a suspended ceiling in the room, two door fans can be used to perform a below ceiling leakage area (BCLA) and neutralize leaks out through the ceiling. This can change a value in the calculation called the lower leakage fraction and yield more realistic results for the actual situation for which the fire extinguishing system is installed. BCLA tests take more time but can be worth it to yield passing results without having to do excessive room sealing to reduce the air leaks.

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Importance of Enclosure Construction

Rooms and enclosures housing mission critical equipment should be constructed with the walls extending from "slab to slab." Walls that are installed from the structural floor to the structural ceiling create a natural fire and smoke barrier around the enclosure. Walls built in this manner have fewer leaks and have a much greater chance of passing a standard enclosure integrity test.

However, it is possible to achieve a successful test in an enclosure where the perimeter walls do not extend from "slab to slab," but instead extend only to above the suspended ceiling. Enclosures like this with large overhead leaks will not pass a standard door fan test but can be successfully tested by other means. Experience has shown that enclosures of this type can retain clean agent for a prolonged period. When preparing an enclosure to retain a gaseous fire suppression agent, the walls and slab must be inspected for penetrations and leakage points. All areas of concern must be properly sealed with air-tight materials, automatic air dampers must close ducts and other openings when suppression is activated, doors should be fitted with pressure seals around the jams and threshold, and large conduits and other penetrations should be sealed up so air cannot escape the room.

Testing by Technical Judgment

In some circumstances it is necessary to gain the approval of the local Authority Having Jurisdiction to waive the quantitative results of a standard door fan test and instead conduct a detailed witnessed leak inspection. This alternate testing process is described in NFPA 2001 Annex C.1.2.2 (5) in a section titled *Technical Judgment*.

Using the door fan and a smoke pencil, all floor and walls are closely examined for leaks. If the smoke moves radically through potential leakage points, one could assume air is passing through the leak, and therefore improperly sealed. However, if the smoke behaves in a passive manner around potential leakage points, one could assume the enclosure is sealed correctly and pass the test by "technical judgment" of the Authority Having Jurisdiction.

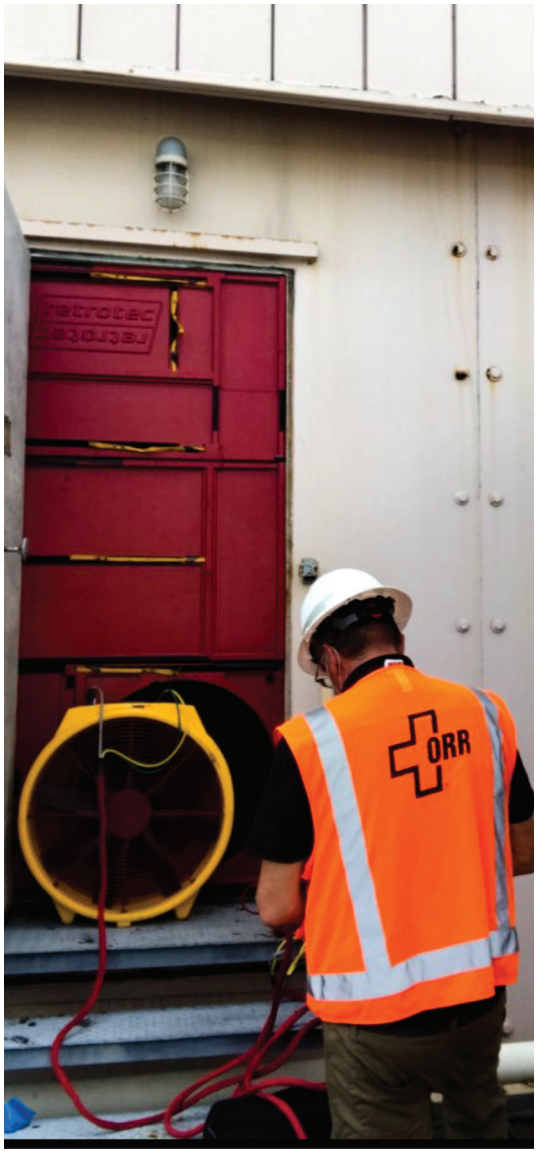
Ongoing Testing

Every year enclosures should be inspected visually for changes in the room that could negatively affect the room integrity and gaseous agent retention. Corrections should be made as necessary. ORR recommends every five years the space should have a new door fan test performed to re-validate the gaseous system will perform without retention or over-pressurization issues. We also recommend a door fan test be performed when any major construction or disassembly/reassembly of the enclosure occur, like in the case of a turbine enclosure overhaul.

Need More Information?

For more information on Room Integrity Testing, click here:

www.orrprotection.com/room-integrity-fan-test



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