Technical Judgment,

Testing Zones with Excessive High Leakage

Gaseous fire suppression systems are designed to control fires in the protected zone. In order to be effective the gaseous agent must be retained in the zone after discharge for an extended period. A protected zone must be constructed and finished to eliminate any loss of the agent after discharge room the zone.

Presently, the accepted method of testing these zones for leakage is by use of the Enclosure Integrity Procedure as outlined in the appendix C of the NFPA 2001 Standard on Clean Agent Fire Extinguishing Systems.

The enclosure integrity procedure has many advantageous: eliminates need and expense of a discharge test of the system and enclosure, tests can be conducted with minimal impact on the occupants or use of zone, the tests are easily repeatable and results are comparable from test to test: i.e. the zone can be tested and tested from year to year to assure the integrity of the zone has been maintained.

Unfortunately, the Enclosure Integrity Procedure also has an disadvantage over a discharge test. The procedure measures all leakage in the protected zone. This means all leakage areas through the walls, floors and the overhead roof or deck; the entire “envelope” of the zone. In zones where there is a dropped ceiling, this includes the portion of the envelop above the dropped ceiling.

All the Clean agents listed in NFPA 2001 as well as CO2 and Halon produce a gas air mixture which is heavier than air. Normal concentrations of Halon and FM-200 produce a mixture which is significantly heaver than air. Normal concentration of Inergen produces a mixture only slightly heavier than air. Due to the weight of the mixture after discharge, the loss of the suppression gas mixture will be through the low leaks in the zone.

Prior to 1989 the usual test procedure for halon protected zones was a discharge test to confirm that the halon concentration would be retained in the zone. This test utilized a three channel chart recording concentration meter. One channel measured the concentration at the ceiling, one at the minimum protected height and one at the floor (sub floor) level. From the concentration charts one could see the level of the suppression gas mixture fall in the zone over a period of time, confirming that the loss was through the low leakage areas.

It was common practice at that time to install halon suppression gas systems in zones in which there was considerable high leakage; such as partition walls that extended only slightly above the dropped ceiling. In these zones if the lower portion of the zone was

properly sealed the zone would contain the suppression gas mixture for the required time.

Due to environmental and costs reasons, discharge testing is no longer used to confirm the holding time of the suppression gas mixture. However the physical principles have not changed and zones with large areas of leakage in the upper area of the zone but no lower leakage will retain the suppression gas mixture. However, these zones will "fail" a standard enclosure integrity procedure test.

This problem has been recognized in the NFPA 2001 Standard 2004 on Clean Agent Fire Extinguishing Systems, Appendix C, Enclosure Integrity Procedure, Section C-1.2.2.(5):

> *Technical Judgment.* Enclosures with large overhead leaks but no significant leaks in the floor slab and walls will yield unrealistically short retention time predictions. Experience has shown that enclosures of this type can be capable of retaining clean agent for prolonged periods. However, in such cases the authority having jurisdiction might waive the quantitative results in favor of a detailed witnessed leak inspection of all floors and walls with a door fan and smoke pencil.

Which means that with proper inspection and testing and with the approval of the authority having jurisdiction such zones may be accepted.

In order to assure that the zones will retain the suppression gas mixture the following points should be considered:

1. A standard enclosure test should be completed even when there is known excessive high leakage in the zone. This test will show the following:

a. Static pressure on the zone, if any. It is important that the static pressure be eliminated at discharge to avoid the accelerated loss of the suppression gas mixture. An excessive level of static pressure could cause to loss of the suppression gas through even the high leakage areas, especially the lighter gases such as Inergen. Eliminating static pressure may mean the shutting down of local or building HVAC systems prior to discharge of the suppression gas.

b. The maximum allowable leakage in the zone. The maximum allowable leakage is the total leakage from the zone which would pass a standard enclosure integrity test. The procedure assumes that half of the maximum allowable leakage is high in the zone and half

is low. In evaluating a zone which has known high leakage, one must consider that the total low leakage can not exceed one half of the maximum allowable leakage.

c. The actual leakage in the zone and the predicted hold time. Unless the high leakage is so great that the test can not be completed, the test will produce an indicator of the leakage from the zone and the predicted worse case hold time. This information will be useful in making a technical judgment.

2. As stated in the NFPA standard referenced above, a door fan should be used to pressurize the zone and smoke pencils used to test all suspect areas for possible leakage. Properly used, smoke pencils can dramatically identify leakage areas. They need to be applied directly next to the suspect areas. The smoke pencils should also be used with caution as the smoke produced is typically very corrosive and should not be inhaled or used directly next to sensitive equipment.

3. The condition of the zone must allow for a complete and thorough examination of the "envelope" (all surface areas) below the drop ceiling or required minimum hold height. This includes the area below the raised floor if any. If this area is obstructed or full of cables a complete examination may not be possible will eliminate the application of the technical judgment paragraph. Likewise hidden areas or inaccessible areas behind HVAC units, in closets would also eliminate the application of a technical judgment. The room survey report which is part of the EIT 2001 Quick Report enclosure integrity test procedure software may be used as a guide for common (but not all) possible leakage areas.

Finally in all cases and particularly in zones which have been accepted on the basis of a technical judgment the protected zones need to be tested and/or examined on a periodic bases for leakage. NFPA 2001 Standard on clean Agent Fire Extinguishing Systems, 2000 Edition Chapter 4 Inspection, Maintenance, Testing and Training Paragraph 4 -4: states:

> Enclosure Inspection: At least every 12 months, the enclosure protected by the clean agent shall be thoroughly inspected to determine if penetrations or other changes have occurred that could adversely affect agent leakage or change volume of hazard or both. Where the inspection indicates conditions that could result in inability to maintain the clean agent concentration, they shall be corrected. If uncertainty still exists, the enclosures shall be retested for integrity in accordance with 4-7.2.3.
> *Exception: An enclosure inspection is not required every 12 months if a documented administrative control program exists that addresses barrier integrity.*

and

Paragraph 4-7.2.3
Review Enclosure Integrity. All total flooding systems shall have the enclosure examined and tested to locate and then effectively seal any significant air leaks that could result in a failure of the enclosure to hold the specified agent concentration level for the specified holding period. The currently preferred method is using a blower door fan unit and smoke pencil. Quantitative results shall be obtained and recorded to indicate that the specified agent concentration for the specified duration of protection is in compliance with Section 3-6, using an approved blower fan unit or other means as approved by the authority having jurisdiction. *(For guidance, see Appendix B.)*

References:

1. NFPA 2001 Standard on clean Agent Fire Extinguishing Systems, 2000 Edition
2. EIT 2001 Quick Test, NFPA 2001 Clean Agent Enclosure Integrity Test and Report Software, Fire Safety Technology, P.O. Box 1063, Severna park, Md 21146 800-685-8303
3. Sealing of Rooms for Proper Containment of Suppression Gas, Fire Safety Technology, P.O. Box 1063, Severna park, Md 21146 800-685-8303

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